L-4/T-II/ChE **Date : 03/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

Sub : **CHE 407** (Process design II)

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Question No. **1** is compulsory and carries **30** marks. Answer any **TWO** from the rest of **THREE**.

1. Answer the following questions **(COMPULSORY)**:

A private oil and gas company is building a new crude oil refinery in Keraniganj with a capacity to process 4 million tones of crude oil per annum.

(a) List the steps required to complete the crude of refinery project. Note that all the steps required for a public sector project may not be necessary for a private sector project. You need to address this issue in your answer. **(10)**

(b) Write down the definition of the above-mentioned project. **(7)**

(c) The company is planning to set up a bitumen plant with a processing capacity of 400,000 tons of bitumen per year next to the crude oil refinery. Since the plant will be next to the crude oil plant would you use a similar project definition as question 1(b)? Explain your answer. **(6)**

(d) The company is considering hiring design engineers and other technical personnel and building the refinery in-house with imported equipment and local technical support instead of appointing a foreign EPC contractor for this project. Do you agree with this consideration? Why or why not? **(7)**

2. (a) If you are hired in the design team by an EPC firm what kind of tasks and engineering projects would you expect to deal with most frequently? **(6)**

(b) Inherently safer design is an important concept of process safety. How can you incorporate this concept in process design and plant design? **(8)**

(c) A recent study showed that 79% of process plant accidents involved a design error, and the most common type of design error leading to accidents was poor layout. Identify some of the errors that can occur during plant layout considerations. **(6)**

3. (a) What are the criteria for selecting plant equipment considering both cost and performance? **(6)**

(b) Identify different types of water used in a chemical process plant and the respective water parameters that need to be maintained for smooth operation. **(6)**

(c) The design engineers of a private company carried out the basic engineering design of a Polyol plant to be established in Gazipur. (i) Recognize the different activities they needed to take up for completing the task. (ii) In your opinion which activity was the most challenging for the team? Why? **(8)**

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4. Stamicarbon is a Neterland-based licencing authority for the urea process. Although Stamicarbon provided the license and process design package for both KAFCO and Shahjalal Fertilizer Project (SFP), the performances of these two plants are not similar. Identify the possible factors in licensing arrangements that could have caused this difference. **(6)**

(b) We discussed two case studies in the class, namely, Kleen Energy explosion in Connecticut, caused by a gas blow that was used to remove debris from the pipeline, and the ammonium nitrate explosion in West Fertilizer Company storage and distribution facility in Texas. Based on relevant codes and standards of the USA, discuss the key lesson learned from these two incidents. **(7)**

(c) In the recent oxygen plant blast in Sitakundo, the factory owner demanded that they have followed national codes and standards and received clearance from all relevant regulatory authorities. If what they claimed is true, do you think the accident could have happened? Your answer should include the major codes and standards that are required to be followed for setting up a factory in Bangladesh. **(7)**

SECTION – B

There are **FOUR** questions in this section. Answer Q. No. 5 and any **TWO**. Question No. 5 is COMPULSORY and carries 30 Marks.

5. (a) "Package units are supplied by EPC". … TRUE/FALSE **(5×6=30)**

(b) Procurement activities include:

(i) Prequalification of Vendors/Contractors

(ii) Inspection

(iii) Preparation of bid documents

(iv) All of the above

(c) "Selection of "Process Licensor" is the sole responsibility of the client"- TRUE/FALSE.

(d) Engineering documentation for fabrication includes:

(i) PBD

(ii) Foundation drawings

(iii) P & I diagram

(iv) All of the above

(e) "Cost plus a fixed fee" type of contract has been found to be most suitable for Bangladesh." –TRUE/FALSE

(f) Department/s in Vendors Organization is/are:

(i) Inspection

(ii) Procurement

(iii) All of the above

(iv) None of the above

Contd P/3

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6. Justify the selection of "Two Envelope" system for evaluation of prequalification application and bids. **(5)**

   (b) Select the most important activity (according to your judgment) to be undertaken by clients" Engineers for review and approved of Engineering Documents give reasons for your answer. **(5)**

   (c) In your ChE 408 Design Project which is/are the Process Critical and or Time Critical equipment? Give reasons. **(5)**

   (d) Select at least four (4) equipment from your ChE 408 design project which should be overdesigned. Give reasons. **(5)**

7. (a) Prescribe steps for carrying out "Performance Test" of a plant as a whole. Identify in each step the organization and/or persons who should be present during the test. **(10)**

