

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CHE 475** (Biochemical Engineering II)

Full Marks : 210

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) Draw a typical microbial growth curve and the product formation curve on the same plot. Label four major phases of the growth curve. Write two reasons for the reduction of growth rate after exponential phase. (4+4+2=10)
- (b) A mouse-mouse hybridoma cell line is used to produce monoclonal antibody. Growth in batch culture is monitored in terms of cell concentration in a 10 L bioreactor that initially contained 100 g/L sugar (considered to be a "high" concentration) and 0.2 g/L biomass. It was found that the doubling time for this culture in exponential phase is very reproducible with  $t_d = 1.75$  hrs. After 6 hrs in culture, the cell density and substrate concentration were measured as 1.24 g/L and 73 g/L, respectively. Estimate:
- (i) The maximum specific growth rate,  $\mu_{max}$  ( $hr^{-1}$ ). (4)
- (ii) The yield coefficient,  $Y_{X/S}$  (g biomass/ g substrate). (4)
- (iii) Total culture time required to reach stationary phase (hr). (8)
- (iv) Approximate lag time,  $t_{lag}$  (hr). (5)
- (c) Now, the same experiment is performed in a continuous fermenter, and at steady state, the sugar concentration is 50 g/L and half saturation constant,  $K_s = 20$  g/L. If the maximum specific growth rate is same as before, calculate the dilution rate,  $D$  of the fermenter. (4)
2. (a) Briefly define four common methods of cell communication. (10)
- (b) What are the four steps in cellular signaling process? Discuss the merits and demerits of traditional approaches and live-cell microscopy in quantification of signaling. (4+8=12)
- (c) What is fluorescence microscopy? Draw a schematic showing the path of fluorescent light during microscopy. (2+5=7)
- (d) Briefly describe phase contrast and DIC microscopy techniques. (3+3=6)
3. (a) Define the following terms: (8)
- (i) Chemotaxis, (ii) Haptotaxis, (iii) Durotaxis, (iv) Critical oxygen concentration.
- (b) Write down the equation for oxygen transfer rate. Draw a concentration profile showing different steps of oxygen transport from a gas bubble to microorganism. List some factors that can affect the oxygen transfer rate. (2+6+5=13)

**CHE 475**

**Contd ... Q. No. 3**

- (c) Draw the biomass growth curve based on (i) optical density, (ii) particle counter, and (iii) viable cell counter. (6)
- (d) Write the Monod's equation and define the parameters of that equation. Draw specific growth rate vs. nutrient curve to show the parameters mentioned in Monod's equation. (2+3+3=8)
4. (a) Explain the economic factors of a fermentation process with the help of process flow diagram. (15)
- (b) What is composting? Write down the key parameters for compost maturity and stability assessment. Explain different phases of composting process. (2+5+5=12)
- (c) Write short notes on any two of the following composting process parameters: (4+4=8)
- (i) Temperature
  - (ii) Moisture content
  - (iii) Particle size

**SECTION – B**

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

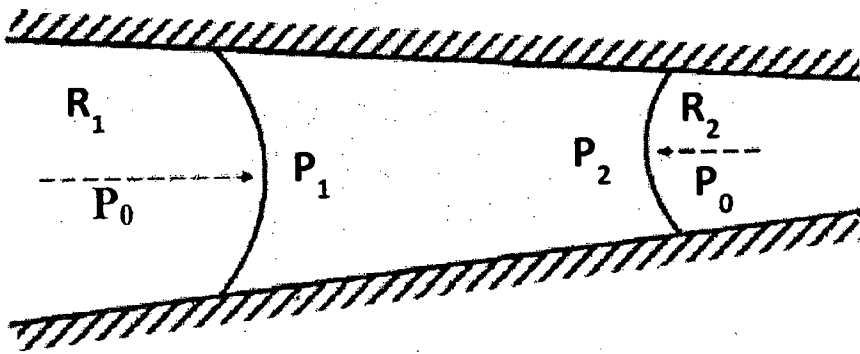
5. (a) Describe the various factors a Biomaterial Engineer would consider for designing a new biomaterial. (15)
- (b) Name the typical components used in a total hip replacement implant. Explain their selection criteria. (10)
- (c) What is Polymerization? Explain step-growth polymerization and chain polymerization mechanisms with appropriate examples. (10)
6. (a) Methyl-methacrylate ( $C_5H_8O_2$ ) is used as a cementing material for total hip replacements and total knee replacement. Calculate the number-average, mass-average, and Polydispersity Index of methyl-methacrylate sample with the following distribution: (15)

