

2023-24

**B. TECH. (AUTUMN SEMESTER) EXAMINATION
CHEMICAL ENGINEERING/FOOD TECHNOLOGY**

Chemical Reaction Engineering I

CHC-3100

Maximum Marks: 60

Credits: 03

Duration: Two Hours

Answer all questions.

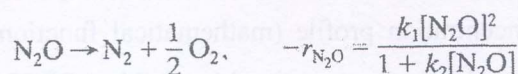
Assume suitable data if missing.

Notations and symbols used have their usual meaning.

Q. No.	Question	M.M.
1(a)	A gaseous phase reaction is carried out in constant volume batch reactor under isothermal condition where number of moles of material changes with time. Develop the general expression which relates the total pressure of the system to the concentration or partial pressure of any of the reaction components.	[08] [CO1]

OR

1(a')	A reversible type first order reaction $A \leftrightarrow 2R$ takes place in a batch reactor. k_1 and k_2 are the rate constants for forward and backward reaction respectively. Find out the equilibrium conversion of A. Explain the procedure and evaluate the expression to determine the rate constant.	[08] [CO1]
1(b)	The maximum allowable temperature for a reactor is 800 K. At present our operating set point is 780 K. Now, with a more sophisticated control system we would be able to raise our set point to 792 K. By how much can the reaction rate, hence, production rate, be raised by this change if the reaction taking place in the reactor has an activation energy of 175 kJ/mol?	[04] [CO1]
1(c)	The decomposition of nitrous oxide is found to proceed as follows:	[03] [CO1]



What is the order of this reaction with respect to N_2O , and overall?

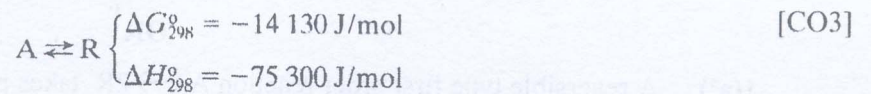
2(a)	Liquid A decomposes in a batch reactor by zero order kinetics. The initial concentration of A is 0.5 kmol/m^3 and for a reaction time of 1200 s, the conversion is 40%. Assume isothermal conditions. Determine the rate constant for this reaction and what will be the conversion for a reaction time of 3600 s?	[5] [CO2]
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contd...2

2(b) A first order liquid phase reaction is carried out in an ideal continuous stirred tank reactor. What will happen to the conversion if a part of the outlet stream is recycled back to the reactor? [02] [CO2]

2(c) The elementary second-order, liquid phase reaction $A+B \rightarrow C+D$ is conducted in an isothermal plug flow reactor of 1 m^3 capacity. The inlet volumetric flow rate is $10\text{ m}^3/\text{h}$ and $C_{A0}=C_{B0}=2\text{ kmol/m}^3$. At these conditions, conversion of A is 50%. Now, if a stirred tank reactor of 2 m^3 capacity is installed in series, upstream of the plug flow reactor, then what conversion can be expected in the new system of reactor? [08] [CO2]

3(a) The reversible first order gas phase reaction [15]



is to be carried out in a batch reactor, starting with a mixture of $C_{A0} = 4\text{ mol/liter}$ to $C_{R0} = 0\text{ mol/liter}$. Reaction gives 50% conversion in 1 min at 60°C and 60% conversion in 12 min at 25°C . Assuming first order kinetics, determine the equilibrium conversion at 60°C and also find the reaction rate at 60°C for 60% conversion of A. Data given: $C_{PA}=C_{PR} = 25\text{ J/mol.K}$

OR

3(a') Explain optimum temperature progression. Develop the relationship between conversion and heat of reaction for adiabatic operations. Also explain the graphical representation of energy balance equation for adiabatic operations. [15] [CO3]

4(a) Develop the output concentration profile (mathematical function) of tracer in an ideal CSTR for an impulse input. Compare it with non-ideal CSTR reactor. [04] [CO4]

OR

4(a') How does the F curve obtain from a RTD experiment? Establish the relationship between F and E curve. [04] [CO4]

4(b) Briefly explain the governing equation of unsteady state tubular reactor. Simplify it for steady state plug flow reactor with axial mixing. Explain the significance of dispersion number. [05] [CO4]

contd....3.