   (b) Recommend a procedure for inspection which could have prevented "Bhopal Disaster". **(10)**

8. Write short notes on. **(40)**

   (a) Justification of selecting "Turn key" type of contract for package units. **(5)**

   (b) Process conditions which make an equipment process critical are to the identified. How will you select and recommend such equipment to the management? Mention the important factors considered. **(5)**

   (c) Select a team for negotiating a contract. (e.g. for EPC) **(5)**

   (d) State the procedure for carrying out Performance Test on a particular equipment. **(5)**

L-4/T-II/ChE **Date : 29/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

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

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) A city corporation decides to install painted metal waste bins all around the city to promote cleanliness. What direct costs and indirect costs of corrosion are involved if you need to replace such a garbage can with a similar one because your old one is no longer useable due to severe corrosion? **(5)**

   (b) What kind of corrosion cell/cells would you expect to form if the waste bins are installed on the paved surface? What would be the case when they are installed to be suspended from a metallic frame? **(5)**

   (c) What are the most likely corrosion mechanisms you would expect to rust away such waste bins? Explain your answer. **(10)**

   (d) The wall of waste bin is corroding at a rate of 54.7 mg per decimeter square per day. If the waste bins are expected to serve for at least five years, what wall thickness would you recommend? Density of iron is 7.87 g/cm^3. **(10)**

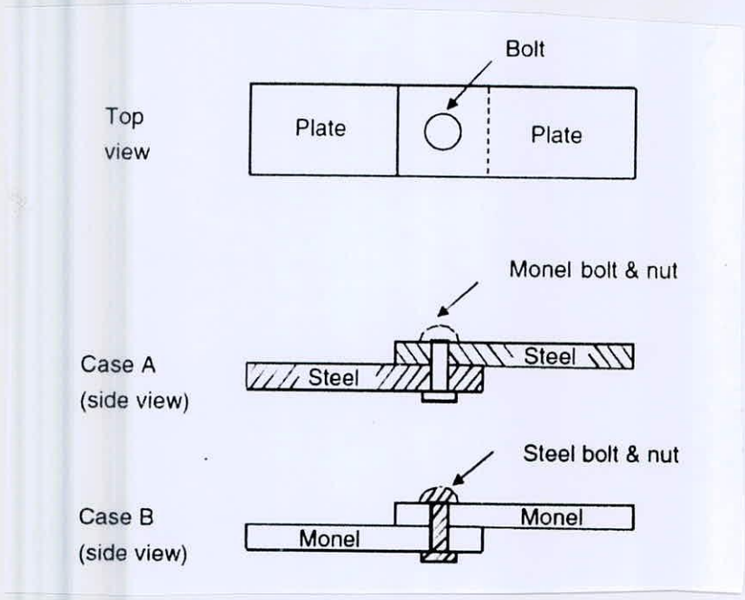
   (e) What alternate material would you suggest for such waste bins? Why? **(5)**

2. (a) In **Case A** bellow, two steel plates are joined with a Monel bolt. In **Case B**, the reverse is done. Both systems are to be immersed in seawater, for which **(10)**

   E (steel) = –0.61 V

   E (Monel) = –0.08 V.

   Thus there is a galvanic effect in which the steel member of the couple will be attacked. In **Case A**, the steel plates will be galvanically attacked. In **Case B**, the steel bolt which keeps them together will be galvanically attacked. One case is much worse than the other. Which case is it? Why?



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Contd...Q. No. 2

(b) Roughly sketch the Pourbaix diagram for water; mark the regions. Why do not we have any vertical or horizontal lines in the water Pourbaix diagram? Briefly explain why this diagram is superimposed on Pourbaix diagram of metals. **(15)**

(c) How does the polarization equation of anodic dissolution vary from that of reduction reaction? Why? **(10)**

3. (a) Briefly discuss the effect of pH on corrosion of iron in slowly moving aerated soft water at room temperature. Use illustrations if necessary. Explain your answer. **(15)**

(b) In part (a), how the curve will change if the temperature is increased to 40°C. Explain your answer. **(5)**

(c) In part (a), how the curve will change if the velocity is increased or decreased? **(5)**

(d) While testing the water supplied to two swimming pools of the university, you found that the Langelier Saturation Index (LSI) is +1.2 for pool 1 and −1.5 for pool. What conclusion can you make from the LSI values on the likely effects of supplied water on pool components? **(5)**