Monomers per chain	Relative abundance
100	20
500	50
1000	50
10000	30
50000	15

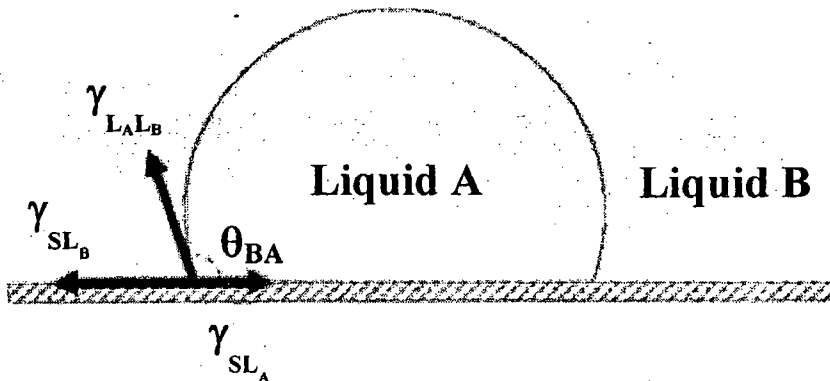
- (b) Describe the key factors contributing to biomaterial failure. (10)
- (c) Write short notes on the following biomaterials: (5+5)
- (i) Biodegradable synthetic polymers;
  - (ii) Smart polymers.

**CHE 475**

7. (a) Write down the biological applications and advantages of microfluidic technology. **(5+5)**  
 (b) Give examples of polymers used to develop microfluidic devices. What are the advantages of using polymers for microfluidic devices over silicon and glass based substrates. **(2+3)**  
 (c) Describe the microfabrication techniques used for polymeric microfluidic devices. **(10)**  
 (d) Explain 'Poiseuille Flow' and 'Electrophoresis' techniques for microfluidic mechanism. **(5+5)**
8. (a) Write short notes on: **(5+5)**  
 (i) Surface Tension  
 (ii) Total and Partial Wetting  
 (b) Calculate the driving force and flow direction of self-motion of a liquid plug between two nonparallel wetting plates. **(15)**



- (c) Derive equation for the Contact Angle ( $\theta_{BA}$ ) of a Two Liquids and a Solid system using Young's Law. In the system a droplet of liquid-A is sitting on a solid surface and immersed into liquid-B. **(10)**



BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CHE 493** (Petroleum Reservoir Engineering)

Full Marks : 210

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) Define oil formation volume factor ( $B_o$ ) and two phase formation volume factor ( $B_t$ ). Show the variations of  $B_o$  and  $B_t$  with pressure on the same plot. (10)
- (b) What is solution gas oil ratio? Discuss the parameters on which solution gas oil ratio depends. (10)
- (c) What is the difference between the values of  $B_g$  and  $B_o$ ? Discuss the reason. (5)
- (d) A sample of reservoir liquid with volume of 400 cc under reservoir conditions was passed through a separator and into a stock tank at atmospheric pressure and 60°F. The liquid volume in the stock tank was 274 cc. A total of 1.21 scf of gas was released. Calculate the oil formation volume factor and solution gas oil ratio. (10)
  
2. (a) Describe the two types of wetting phase distributions within a porous system with necessary figures. (10)
- (b) What do you understand by "Saturation History"? How does it affect capillary pressure-saturation relationship? Describe with example. (15)
- (c) Draw the relative permeability curves of a gas-water system and define irreducible water saturation and residual gas saturation. (5)
- (d) The fluids in a straight tube have an interfacial tension equal to 32 mN/m and exhibit a contact angle of 80° and capillary pressure of 5.5 kPa. What is the radius of the tube? (5)
  