4(c) The concentration reading in the table represent a continuous response to a pulse input into a closed vessel. [06]
[CO4]

Time, t (min)	Tracer Output Concentration, C_{pulse} (gm/liter fluid)
0	0
5	2
10	4
15	5
20	4
25	3
30	2
35	0

The vessel is to be used as a chemical reactor for a liquid decomposing with rate $r_A = -kC_A$, $k=0.421 \text{ min}^{-1}$. Find the fraction of reactant unconverted in the real reactor and compare this with the fraction unconverted in a plug flow reactor of the same size.

2023-24
B.TECH. (ODD SEMESTER) EXAMINATION
FOOD TECHNOLOGY
MASS TRANSFER OPERATIONS
FTC3010

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Answer all the questions.

Q No	Question	Marks	CO covered
1(a)	Diffusivity of carbon tetrachloride (CCl_4) through oxygen (O_2) was determined in a steady state Arnold evaporating cell. Cell having a cross sectional area of 0.82 cm^2 , was operated at 273 K and 755 mmHg pressure. Average length of the diffusion path was 17.1 cm . If 0.0208 cc of CCl_4 was evaporated in 10 hours of steady state operation, what should be the value of diffusivity of CCl_4 through oxygen? [Vapor pressure of CCl_4 at $273 \text{ K} = 33 \text{ mmHg}$, Density of $\text{CCl}_4 = 1.59 \text{ g/cm}^3$, Molecular weight of $\text{CCl}_4 = 154 \text{ g/mol}$, $R = 8314 \text{ m}^3 \cdot \text{Pa} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$]	10	[CO-1]
1(b)	At 293 K , the solubility of ammonia in water is given by Henry's law, $p = 0.3672 C$, where p is in atmosphere and C is in kmol/m^3 . A mixture of 15% ammonia and 85% air by volume at 1 atm is in contact with an aqueous solution containing 0.147 kmol/m^3 . The air velocity is such that $k_G/k_L = 0.9$. Find the concentration of ammonia and partial pressure at interface.	05	[CO-1]
2(a)	Briefly explain the terms; (i) Downcomers, (ii) Weirs	04	[CO-2]
2(b)	What are the functions of a tray (also referred to as plate) in an absorption column? List down the various types of trays in use.	05	[CO-2]
2(c)	Briefly explain the criteria and considerations for the selection of solvent for absorption.	06	[CO-2]

OR

Contd...2.

- 2' An aqueous waste stream containing a toxic volatile organic compound (VOC) has to be air-stripped in a tray tower so that the air, loaded with VOC may flow to the flare for incineration. The waste stream has 0.1 kg of the organic per 100 kg of water and the concentration has to be reduced to 50 ppm. The equilibrium distribution of the solute between air and water is linear and can be expressed as;

$$Y = 4.35 X \text{ (where } X, Y: \text{ kg VOC per kg air or water)}$$

A column of suitable diameter having 20 trays that are 50% efficient is available. Can the tower meet the requirement? The air rate is 1500 kg/h and the wastewater is to be treated at a rate of 4000 kg/h.

- 3(a) How does packed height depend upon cooling range and approach? 05 [CO-3]
3(b) Differentiate between forced draft and induced draft type cooling towers. 10 [CO-3]
Mention their advantages and disadvantages.