(e) What may cause the breakdown of passivity of steel in concrete structure? **(5)**

8. (a) Discuss the step-by-step procedure to be followed in material selection for chemical process industries. **(25)**

(b) While selecting a material for a particular job, calculation based on the corrosion test data indicated that the wall thickness for the material for a service life of 20-years may exceed 10 mm. What alternatives would you consider? In what order? **(10)**

SECTION – B

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

5. (a) Briefly describe the environmental factors that cause atmospheric corrosion. **(15)**

(b) Examine how atmospheric corrosion affects industries and infrastructure from an economic and safety perspective. **(10)**

(c) How can underground pipeline corrosion be prevented or controlled? **(10)**

6. (a) What is stray current corrosion and how does it occur? **(10)**

(b) How would you prevent corrosion from stray current in metallic structures? Explain using suitable sketches. **(15)**

(c) What role can metallic coating play in preventing corrosion? Discuss with appropriate examples. **(10)**

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7. (a) What is microbially influenced corrosion? Describe the sulfur cycle in nature. **(10)**

   (b) Discuss the characteristics of stress corrosion cracking. **(10)**

   (c) Discuss the five different methods of corrosion protection. **(15)**

8. (a) "Removal of oxygen from boiler water is very crucial in safety perspective" True/False-Explain your answer. **(8)**

   (b) Explain the sacrificial anode-based cathodic protection technique for corrosion prevention. **(12)**

   (c) Write short notes on: **(15)**

   (i) Fretting corrosion

   (ii) Pilling-Bedworth Ratio

   (iii) Pickling inhibitors

L-4/T-II/ChE **Date : 27/03/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

Sub : **CHE 411** (Economics and Management of Chemical Process Industries)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Question No. **1** is compulsory and carries **50** marks. Answer any TWO from the rest of **THREE**.

1. Answer the following questions **(COMPULSORY)**:

(a) How can a firm determine its MARR based on the opportunity cost viewpoint?-Describe it. **(10)**

(b) Discuss the following terms in relation to engineering economics: (i) Nominal interest rate (ii) Deferred annuities (iii) Capitalized costs (iv) Carry back and carry forward losses (v) Bailee's liability. **(10)**

(c) Is it possible to deduce the relationship between effective interest rate and continuous interest rate from the concept of nominal interest rate?-Show your works. **(10)**

(d) Identify and criticize the shortcomings of the three models used for calculating the cost of equity capital. **(10)**

(e) A power plant for generating electricity is an essential part of a chemical process plant for uninterrupted power supply. Two alternative power plants having same capacity have been suggested. One is steam turbine based and the other one is gas turbine based. The following information applies: **(10)**

Parameters	Steam turbine based power plant	Gas turbine based power plant
Initial investment	$\$ 700 \times 10^3$	$\$ 467\times 10^3$
Fuel costs/yr	$\$ 17 \times 10^3$	$\$ 24 \times 10^3$
O & M costs/yr	$\$ 11 \times 10^3$	$\$ 14 \times 10^3$
Insurance & Taxes/yr	$\$ 17 \times 10^3$	$\$ 15 \times 10^3$
Life (years)	25	15
Salvage	0	0

All other costs are the same for either type of power plant. A 9% return is required on the investment. If one of these power plants must be accepted evaluate which one should be recommended?

2. (a) Each year sector 'M' purchases \$10 million goods from sector 'A' and sector 'A' makes annual purchases of \$4 million from sector 'M'. Within –sector purchases are \$2 million for sector 'M' and \$4 million for sector 'A'. Total sales are \$10 million in sector 'M' and \$20 million in sector 'A'. Calculate the direct requirement matrix from the above data and show utility of the matrix. **(22 ½)**

Contd P/2

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Contd...Q. No. 2

(b) A heat exchanger has been designed for use in a chemical process. A standard type of heat exchanger with a negligible salvage value costs $4,500 and will have a useful life of 7 years. Another proposed heat exchanger of equivalent design capacity costs $7,000 but will have a useful life of 10 years and a scrap value of $1,000. Assuming an interest rate of 8%, examine which heat exchanger is cheaper by comparing capitalized cost. **(22 ½)**

3. A Midwestern industrial state is considering the construction and operation of facilities to provide electricity to several state owned properties. Electricity will be provided via two coal-burning power plants and a distribution network wired to the properties targeted for conversion. Assume that there have been four competing designs identified for the power plants. Each design affects costs and benefits in a unique way. Given the following data for the four MEAs, identify which one of the projects should be recommended with the conventional B/C ratio method. **(45)**