3. (a) Simplify Havlena-Odeh form of oil material balance equation for a water-drive oil reservoir with an initial gas cap. How can you obtain a straight line equation from the simplified equation? (5+5)
- (b) Show that for an oil reservoir with an initial gas cap, initial gas saturation is  $\frac{m(1 - S_{wc})}{1 + m}$  and initial oil saturation is  $\frac{1 - S_{wc}}{1 + m}$  (Symbols have their usual meaning). (5+5)
- (c) A sandstone reservoir is producing under solution gas-drive conditions starting with an initial reservoir pressure of 2500 psia, the production profile as a function of reservoir pressure is shown below. (15)

**CHE 493**

**Contd ... Q. No. 3(c)**

Pressure (psia)	N <sub>p</sub> (MMSTB)	B <sub>o</sub> (Bbl/STB)	Z	R <sub>s</sub> (SCF/STB)	B <sub>g</sub> (Bbl/SCF)
2500	0	1.2762	0.827	575	0.000976
1600	26	1.1947	0.851	391	0.00157
1400	38	1.1688	0.864	333	0.00182
1200	51	1.144	0.879	278	0.00216

Cumulative GOR is maintained at 954 SCF/STB. State any additional assumptions and calculate STOIP.

- 4. (a) Describe P/Z method of estimating GIIP. (15)
- (b) What are the different types of hydrocarbon recovery techniques? Explain in detail. (15)
- (c) What do you understand by the information that the value of the water drive index and segregation drive index of a reservoir are 0.6 and 0.3 respectively? (5)

**SECTION – B**

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

- 5. (a) Describe different types of rocks. (15)
- (b) Draw a complete rock cycle. (10)
- (c) What is petroleum trap? Write down the names of different types of traps. (10)
- 6. (a) Write down the assumptions used in the derivation of the radial diffusivity equation. (5)
- (b) Find a solution of the radial diffusivity equation using the following boundary condition for steady state condition. (15)
  - (i)  $p = p_i$  when  $r = r_c$
  - (ii)  $q = q_w$  when  $r = r_w$

Radial diffusivity equation:  $\frac{1}{r} \frac{\delta}{\delta r} \left( r \frac{\delta p}{\delta r} \right) = \frac{\phi \mu c}{k} \frac{\delta p}{\delta t}$  (Symbols represent their usual meaning).

- (c) During drilling a well is damaged out to a radius of 4 ft from the wellbore so that the permeability within the damaged zone is reduced to  $\frac{1}{100}$ th of the undamaged effective permeability. After completion the well is stimulated so that the permeability out to a radius of 10 ft from the wellbore is increased to ten times the undamaged permeability. (5+10)
  - (i) Sketch the pressure profiles and geometry
  - (ii) What will be the increase in Productivity Index (PI) ratio if the wellbore radius is 0.333 ft and the drainage radius is 660 ft?

**CHE 493**

**Contd ... Q. No. 6(c)**

Given:

Inflow equation appropriate for the pressure distribution

$$P_e - P_{wf} = q\mu/2\pi k_e h. \left[ \ln \frac{r_e}{r_w} - \frac{1}{2} + S \right]$$

$$\text{Skin factor, } S = \frac{k_e - k_a}{k_a} \cdot \ln \frac{r_a}{r_w}$$

$k_e$  = undamaged effective permeability

$k_a$  = permeability within the damaged zone

$r_a$  = radius of the damaged zone

[Symbols represent their usual meaning].

7. (a) Define Productivity Index (PI). Write down the names of the various methods to increase PI. (5)

(b) What are the possible reasons for abnormal pressure in a reservoir? (5)

(c) If the pressure in a reservoir at the OWC (oil-water contact) is 3625 psi, calculate the pressure at the top if there is 600 ft continuous oil column. Normal pressure gradient exists throughout the reservoir (5)

Typical pressure gradients are (psi/ft):

water = 0.45

oil = 0.35

gas = 0.08

(d) A well and reservoir are described by the following data – (20)

porosity = 19%

formation volume factor = 1.4  $\text{rm}^3/\text{sm}^3$

net thickness of formation = 100 m

viscosity of reservoir oil =  $1.4 \times 10^{-3}$  Pa.S

compressibility =  $2.2 \times 10^{-9}$   $\text{Pa}^{-1}$

permeability = 100 mD

wellbore radius = 0.15 m

external radius = 900 m

initial reservoir pressure = 400 bar

skin factor = 0

well flow rate (constant) = 159  $\text{stm}^3/\text{day}$

Calculate the pressure in the reservoir at a radius of 9 m after 4 hours of production.

