L-4/T-2/CHE **Date : 16/01/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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. Answer any **THREE**.

1. (a) You purchased a building at Dhaka 10 years ago for $ 1,00,000. Its annual maintenance expense has been $ 5,000 per year. At the end of fourth year, you spent $ 10,000 for wall repairing activity. At the end of 10 years (Now), you sell the building for $ 1,20,000. During the period of ownership, you rented the building for $ 10,000 per year paid at the beginning of each year. Use the annual worth method to evaluate this investment when the expected MARR is 13%. **(16⅔)**

(b) There are various brick kiln technologies in Bangladesh to produce clay fired bricks. Among the technologies, Fixed chimney kiln (FCK) is the most adopted technology all through Bangladesh due to its low initial cost and easy operability. However, yearly average production of this kiln is around 4 million bricks each having a final weight of 2.7 kg (fired brick). For this 4 million brick production , annual labor cost is around 45,00,000 BDT, annual land rental value is 1,50,000 BDT, annual firing preparation and maintenance cost is 8,00,000 BDT and annual staff salary is 6,00,000 BDT. FCK consumes around 22 tonnes of coal to produce 1,00,000 bricks and the cost of coal is 6,000 BDT/ton of coal. Additionally, the brick manufacturer has to pay a VAT amount 3,85,000 BDT on A million bricks to the Government. The initial investment amount is around 45,00,000 BDT. Salvage value of the FCK after 20 years is 4,00,000 BDT. Soil is the essential raw material for brick production. FCK owners purchase 100 ft^3 soil at a price of 1,200 BDT which is used to produce 1,000 Bricks. Owners' MARR is 15%. What is the production cost per kg of fired brick? **(30)**

2. (a) What are the non-probabilistic methodologies for dealing with uncertainty in engineering economy studies? Explain their applicability in engineering economy study. **(16⅔)**

(b) Suppose that for an engineering project the optimistic, most likely and pessimistic estimates are shown below. **(30)**

	Estimation Conditions		
	Optimistic (O)	Most likely (M)	Pessimistic (P)
Capital Investment	-$ 150,000	-$ 150,000	-$ 150,000
Useful life	19 years	10 years	7 years
Market value	0	0	0
Annual Revenue	$ 120,000	$ 70,000	$ 40,000
Annual Expenses	-$ 19,000	-$ 43,000	$ - 60,000
MARR	10%	10%	10%

Contd P/2

CHE 411

Contd ... Q. No. 2(b)

It is thought that the most critical elements are annual revenue, annual expenses and useful life. Develop a table showing the equivalent worth for all combinations of the estimates for these three factors, assuming that all other factors remain at their most likely values.

3. (a) What are the basic differences between privately owned and publicly owned projects? What are the characteristics of Multiple-Purpose projects? Give an example in context of Bangladesh and write down its characteristics. What are the possible conflicts among the agencies of this multiple-purpose project? **(16⅔)**

(b) A governmental agency is considering four independent projects. The current budget for this agency allows not more that $ 35,000,000 to be spent in terms of initial investment and the normal interest rate is 10%. Using the B/C ratio method, which of the projects shown in the table below should be selected? **(30)**

Project	Initial investment	Annual cost	Annual benefit	Salvage value	life
A	$ 12,000,000	$ 1,250,000	$ 3,250,000	$ 750,000	30 years
B	$ 20,000,000	$ 4,500,000	$ 8,000,000	$ 725,000	31 years
C	$ 10,000,000	$ 750,000	$ 1,250,000	$ 0	30 years
D	$ 14,000,000	$ 1,850,000	$ 4,050,000	$ 700,000	29 years

4. (a) What are ordinary annuity and annuity due? Explain the terms along with their uses in engineering economy studies. Also develop the relationship between amount of annuity due and the periodic payment. **(11⅔×4=46⅔)**

(b) What are the sources of funds to an engineering firm for capital spending? "Capital Asset Pricing Model is the best model in calculating cost of Equity Capital" – Justify your answer through developing and explaining each of the terms associated with this model.

(e) Develop a historical table for input-output analysis between two sectors in engineering economy study and show the Direct Requirement Matrix of that input-output model explaining each component of the development matrix.

(d) Write short notes on the following-

(i) Excise tax

(ii) Surtax

(iii) Carry-back and Carry-forward of losses

(iv) Attractive nuisance and Bailee's liability.