	Values (x$\$10^4$) for competing design alternative			
	A	B	C	D
Plant construction Cost	$12,500	$11,000	$12,500	$16,800
Annual O&M cost	120	480	450	145
Annual savings from utility payments	580	700	950	1300
Annual Revenue from over capacity	700	50	200	250
Annual effect of jobs created	400	750	150	500
Project life (years)	20	20	30	35
MARR(%)	10	10	10	10

4. The best (most likely) cash flow estimates are given below for a piece of equipment being considered for immediate installation. Because of the new technology built into this machine, it is desired to investigate its PW over a range of ±50% changes in the estimates for capital investment, annual net cash flow and useful life. Plot a diagram and analyze the sensitivity of PW to percent deviation changes in each separate factor estimate when the MARR is 10%. **(45)**

   Given Data:

   - Capital Investment: $ 12,000
   - Revenue/yr: $5,000
   - Expenses/yr: 3,000
   - Market value: $1,000
   - Useful life: 6 years

SECTION – B

There are **FOUR** questions in this section. Q. No. 5 is compulsory and contains 60 Marks. Answer any **TWO**. The symbols have their usual meanings. If not explained.

5. (a) Explain the difference between PERT and CPM networks. Mention the circumstances under which one is preferred to the other. **(10)**

Contd P/3

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Contd...Q. No. 5

(b) In recent years, many employers seek out technically trained job candidates who also have studied management. What advantages do you think employers see in a technical personal studying management? Also explain what you understand by the word "technically" here. **(15)**

(c) Briefly explain how Conflict of interest may lead to ethical violation. **(10)**

(d) Describe the bureaucratic organization structure and discuss its advantages and disadvantages. **(10)**

(e) Explain at least five major communication barriers in organizations. Also mention how to overcome these communication barriers. **(15)**

6. A building project consists of 12 activities. The normal duration required to perform various activities and the relationship among the activities are given below: **(35)**

Activity	A	B	C	D	E	F	G	H	I	J	K	L
P:redecessor	-	-	A	B	C	B	F	C	D, G	E, I	J, H	K
Duration (weeks)	7	5	10	5	8	6	5	4	10	5	8	9

Construct an arrow network and compute (i) the project completion time; (ii) the critical path; and (iii) the total float and for float free each activity.

7. Read the attached article and answer the following:

(a) What is your evaluation of Y's leadership style? **(10)**

(b) What is your evaluation on X and Y in context of seventeen managerial roles? **(20)**

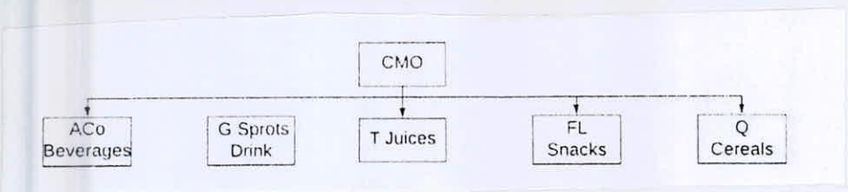
(c) What would be your advise to Y as a business owner in light of the incident mentioned in the article. **(10)**

8. Assume that you are asked to assist in the re-design of the organization structure at ACo. Assume also that ACo has the structure drawn below for its major products. ACo Chairwoman and CEO Indra Nooyi presents one reason she would like to see a new organization structure: "We have some of the world's strongest brands and some of the world's greatest marketers, but never have we integrated our marketing efforts in a holistic, global and disciplined fashion across the ACo enterprise. We want to integrate our brand marketing efforts and stay ahead of macro consumer trends with a deeper level of sophistication." **(40)**

In creating your revised organization structure you need to work closely with Jill Beraud, the Global Chief Marketing Officer at ACo. Her goal is to build ACo's food and beverage brands on an international scale and integrate the company's entire marketing efforts.

(a) Draw a revised organization structure that will help ACo attain the marketing integration it seeks.

(b) In addition to implementing the new structure you have drawn, what steps can Beraud take to facilitate an integration of marketing efforts across the major brands at ACo?



Article for Question 7:

X was confused. As a Twitter employee, he suddenly lost access to his computer. But since he received no confirmation email, he was unsure if his employment had actually been terminated.

So, nine days later, after repeated tries to reach the head of HR, and even CEO Y himself with no reply. He decided to take the matter public.