**CHE 493**

8. (a) Develop average permeability equation for linear flow in parallel and series combination of beds. (5+5)

(b) What is the equivalent linear permeability of four beds in series having equal formation thickness under the following conditions? (10)

Bed	length of bed (ft)	Horizontal Permeability (mD)
1	250	25
2	250	50
3	500	100
4	1000	200

Assume bed 1 is adjacent to the wellbore.

(c) Explain the principle of "Gas Expansion" method to determine porosity. (10)

(d) A calibration procedure resulted in  $V_1 = 100$  cc and  $V_2 = 80$  cc respectively. A core sample was placed in the first chamber at 0 kPa pressure. Gas was admitted to the second chamber to a pressure of 413.7 kPa. The valve was opened and the final equalized pressure was recorded as 199.783 kPa. What is the grain volume? (5)

-----

Could - - - 175

= 5 =

† of equation for question 7(d).

$$\dagger > \frac{400 \phi \mu c \pi \omega^2}{k}$$

$$\dagger < \frac{\phi \mu c \pi \omega^2}{4k}$$

$$\dagger > \frac{25 \phi \mu c \pi \omega^2}{k}$$

$$P_i - P_{wf} = - \frac{q \mu B_o}{4 \pi k h} \times \ln \left( \frac{\dagger \phi \mu c \pi \omega^2}{4 k t} \right)$$

[Symbols represent their usual meaning]

### Useful Formula

General oil MBE

$$N_p [B_o + (R_p - R_s) B_g] = N B_{oi} \left[ \frac{(B_o - B_{oi}) + (R_{si} - R_s) B_g}{B_{oi}} + m \left( \frac{B_g}{B_{gi}} - 1 \right) + (1+m) \left( \frac{C_w S_{wc} + C_f}{1 - S_{wc}} \right) \Delta P \right] + (W_e - W_p) B_w$$

General gas MBE:

$$G_i (B_g - B_{gi}) + G_i B_{gi} \left[ \frac{C_w S_{wc} + C_f}{1 - S_{wc}} \right] \Delta P + W_e = G_p B_g + B_w W_p$$

$$B_g = 0.02829 \frac{zT}{P} \text{ ft}^3/\text{SCF}$$

$$= 0.00504 \frac{zT}{P} \text{ bbl}/\text{SCF}$$

where,

P in psia, and T in °R



Extra

L-4/T-2/CHE

Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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

Full Marks : 210

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) If you were to generate a corrosion map for Bangladesh that will show the regions of highest rate of atmospheric corrosion, suggest two regions of different atmospheric conditions that you will mark. Justify your answer. (10)  
(b) Prescribe the tests you will carry out to ensure long service lives of steel pipes buried underground. Give recommendations to prevent corrosion of the pipes corresponding to each test result. (20)  
(c) 'When in doubt, use lead'. Can this be justified today? Give reasons. (5)
2. (a) You have been asked to provide suggestions for the design of a reactor for a batch process in a pharmaceutical industry. Reactant are to enter through a 90° angled pipe connected to the bottom part of the tank. Reactants will reach a high temperature of around 200 - 300°C while being agitated. Once reaction is complete, the product will be drawn off and the reactor cleaned for the next batch. Using the provided information, prescribe design methods that will ensure better corrosion prevention of the reactor system. You should include diagrams to explain your suggestions. (15)  
(b) "Incorporation of anodic protection systems to prevent corrosion of sulphuric acid and oleum tanks are far more acceptable than cathodic protection systems, although cathodic protection systems are more widely used elsewhere". (15)  
Analyze the above statement, providing sound reasons for your answer.  
(c) In dry corrosion, the rectilinear law is a special case of parabolic law. Justify. (5)
3. (a) How do dissolved gases cause corrosion in high pressure boilers? Suggest various ways by which water drawn from a nearby river can be treated for use as boiler feed water. (5+10)  
(b) Addition of titanium or columbium decreases the susceptibility for intergranular corrosion of austenitic stainless steel. Give reasons way this happens with proper explanation of the mechanism behind this. What other ways can help prevent this type of corrosion? (6+4)  
(c) "A poor paint system on a properly prepared metal surface generally outperforms a better paint on a poorly prepared surface". Justify the statement emphasizing on what is considered a good paint and a properly prepared surface. (10)