Contd P/3

CHE 411

SECTION – B

There are **FOUR** questions in this Section. Answer **THREE** questions including Q. No. 5.

5. **Compulsory** Select correct answer and give concise reason for your choice **(10×5=50)**

(i) ---------- is the process of getting activities completed efficiently and effectively with and through other people

(a) Leading

(b) Management

(c) Supervision

(d) Controlling

(ii) ---------- distinguishes a managerial position from a nonmanagerial one

(a) Manipulating others

(b) Concern for the law

(c) Increasing efficiency

(d) Coordinating and integrating others' work

(iii) The process of monitoring comparing and correcting is called

(a) Controlling

(b) Coordinating

(c) Leading

(d) Organizing

(iv) What are the three interpersonal roles of managers?

(a) Figurehead, leader and liaison

(b) Spokesperson, leader, coordinator

(c) Director, coordinator, disseminator

(d) Communicator, organizer, spokesperson

(v) The degree to which decision making is confined at a single point in an organization is described as ----------.

(a) Unity of command

(b) Chain of command

(c) Span of management

(d) Centralization

(vi) When Shumaila is comparing actual sales figures with goals established earlier to see if her department met the target, she is performing which of the following functions?

(a) Planning

(b) Organizing

(c) Leading

(d) Controlling

Contd P/4

CHE 411

Contd ... Q. No. 5

(vii) Which of the following is a function of how much decision-making authority is pushed down to lower levels in the organization?

(a) Departmentalization

(b) Centralization

(c) Span of control

(d) Power

(viii) In general, if a policy is not thought out an established

(a) a situation requiring action will arise

(b) social issues will cause change in the organization

(c) managers will be hired from the outside

(d) there will be significant staff turnover

(ix) Which of the management tasks is the most important for a supervisory manager?

(a) Planning

(b) Organizing

(c) Controlling

(d) Staffing

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

(a) Policy

(b) Procedure

(c) Rule

(d) Project

6. (a) Explain why "Technology Transfer" is difficult to achieve. **(15)**

(b) With the help of sketches, discuss different (at least 4) communication networks. **(20)**

(c) List five features of "Bureaucracy". **(10)**

7. (a) Draw an organogram of a company that **(21)**

- produces three products in two locations
- employs staff managers
-conducts research and development of new products

(d) Why are plans important? How many types of plans are there? **(12)**

(c) Discuss the interrelationships among MIS, DSS, EIS, and OAS systems. **(12)**

Contd P/5

CHE 411

8. (a) The following table shows the activities that need to be undertaken to complete an engineering project. Draw the Activity Diagram for the project. Calculate the early time, late time and total float for each event, and identify the Critical Path of the given project with the help of arrow network. **(10+6+6+5+10=37)**

Activity Symbol	Estimated Time (week)	Post Requisite
A	6	B, C
B	8	D, F, H
C	10	D
D	8	E
E	10	J
F	8	G
G	8	J
H	4	I
I	8	J
J	10	K
K	4	

(b) Explain the advantages and disadvantages of Gantt Chart. **(8)**

L-4/T-2/CHE Date : 21/01/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) Describe sedimentary rock with three component diagram. **(10)**

   (b) Describe typical fluid distribution in hydrocarbon reservoir for **(12)**

   (i) Oil reservoir

   (ii) Associated oil gas reservoir

   (iii) Non-Associated gas reservoir

   (c) What are petroleum traps? Describe convex trap reservoir. **(8)**

   (d) Draw rock cycle. **(5)**

2. (a) Define oil formation volume factor (FVF) and solution gas oil ratio (Rs). Show the variation of FVF and Rs with pressure. **(15)**

   (b) A small operator purchased an oil reservoir that now contains significant gas cap. The properties of the reservoir of the reservoir are shown in the table below. The initial reservoir pressure was 3500 psia. The current pressure is 1500 psia after it had produced 30 MM stb oil and 18 MMM scf gas. The connate water saturation was 8%. There was negligible water production and the Geologist suspects that the reservoir is volumetric. Using the following PVT data answer the following questions. **(20)**

P (psia)	Bo (bbl/stb)	Rs (scf/stb)	Bg (bbl/scf)
3500	1.2480	510	-
3330	1.2511	510	0.00087
3000	1.2222	450	0.00096
2700	1.2022	401	0.00107
2400	1.1822	352	0.00119
2100	1.1633	304	0.00137
1800	1.1450	257	0.00161
1500	1.1287	214	0.00196

   (i) Was the reservoir initially saturated or unsaturated? Why?