What happened next is a story that's crazier than fiction. It involves a public conversation between Y and X, a personal attack on X and his disability (he suffers from muscular dystrophy), and a masterful, emotionally intelligent response that actually leads to Y Apologizing.

How did X handle this conflict, along with being falsely accused? What lessons does this hold for business owners? Using tweets from both Y and X, it's possible to reconstruct the story and extract some major lessons.

After X's initial tweet started gaining momentum, Y finally did respond--with a single question: "What work have you been doing?"

X outlined a list of accomplishments from the past months. He then returned to his original question, but also stated that in the meantime he had now finally received a reply from Twitter HR that he was no longer employed.

Soon after, Y tweeted the following: "The reality is that this guy (who is independently wealthy) did no actual work, claimed as his excuse that he had a disability that prevented him from typing, yet was simultaneously tweeting up a storm. Can't say I have a lot of respect for that."

At this point, X could have responded in a number of ways.

He could have immediately returned the attack on Y, but that would likely have made the situation worse. He could have ignored Y's scathing words, but others may have taken that as an implication that Y was right.

Instead, X demonstrated emotional intelligence, the ability to pause, gather his emotions, and respond in a way that helps him reach a goal--in this case, set the matter straight and help Y to realize that he was wrong.

"Hi again," tweeted X in response, four hours later. "I hope you are well. I'm fine too. I'm thankful for your interest in my health. But since you mentioned it, I wanted to give you more info. I have muscular dystrophy. It has many effects on my body."

X then proceeds to use brilliant storytelling to describe his disability and how it affects him. "My legs were the first to go," writes X. "When I was 25 years old I started using a wheelchair. It's been 20 years since that happened. In that time the rest of my body has been failing me too. I need help to get in and out of bed and use the toilet."

X continues by sharing a bit about his family.

"My family is the best," X writes. "I have two kids. I see them every day. I recommend that. My wife is fantastic. Strong, kind, smart, amazing artist. Couldn't be happier with her."

Next, X details how he came to work at Twitter. He joined the Twitter ranks after a successful company he helped build was acquired by Twitter. "Financially it wasn't the best decision," X writes. "My company was making a lot of money and Twitter's offer was lower than any smart valuation would say."

"But like you I made a bet on Twitter having a lot more potential than it has had."

With these words, X attempts to strike a common ground with Y, to help him see that, despite their obvious differences, they share some common ideals.

X next relates how, after Y's acquisition of Twitter, X met with his manager every week and asked what he should focus on, and then proceeded to do those things. "Every one of them," he says.

Finally, X explains why he can type on a phone, but not so much on a computer--because typing or using a mouse for extended periods of time causes his hands to cramp up, whereas typing on a phone keyboard for an hour or two at a time doesn't present any problems.

To be fair, while X remains mostly respectful in this thread, he does take a couple of jabs at Y's expense. For example, X mentions how he read that Y can't go to the toilet on his own. "I'm sorry to hear about that," X writes. "I know the feeling. The only difference is I can't do it because of a physical disability and you're afraid someone you hurt will attack you."

But through it all, X communicates in a way that encourages further communication, rather than shutting it down. Which is why, after Y heard directly from persons who had worked with X and vouched for his work ethic, talent, and humility, Y says he did a video call with X to discern fact from fiction.

Following that call, Y tweeted the following: "I would like to apologize to X for my misunderstanding of his situation. It was based on things I was told that were untrue or, in some cases, true, but not meaningful. He is considering remaining at Twitter."

The key, though, is that X was able to accomplish multiple goals: He received confirmation on his employment. He set the record straight. And likely, he will now get the money he's entitled to from his employment at (and termination from) Twitter--maybe even more.

So, what's the lesson for business owners

L-4/T-II/ChE **Date : 10/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

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

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Dhaka becomes one of the world's most polluted cities. In the context of Dhaka City, discuss the effects of air pollution. **(10)**

   (b) How is the air quality index calculated? What pollutant is to blame for Bangladesh's high AQI, and why? **(10)**

   (c) In the context of a major Bangladesh city, discuss the management strategy to mitigate air pollution. **(15)**

2. (a) Explain the air pollution caused by the brick industry in Bnagladesh. How difficult is it to measure pollution from the brick industry? **(15)**

   (b) Atmospheric stability can have a substantial impact on air quality-True/False, Explain your answer. **(10)**