Contd ..... P/2

**CHE 409**

4. (a) What are the reasons for which high corrosion rate can occur even when the saturation index of water is positive? (5)
- (b) Give reasons why iron corrodes faster in (5×3=15)
- (i) seawater than natural water
  - (ii) acid than alkali
  - (iii) closed system than open system, when temperature is increased.
- (c) Rust consists of layers of iron-oxide in different forms. Explain. (7)
- (d) Too little an inhibitor is less desirable than none at all. Justify this statement. (8)

**SECTION - B**

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

5. (a) Analyze role of the Oxygen Electrode in corrosion phenomenon studies. Give specific examples. (10+10)
- (b) How can EMF series help in corrosion studies in industry? Show how the difficulties or shortcomings inherent in EMF series can be overcome. (5+10)
6. (a) How can Activation Polarization affect the corrosion rate? Show with the help of two examples how Activation Polarization becomes the critical factor in corrosion. (5+15)
- (b) In case of Combined Polarization, in which circumstance Concentration Polarization becomes more important than other forms of polarization? How can the effect of Concentration Polarization be reduced? (5+10)
7. (a) How do crystal imperfections and defects cause corrosion? Will you choose high purity metals for corrosion resistance? Give reasons for your answer. (10+5+10)
- (b) An austenitic iron-carbon alloy has been quenched. What changes will occur in its corrosion behaviour? How can its corrosion resistance be improved? (5+5)
8. (a) How can stability of passive state and/or film may be determined? (10)
- (b) How does potentiostatic polarization differ from galvanostatic polarization? Which one would you prefer? Give reasons for your answer. (5+5)
- (c) Why cold work increases the corrosion rate? Give specific examples to indicate the important factor which increases the rate of corrosion. (5+10)
-

EXTRA

L-4/T-2/CHE

Date : 07/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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. Answer any **THREE**.

1. (a) Discuss the impact of codes and standards on plant design. (9)  
(b) Why do you desire a process or equipment to be proven? (9)  
(c) List the codes and standards applicable for Pressure Vessels, Process Furnace, Welding Materials, and Shell and Tube Heat Exchanger. (5 1/3)
2. (a) Discuss the points to be considered in writing a specification sheet of an equipment. (9)  
(b) What are the activities to be conducted during procurement of a process plant? (5 1/3)  
(c) Explain the evaluation procedure of prequalification applications and bids. (9)
3. (a) List the engineering documents which are subject to review during plant design. (9)  
(b) Explain the term – performance test of the plant. (3 1/3)  
(c) Discuss the steps that are involved during performance tests of individual equipment and the process plant. (11)
4. (a) Briefly discuss the engineering specifications for inspection and tests. (9)  
(b) Write a short note on the scope of supply of a vendor for a piece of equipment. (5 1/3)  
(c) Discuss the importance of documentation during plant design. (3)  
(d) Explain the factors which influence the selection of the type of contracts. (6)

**SECTION – B**

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

5. (a) List the factors which are to be considered for evaluation of "Process Licensors". (7 1/3)  
(b) Write down the names of three process licensors for each of the following process (4 1/2)  
(i) PVC (ii) Urea (iii) Nitric Acid  
(c) What do you understand by know-how fee and engineering fee? (3)  
(d) Do you think Bangladeshi client should get process license from a licensor directly? Give reasons for your answer. (8 1/2)