   (ii) Calculate initial oil in place?

   (iii) What was the initial SCF of gas in place (free + dissolved)

   (iv) What was the initial SCF of free gas in the reservoir?

   (v) What was the final reservoir gas saturation?

Contd P/2

CHE 493

3. (a) Describe different flow regimes and state the boundary conditions applied to them. What information can be obtained from the data collected from different flow regimes? **(10)**

(b) Derive the integral form of Darcy's equation for the flow across a spherical control volume of radius r. **(10)**

(c) A well was given stimulation treatment which created an improved permeability zone up to a radial distance of 150 ft from the well bore. Estimated permeability of this zone is 200 mD, while the zone beyond had permeability of 15 mD. Assume steady state, single phase and incompressible fluid flow. The outer boundary is 1500 ft from the well bore. Pressure at the outer boundary is 2200 psia, while well bore pressure is 100 psia. Well bore radius is 0.5 ft, reservoir thickness is 20 ft and porosity is 18%. Formation volume factor of fluid is 1.121 bbl/stb and viscosity is 1.5 cp. Calculate– **(10+5=15)**

(i) Flow rate in stb/day

(ii) The pressure of the reservoir at a distance of 300 ft from the centre of the well bore.

See table 3(c) for radial inflow equations for stabilized flow conditions.

4. (a) Develop average permeability equations for radial flow in parallel and series combination of beds. **(9)**

(b) Three beds of 50 mD, 110 mD, 795 mD and 5 ft, 7 ft, 15 ft thickness respectively are conducting fluid in parallel flow. If all are of equal length and width, what is the average permeability? **(10)**

(c) Define the following– **(16)**

(i) Effective porosity

(ii) Induced porosity

(iii) Connate water saturation

(iv) Irreducible water saturation

	STEADY STATE	SEMI-STEADY STATE
General relationship between p and r	$p - p_{wf} = \frac{q\mu}{2\pi kh} \ln \frac{r}{r_w}$	$p - p_{wf} = \frac{q\mu}{2\pi kh}\left(\ln \frac{r}{r_w} - \frac{r^2}{2r_e^2}\right)$
Inflow equations expressed in terms of $p = p_e$ at $r = r_e$	$p_e - p_{wf} = \frac{q\mu}{2\pi kh} \ln \frac{r_e}{r_w}$	$p_e - p_{wf} = \frac{q\mu}{2\pi kh}\left(\ln \frac{r_e}{r_w} - \frac{1}{2}\right)$
Inflow equations expressed in terms of the average pressure	$\bar{p} - p_{wf} = \frac{q\mu}{2\pi kh}\left(\ln \frac{r_e}{r_w} - \frac{1}{2}\right)$	$\bar{p} - p_{wf} = \frac{q\mu}{2\pi kh}\left(\ln \frac{r_e}{r_w} - \frac{3}{4}\right)$

TABLE 3C

Radial inflow equations for stabilized flow conditions

Contd P/3

CHE 493

SECTION – B

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

5. (a) The Xanadu gas field started production at 3250 psia and was abandoned at 1500 psia. Following data are known: Porosity = 22%, water saturation = 23%, residual gas saturation = 24% **(15)**

P (psia)	Bg (ft^3/scf)
3250	0.00533
1500	0.01122

(i) What is the initial gas in place per unit volume (acre-foot) of the reservoir?

(ii) How much gas is produced per unit volume of the reservoir?

(iii) What is the recovery factor?

(b) Show that the pressure and gas deviation factor versus cumulative production relationship of a dry gas reservoir can be expressed as a straight line. When only volumetric depletion takes place. Explain what is volumetric depletion? **(15)**

(c) What are the different reserve estimation methods? **(5)**

6. (a) What are the different petroleum reservoir drive mechanisms? **(5)**

(b) The general form of the material balance equation is as follows– **(10)**

$$N(B_t - B_{ti}) + \frac{NmB_{ti}}{B_{gi}}(B_g - B_{gi}) + (1+m)NB_{ti}\left[\frac{c_w S_{wi} + c_f}{1 - S_{wi}}\right]\Delta P + W_e = N_p[B_t + (R_p - R_{soi})B_g] + B_w W_p$$

symbols represent their usual meaning.