OR

- 3' An air - water sample has a dry bulb temperature of 50 °C and a wet bulb temperature of 35 °C. Estimate the below properties at a total pressure of 1 atm. (1 atm = $1.0133 \times 10^5 \text{ N/m}^2$, Average molecular weight of air = 28.84, $\lambda_0 = 2502 \text{ kJ/kg}$)

i) Absolute Humidity (mass ratio unit), ii) Absolute Humidity (mole ratio unit), iii) Percentage Humidity, iv) Partial Pressure, v) Dew Point, vi) Humid Heat, vii) Enthalpy

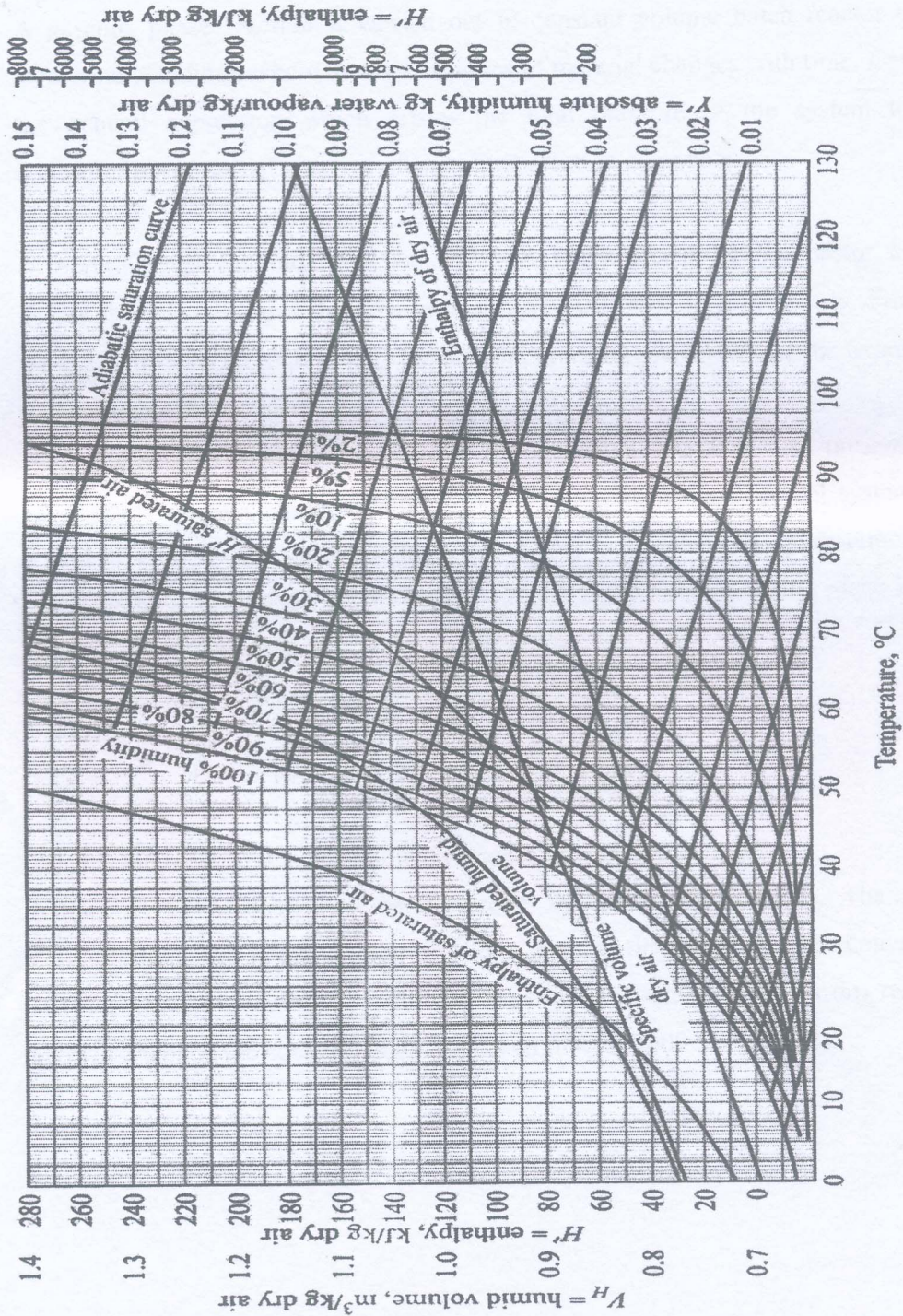
- 4(a) Draw a curve to represent the different types of moisture in a wet solid, i.e., bound moisture, unbound moisture, equilibrium moisture and free moisture and define each of the moisture type. 10 [CO-4]
4(b) Define nucleation and mention the different types of nucleation. What is the difference between primary and secondary nucleation? 05 [CO-4]