Contd ..... P/2



**CHE 407**

6. (a) What do you mean by "Detailed Engineering"? List the aspects of chemical engineering involved in "Detailed Engineering". (12)
- (b) What are the documents included in "Process Licensors Basic Design Package". (11 1/3)
7. (a) For the purpose of environment protection what studies should you consider in designing and building "Nuclear Plant" in Bangladesh? (8)
- (b) What is Design Basis? (5)
- (c) Discuss some of conditions of steam, electric power and air. (10 1/3)
8. (a) What is "Engineering Specifications" in context of chemical plant? (4)
- (b) Why is it essential to define a process plant? (5)
- (c) Name ten package units usually procured from vendors. (5)
- (d) What do you mean by "Start-up" and "Performance Tests"? (6)
- (e) What is "Project Engineering"? (3 1/3)
-

L-4/T-2/CHE

Date : 17/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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

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. Answer **Q. No. 1** and any **TWO** from the rest.

1. **COMPULSORY**. Select the correct answer and give concise reason for your choice. **(10×5=50)**
- (a) The three main types of managers include:
- (i) general, specific, and frontline managers.
  - (ii) general, specific, and detailed managers.
  - (iii) general, functional, and frontline managers.
  - (iv) general, functional, and detailed managers.
- (b) Technical skills are most important for which of the following:
- (i) first line managers
  - (ii) middle managers
  - (iii) vice president-Production
  - (iv) top managers
- (c) Motivation is related to:
- (i) planning
  - (ii) controlling
  - (iii) leading
  - (iv) tactical decisions
- (d) The leader of an organization performs \_\_\_\_\_, as per Mintzberg.
- (i) An Interpersonal role
  - (ii) An Informational role
  - (iii) A Decisional role
  - (iv) All of the given options
- (e) The degree to which decision making is confined at a single point in an organization is described as \_\_\_\_\_.
- (i) Unity of command
  - (ii) Chain of command
  - (iii) Span of management
  - (iv) Centralization
- (f) A budget is an example of which of the following plan?
- (i) Strategic plan
  - (ii) Single use plan
  - (iii) Tactical plan
  - (iv) Standing plan

Contd ..... P/2

**CHE 411**

**Contd ... Q. No. 1**

(g) A manager who strives to ensure the activities of the organization's employees are supported and blend well with those of individuals outside the firm could be said to hold which of the following interpersonal role within the company?

- (i) Liaison
- (ii) Disseminator
- (iii) Figurehead
- (iv) Entrepreneur

(h) In Maslow's need hierarchy, a healthy work environment is an example of what type of need?

- (i) Physiological
- (ii) Esteem
- (iii) Safety
- (iv) Social

(i) An office supply firm that has the three departments based upon retail, wholesale, and governmental buyers is using which of the following types of departmentalization?

- (i) Functional
- (ii) Product
- (iii) Customer
- (iv) Geographic

(j) Which of the following is a general statement or understanding that guide or channelize thinking in decision making?

- (i) Policy
- (ii) Procedure
- (iii) Rule
- (iv) Project

[Important Note: If you do not provide reason to your choice, your answer will be considered to be incomplete].

2. (a) Draw hypothetical organisation charts for "FACEBOOK" and "UNILEVER". How are they different? What are the reasons for the difference? Explain fully with examples of specific issues. (25)

(b) With the help of a figure explain **Technology Life Cycle**. What are 'S' curves in technology management? Choose a suitable technology example to explain three sequential 'S' curves. (20)

3. (a) Briefly describe with figures three (3) communication networks. (12)

(b) A company wants to start a new business of marketing LPG in Bangladesh. Describe the planning that is required to execute the venture using "*A Model for Planning Approach*" described in your textbook. (21)

(c) There are seven (7) *Principles of Control*. Describe any four (4) of these. (12)

**CHE 411**

4. (a) A project consists of eight activities whose durations are as follows: (30)

Activity	A	B	C	D	E	F	G	H
Duration	4	4	3	5	4	1	6	5

The precedence relations are as follows:

- B must follow A
- D must follow A and C
- F must follow C and E
- G must follow C and E
- H must follow B and D

Draw an activity network and find the critical path.