(i) Modify the above mentioned MBE to the equation proposed by Havlena and Odeh and explain the different terms of the equation.

(ii) Simplify the MBE given above so that it can be used for a gas reservoir with a bottom water drive.

(c) The production history and the PVT data of a gas cap drive reservoir are given below: **(20)**

P (psia)	Np (MSTB)	Gp (MSCF)	Bt (bbl/STB)	Bg (bbl/SCF)
4415	-	-	1.6291	0.00077
3875	492.5	751.3	1.6839	0.00079
3315	1015.5	2409.6	1.7835	0.00087
2845	1322.7	3901.6	1.9110	0.00099

The initial gas solubility Rsi is 975 scf/STB. Estimate the initial oil-and gas-in-place.

Contd P/4

CHE 493

7. (a) Draw the relative permeability curve for oil-gas system where oil is the wetting phase. Label axes, characteristic points and areas. Also define critical gas saturation and residual oil saturation. **(10)**

   (b) Describe the uncertainties associated with the determination of hydrocarbon water contact? **(10)**

   (c) Define capillary pressure. Sketch capillary pressure versus saturation for drainage and imbibitions. **(10)**

   (d) There are 950 MMstb of oil initially in place in reservoir. It is estimated that 500 MMstb can be produced. Already 100 MMstb have been produced. What are the reserves? **(5)**

8. (a) What is gas cycling and why in some cases is it used? **(5)**

   (b) A well is initially producing at a rate of 400 stb/d from a reservoir which has the following rock and fluid properties– **(20)**

   $k = 50$ mD

   $h = 30$ ft

   $rw = 6$ inches

   $\varphi = 0.3$, $\mu = 3$ cp

   $c = 10 \times 10^{-6}$/psi

   $Bo = 1.25$ rb/stb

   (i) After what value of the flowing time is the approximation $ei(x) = -\ln(\gamma x)$ valid for this system?

   (ii) What will be the pressure drop at the well after flowing at the steady rate of 400 stb/d for 3 hours, assuming transient conditions still prevail?

   (c) What is Klinkenberg effect? Describe how this effect can be corrected during permeability measurement using gas. **(10)**

Parameter	Symbol	Dimensions	Absolute units		Hybrid units	
			cgs	SI	Darcy	Field
Length	l	L	cm	metre	cm	ft
Mass	M	M	gm	kg	gm	lb
Time	t	T	sec	sec	sec	hr
Velocity	u	L/T	cm/sec	metre/sec	cm/sec	ft/sec
Rate	q	L^3/T	cc/sec	$metre^3$/sec	cc/sec	stb / d (liquid) Mscf / d (gas)
Pressure	p	$(ML/T^2)/L^2$	$dyne/cm^2$	Newton/$meter^2$ (Pascal)	atm	psia
Density	ρ	M/L^3	gm/cc	$kg/metre^3$	gm/cc	lb/cu.ft
Viscosity	μ	M/LT	gm/cm.sec (Poise)	kg/metre.sec	cp	cp
Permeability	k	L^2	cm^2	$metre^2$	Darcy	mD

TABLE 8(b)
Absolute and hybrid systems of units used in Petroleum Engineering

L-4/T-2/CHE **Date : 21/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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

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. Student **must answer Q. No. 4** and **TWO** other questions from Questions #1 to #3.

1. (a) Describe the various types of reactors used for wastewater treatment with appropriate diagram and applications. **(15)**

   (b) Briefly discuss the unit operations and processes used to remove colloidal and dissolved solids from industrial wastewater. **(10)**

   (c) Briefly discuss the types and constituents of waste generated from a typical Pharmaceutical Industry. **(10)**

2. (a) Discuss the fundamentals of chemical coagulation with the help of surface charge and electrical double layer. **(7)**

   (b) A textile dyeing industry produces 75 m^3/hr wastewater, which contains 250 mg/L total suspended solids (TSS), 45 mg/L total alkalinity (as $CaCO_3$), 275 mg/L BOD_5 and 435 mg/L COD. During the treatment process, in the absence of any chemical coagulant, the primary clarifier can remove 55 percent of TSS. Use of chemical coagulants can improve TSS removal up to 85 percent. Ferric Chloride and Ferric Sulfate are two favourable options as chemical coagulants. Assume the chemical sludge properties (specific gravity and moisture content) are the same for any of the chemical coagulants. For maximum TSS removal using chemical coagulation, ETP operator uses following dosing rates: 50 kg Ferric Chloride per 1000 m^3 wastewater, and 55 kg Ferric Sulfate per 1000 m^3 wastewater. Estimate the mass and volume of sludge produced from wastewater with and without chemical coagulants. Report the amount of lime required for chemical coagulation. Which chemical coagulant would be more preferred for the given treatment process, and why? **(28)**