   (c) Discuss the lessons learned form 1948 Donora incident? **(10)**

3. (a) What are the major sources of SO_x pollution in Bangladesh? Recommend potential methods for removing SO_x from industrial flue gas? Explain the dual alkali gas desulfurization process. **(20)**

   (b) What are the main pollutants released by the urea fertilizer sector? Provide an explanation of the ammonium emission control strategy. **(15)**

4. (a) What strategies can be used to reduce air pollution without using a control device? **(10)**

   (b) "For the purpose of measuring particulate concentration, source sampling must be isokinetic" Explain the statement with examples. **(10)**

   (c) Why is stack gas velocity measurement crucial for monitoring stack gas? Describe the procedure for measuring stack gas velocity. **(15)**

SECTION – B

There are **FOUR** questions in this section. Question No. 5 COMPULSORY. Answer any **TWO** from the rest.

5. (a) List the major sources of pollution with pollutants names from a tannery industry. **(7)**

   (b) Compare aerobic and anaerobic treatment processes. **(8)**

Contd P/2

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Contd...Q. No. 5

(c) NM Textile Industries Ltd., recently hired an environmental expert for their liquid and solid waste management in context of zero discharge. The expert has designed an ETP in context of zero liquid discharge and proposed a plan for solid waste management. Prescribe the proposed design of the ETP and solid waste management plan. **(30)**

6. (a) What are the different types of biofilm system for industrial wastewater management? Describe the operation principles of the trickling filter with a neat sketch. **(14)**

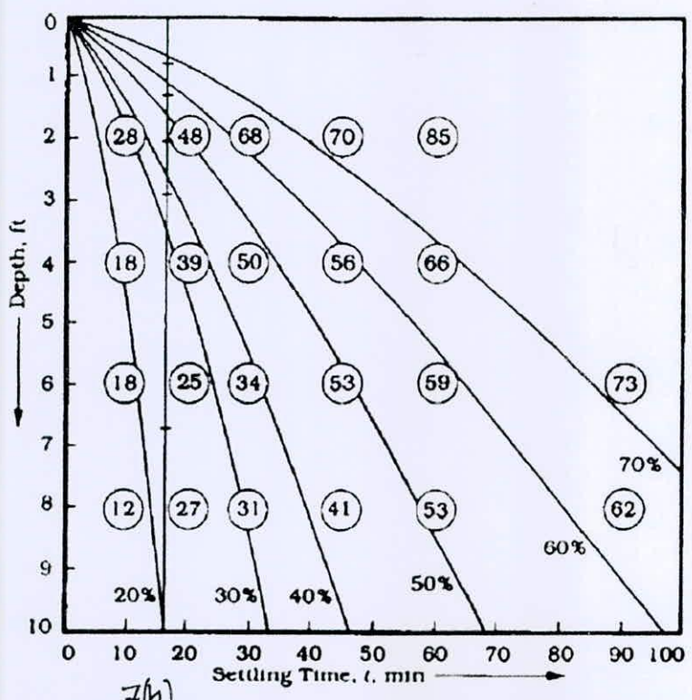
(b) Write explanatory notes on the followings (draw schematic if applicable): **(16)**

(i) Organics conversion process in an Anaerobic System

(ii) Up-flow anaerobic sludge blanket reactor

7. (a) Briefly explain the black liquor recovery process with a neat sketch for the pulp and paper industry. **(12)**

(b) A primary clarifier is to be designed to treat industrial wastewater with 320 mg/L TSS and a flow of 2.0 MGD. A batch-settling test was performed using an 8-in diameter column which was 10 ft long with withdrawal points every 2 ft. An Environmental Engineer conducted the column test and reduced the data into the following graph of TSS removal (%) at various depths and settling time. **(18)**



7(b)

FIGURE ~~9.14~~ ***Graph Showing Suspended Solids Removal (as a Percent) at Various Depths and Settling Times, for Example 9.1***

Calculate the Design detention time and overflow rate if 70% of the suspended solid is to be removed.

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8. (a) Write the full form of the followings: **(15)**

(i) RCRA

(ii) TSCA

(iii) EPA

You have been appointed as a Sustainability and Environmental Chief at Ruppur Nuclear Plant. You have been processed to design a feasible waste management process for that plan; which method will you prefer? Justify your answer.

(b) Explain degradation principle of a Facultative Lagoon with a sketch. Compare activated sludge process to a Facultative Lagoon system in context of wastewater treatment. **(15)**