- (b) Think of a problem that was creatively solved. Did the solution come from group discussion, or was it the result of an individual effort? Reconstruct the phases of the creative process. (15)

**SECTION - B**

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

5. (a) Develop the expression for capitalized cost based on discrete interest compounding. (10)

(b) A heat exchanger has been designed for use in a chemical process. A standard type of heat exchanger with a negligible scrap value costs \$ 4,000 and will have a useful life of 6 years. Another proposed heat exchanger of equivalent design capacity costs \$ 6800 but will have a useful life of 10 years and a scrap value of \$ 800. Assuming an effective compound interest rate of 8% per year, determine which heat exchanger is cheaper by comparing the capitalized costs. (15)

- (c) Data for a mine are as follows: (21 2/3)

- Estimated probable output: 20,000 tons/yr
- Time to exhaust property: 12 years
- Selling price of mined, dressed and smelted <sup>ore</sup> ~~are~~ \$ 10/ton
- Management costs, not including change for depletion: \$ 5,000/yr
- Costs of operating mine and smelter: \$ 7.53/ton
- Desired nominal interest rate: 8% compounded quarterly

Draw the cash flow diagram and comment on the economic feasibility of the project by PW method.

**CHE 411**

6. (a) What are the difficulties associated with the IRR method for project evaluation? Explain with example. (10)

(b) A piece of new equipment has been proposed by engineers to increase the productivity of a certain manual welding operation. The investment cost is \$ 25,000 and the equipment will have a salvage value of \$ 5,000 at the end of its expected life of 5 years. Increased productivity attributable to the equipment will amount \$ 8000/yr after extra operating costs have been subtracted from the value of the additional production. MARR for this alternative is 20% per year.

(i) Suppose  $\epsilon = \text{MARR} = 20\%$ . What is the ERR of the alternative? Is the alternative acceptable? (16 $\frac{2}{3}$ )

(ii) Find discounted payback period for the above stated alternative and comment on your result. (20)

7. (a) A certain service can be performed satisfactorily by either MEA 'M' or 'N'. Alternative 'M' has a first cost of \$ 8,000, an estimated service life of 10 years, no market value and annual revenue less expenses of \$ 2,400. The corresponding figures for alternative 'N' are \$ 18,000, 20 years, market value equals to 20% of the first cost, and \$ 4,000. Based on principle of MEA, specify which of the MEAs will you recommend for that service, if the MARR is 15%? Find your answer with FW method using a study period of 16 years. (20)

(b) Three mutually exclusive alternative public work projects are under consideration. Their respective cash flow is included in the table below. Project-I has an anticipated life of 45 years and useful lives of project-II and project-III have been estimated to be 35 and 25 years respectively. If the nominal interest rate is 10%, which one of the projects should be selected by assuming repeatability with conventional B/C ratio method? (26 $\frac{2}{3}$ )

Parameters	Project-I	Project-II	Project-III
Capital Investment	\$ 875 × 10 <sup>3</sup>	\$ 750 × 10 <sup>3</sup>	\$ 625 × 10 <sup>3</sup>
Annual O and M	\$ 130 × 10 <sup>3</sup>	\$ 120 × 10 <sup>3</sup>	\$ 110 × 10 <sup>3</sup>
Annual benefit	\$ 260 × 10 <sup>3</sup>	\$ 245 × 10 <sup>3</sup>	\$ 230 × 10 <sup>3</sup>
Useful life (years)	45	35	25

8. (a) How can you rank the order of MEAs (for investment alternative) for their comparison with rate of return method? Explain. (10)

(b) What investment criteria should the firm follow when it faces capital rationing? Why? (10)



**CHE 411**

**Contd ... Q. No. 8**

(c) The best (most likely) cash flow estimates are given below for a new 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  $\pm 30\%$  change in the estimates for (i) annual net cash flow and (ii) useful life. Best on these best estimates, plot a diagram that summarizes the sensitivity of PW to percent deviation changes in each separate factor estimate when the MARR = 12%. Comment on the results.

(26 $\frac{2}{3}$ )

Given:

Capital Investment	:	\$ 11,500
Revenue/yr	:	\$ 5,000
Expenses/yr	:	\$ 2,000
Market value	:	\$ 1,000
Useful life	:	6 years.

-----