   Given that the specific gravity of raw sludge is 1.03 with moisture content 94 percent. For chemical sludge, the specific gravity is 1.06 and moisture content is 92.5 percent.

$$\underset{(399.9)}{Fe_2(SO_4)_3} + \underset{(3\times100 \text{ as } CaCO3)}{3Ca(HCO_3)_2} \leftrightarrow \underset{(2\times106.9)}{2Fe(OH)_3\downarrow} + 3CaSO_4 + 6CO_2$$

$$\underset{(2\times162.2)}{2FeCl_3} + \underset{(3\times100 \text{ as } CaCO3)}{3Ca(HCO_3)_2} \leftrightarrow \underset{(2\times106.9)}{2Fe(OH)_3\downarrow} + 3CaCl_2 + 6CO_2$$

With Lime,

$$\underset{(399.9)}{Fe_2(SO_4)_3} + \underset{(3\times56 \text{ as } CaO)}{3Ca(OH)_2} \leftrightarrow \underset{(2\times106.9)}{2Fe(OH)_3\downarrow} + 3CaSO_4$$

$$\underset{(2\times162.2)}{2FeCl_3} + \underset{(3\times56 \text{ as } CaO)}{3Ca(HCO_3)_2} \leftrightarrow \underset{(2\times106.9)}{2Fe(OH)_3\downarrow} + 3CaCl_2$$

Contd P/2

CHE 485

3. (a) Explain the generalized Environmental Impact Assessment (EIA) Process using appropriate process diagram. **(7)**

(b) Write a short note on Zero Discharge of Hazardous Chemicals (ZDHC). **(5)**

(c) What is water footprint? Briefly discuss different sources of water footprint to produce a piece of 'T-shirt'. **(8)**

(d) A textile dyeing industry operates an effluent treatment plant which contains two clarifiers to separate suspended solids from chemical and biological units. The solid contents of the clarifiers go to a digester to digest sludge. The solid contents, volatile matter, specific gravity of fixed solids and specific gravity of volatile solids of the sludge are 5%, 60%, 2.5 and 1.0, respectively. After digestion, the solid contents, volatile matter, specific gravity of fixed solids and specific gravity of volatile solids of the digested sludge are 10%, 37.5%, 2.5 and 1.0, respectively. Determine the liquid volume before and after digestion for 500 kg (dry basis) of the sludge generated. **(15)**

4. (a) An established textile industry is planning to install an Effluent Treatment Plant (STP) to treat the wastewater produced from their industry. As an Environmental Engineer what are the steps you would recommend in choosing the ETP? **(10)**

(b) A textile dyeing plant of daily capacity 5 ton, uses 2.25 kg dye for every 100 kg fabric. The major pre-dyeing, dyeing and post-dyeing stages are shown in the table below. The liquor ratio for any stage (except rinsing) of pre-dyeing, dyeing and post-dyeing stages is 1 : 8 (i.e. 8 liters of liquid for 1 kg fabric). For rinsing, the dyeing machine uses three times more water than a regular dyeing step. Key pollution indicating parameters of different dyeing steps for a 600 kg fabric batch are also given in the table. The pollution load of the wastewater varies from stage to stage. For simplification, it is assumed that the COD:BOD ratio of wastewater produced from any stage above 3:1 is considered highly polluted, and COD:BOD ratio of wastewater below 3:1 is considered less polluted. The industry runs an ETP to treat the wastewater produced from the following stages. The ETP contains Physico-Chemical and Biological units. To reduce the operating cost, the industry desires to segregate the less polluted wastewater from the highly polluted wastewater, and treat them separately: only biological treatment for less polluted streams, and Physico-chemical followed by biological treatment for highly polluted streams.

Fabric: 600 Kg

Stages	TDS (mg/L)	COD (mg/L)	BOD_5 (mg/L)
Scouring	5850	10120	2050
Hot Wash	3060	3050	625
Neutralization	540	1440	290
Dyeing	57800	3520	725
Rinsing	6700	720	275
Neutralization	305	900	360
Rinsing	200	430	215
Hot Wash with Soap Agent	950	720	235
Rinsing (Hot)	205	345	175
Softening	245	165	80

Contd P/3

CHE 485

Contd ... Q. No. 5

What would be the composite characteristics (in mg/L) of the highly polluted and less polluted wastewater produced by the above mentioned industry? What volume of wastewater (m^3) would have to be treated by the Physico-chemical and biological units annually? **(25)**

SECTION – B

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

5. (a) What are the general types of particulate pollutants in atmosphere? Describe their physical state, sources and transportation behavior in atmosphere. **(10)**

   (b) Classify ambient air pollutants according to their origin and describe briefly with examples their sources and possible impacts. **(15)**

   (c) Describe the factors affecting dispersion of air pollutants. What is Gaussian dispersion model? Write down the types of air monitoring instrumentation. **(10)**

6. (a) Draw a simplified flow chart of Ammonia production process and point out the major origins of air pollutants. **(15)**

   (b) Discuss the flue gas desulfurization process with process block diagram. **(10)**

   (c) Write a short note on "effect of air pollution control on climate". **(10)**

7. (a) How can you reduce thermal NO_x and fuel NO_x from combustion system? State briefly. **(10)**

   (b) Discuss the environmental impact of Petroleum industry? **(15)**

   (c) Write a short note on oil spill and clean up methods. **(10)**

8. (a) Discuss major advantages and disadvantages of thermal oxidation, catalytic oxidation and GAC adsorption processes to remove VOCs from industrial emission stream. **(15)**

   (b) State Pasquill-Turner stability classes. How is the air quality of an area affected by atmospheric stability? **(12)**

   (c) What is noise pollution? Discuss the control of noise pollution. **(8)**

L-4/T-2/CHE **Date : 26/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) "In industrial atmosphere, direct exposure of a metal to rain is beneficial compared to a partially sheltered exposure" – Why? "This advantage presumably would not extend to uncontaminated atmospheres" – Explain. **(6+4)**

   (b) "Critical humidity for steel is about 60% RH." What is its significance? Can this information be somehow used for corrosion control? **(10)**

   (c) "Corrosion of metallic materials specially of steel buried underground is of tremendous interest and importance" – Is this statement true for Bangladesh? Justify your answer. **(8)**

   (d) "Soil corrosion rates vary in a big way with type or kind of soil." – Explain. **(7)**

2. (a) How can you use "bonding" for preventing stray current corrosion? **(8)**

   (b) Why do you need to consider corrosiveness of the process environment at the design stage? **(7)**

   (c) Discuss the effect of heat treatment on the corrosion rate of cold-worked carbon steel. **(10)**

   (d) With the help of S-N curve, explain the effect of the conjoint action of repeated cyclic stresses and a corrosive environment on steel or any other metal/alloy. **(10)**

3. (a) Explain "Electrochemical Dissolution Theory" and "Stress Sorption Theory" of stress corrosion cracking. **(20)**

   (b) What are the remedial measures for stress corrosion cracking of austenitic stainless steel? **(10)**

   (c) What is "Alclad"? **(5)**

4. (a) What are the five generic methods for corrosion prevention? How many of these are currently in use for protection of underground gas transmission pipelines in Bangladesh? **(10)**

   (b) Explain why (very briefly) cathodic current protects the outside of the pipes only. **(5)**

   (c) Why do we need surface preparation for paint application? What are the requirements of a good paint for corrosion protection? **(10)**

   (d) Why water supply companies usually do not treat potable water chemically? What measures can be taken if the SI of potable water is negative? **(10)**

Contd P/2

CHE 409

SECTION – B

There are **FOUR** questions in this section. Answer **Q. No. 5** which is compulsory and any **TWO** from the rest. **Q. No. 5 is COMPULSORY.**

5. **(COMPULSORY)** Answer all the questions. Choose the correct answer and give reasons for your answer. Give tick (√) mark to the correct answer. **(5×9=45)**

(a) With pitting type of attack, failure might occur suddenly. TRUE/FALSE

(b) A galvanic series cannot be used for different environments. TRUE/FALSE

(c) The higher the FLADE potential easier it is for corrosion to occur. TRUE/FALSE

(d) Concentration polarization is absent when Activation polarization is present. TRUE/FALSE

(e) Once solidified, at room temperature, the corrosion properties of an alloy cannot be changed. TRUE/FALSE

(f) Effect of fluid velocity on corrosion of Iron in dilute acid is absent in deaerated solutions. TRUE/FALSE

(g) Within pH range 4-10, H_2 diffusion is the controlling factor for corrosion of steel. TRUE/FALSE

(h) During uniform corrosion adjacent grains of a metal may act as anode and cathode. TRUE/FALSE

(i) The existence of more than one phase in an alloy usually results in better corrosion resistance than for individual single-phase materials. TRUE/FALSE

6. (a) Show how Activation Polarization becomes the critical factor in corrosion. In this respect elaborate the role of Hydrogen over-voltage. **(10+10)**

(b) Can tempering improve corrosion resistance of all alloys? Give reasons for your answer. **(5+5)**

7. (a) You are going to import an alloy. What kind of information regarding its metallurgical history will you ask the supplier to provide? **(10)**

(b) Determination of "Saturation Index" for boiler water has been considered an important step for a long time. Why? What process changes can make it less important? **(10)**

(c) Do you agree that the "Oxide-Film Theory" and "Adsorption Theory" for passivity are not contradictions? Give reasons for your answer. **(10)**

8. Write short notes on: **($7\frac{1}{2}$ ×4=30)**

(a) Area Effect

(b) Cavitation Erosion

(c) Pourbaix Diagrams

(d) Corrosion tendency of Grain Boundaries.

L-4/T-2/CHE **Date : 30/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) Show with the help of a block diagram the parties involved in project implementation in public sector in Bangladesh and the interrelation among them. **(8)**

   (b) A 100 ton per day condensate refinery plant is to be built in Chittagong. Write down the following **(15 1/3)**

   (i) Complete definition of the project

   (ii) Stages of implementation of the project.

2. (a) What are the essential features of design philosophy in the context of Bangladesh? **(6 1/3)**

   (b) "Trade Offs between operational saving and incremental investment are to be considered during economic evaluation" – explain the statement. **(8)**

   (c) Write down the major component of design basis. Give two reasons why information about wind direction and wind speed are critical for plant design. **(9)**

3. (a) What are the different types of process licensing arrangements in practice? Write briefly about the process licensing arrangements made for Shahjalal Fertilizer Project in Bangladesh. **(13)**

   (b) What is Front End Engineering Design (FEED)? In which stage of plant design FEED needs to be carried out? **(10 1/3)**

4. (a) List the items covered in codes and standards. Elaborate on the following statement – "Adherence to a particular codes and standards has many advantages". **(11 1/3)**

   (b) Write short note on **(12)**

   (i) Plant life, (ii) Scope of contractor's work for a turnkey project

Contd P/2

CHE 407

SECTION – B

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

5. (a) How important is the process of prequalification of Vendor in the context of a country like Bangladesh? Which specific information do you think are more important for local vendors to state while seeking prequalification when there are many foreign vendors? **(6+6)**

   (b) While selecting a "General Contractor" for building a large fertilizer plant which specific information will you seek in the area of a "work experience" of the bidders? Suggest a plan for "marking" the bidders for their "work experience". **(4+4)**

   (c) Do you think the "Two Envelope" system of evaluation for contractor a fair system? Give reasons for your answer. **(3 1/3)**

7. (a) You have been asked to evaluate a PFD for a plant (as submitted by a Design Firm). What specific information will you look for in the drawings? Do you consider P&I diagrams to the extended version for PFD's? Give reasons for your answer. Which diagram will provide you with "guaranteed values" for feed, materials, utilities, catalysts, etc.? **(6+3+3)**

   (b) To ensure process safety which factor will you consider in the "Plot Plan" or "Plant Layout"? Draw a rough "Plot Plan" to show the possible "unsafe" or "hazardous area". **(6+5 1/3)**

7. (a) Discuss the importance of the tests which are performed before the final "Performance Test" is undertaken. **(10)**

   (b) Why is it essential to over design some package units? Give examples. **(3 1/3)**

   (c) What has been our experience in Bangladesh with regard to "Performance Tests"? **(10)**

8. Write short notes on:

   (a) The "Bhopal Tragedy" and poor inspection. **(10)**

   (b) Third Party Inspection - examples of success and failure. **(8)**

   (c) Special items to be discussed in the context of our country while negotiating a contract. **(5 1/3)**