contd...3.

Formulas for reference:

Kremser Equation

$$\text{For Stripping: } N = \frac{\log \left[\left(\frac{X_0 - (Y_{N+1}/\alpha)}{X_N - (Y_{N+1}/\alpha)} \right) (1 - \bar{A}) + \bar{A} \right]}{\log(1/\bar{A})}$$



2023-24
B.TECH. (V SEMESTER) EXAMINATION
FOOD TECHNOLOGY
CEREALS, PULSES AND OILSEED TECHNOLOGY
FTC 3020

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Answer all the questions.

Q. No.	Question	Marks	CO covered
1 (a)	Briefly discuss the structure and proximate composition of wheat along with the neat and clean structure diagram.	05	CO-1
1 (b)	What is food processing, and briefly discuss the need of food processing with examples.	05	CO-1
1 (c)	Discuss the importance of the physical properties of grains and briefly define sphericity, porosity, and roundness.	05	CO-1
2	What is parboiling of rice? Briefly explain the parboiling processes along with the advantages and disadvantages of parboiling rice.	15	CO-2
OR			
2' (a)	What are the criteria for storage of wheat before processing? Briefly discuss the steps involved in wheat milling.	10	CO-2
2' (b)	What are flour improvers? Discuss bleaching agents and biological additives.	05	CO-2
3	Explain the processes of corn milling along with the structure and composition of corn and also give an overview of corn milling machines	15	CO-3
4	Discuss the steps involved in oil extraction from oil seeds along with the process flow diagram. Also, discuss the methods of oil extraction.	15	CO-4
OR			
4'	Briefly explain the steps involved in the processing of vegetable oils, such as degumming, neutralization, bleaching, and hydrogenation, along with the flow diagram.	15	CO-4

2023-24
B.TECH. (ODD SEMESTER) EXAMINATION
FOOD TECHNOLOGY
FOOD FERMENTATION AND BIOTECHNOLOGY
FTC3030

Maximum Marks: 60

Credits: 03

Duration: Two Hours

Answer all the questions.

Q No	Question	Marks	CO covered
1	In an enzymatic reaction starch is hydrolyzed via enzyme amylase. The Michaelis constant for the amylase is 7mM. The enzyme is subject to deactivate at 55°C with a half-life of 10 minutes. The initial concentration of starch is 58 gmol/m ³ and the beginning rate of hydrolysis is 0.09 mmol/L s. In what time 70% of the starch will be hydrolyzed?	15	[CO-1]

OR

1'	The activities of soluble and immobilized enzymes were compared at 70°C in a reaction. The initial rate data at fixed concentration of substrate is given in the following table (in logarithmic scale). Find the half-life for each form of enzyme. Based on your answer comment about activity of both types of catalyst.	15	[CO-1]
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Time (min)	Activity of Soluble Enzyme (mmol/L min)	Activity of immobilized enzyme (mmol/L min)
0	0.92	0.67
3	0.87	0.62
6	0.81	0.57
9	0.75	0.52
12	0.70	0.48
15	0.65	0.44
20	0.58	0.38
30	0.43	0.26
40	0.31	0.15
50	0.20	0.04

contd over 2

- 2 (a) State 4 limitations of cross-linking binding. 5 [CO-2]
- 2 (b) Explain the microencapsulation technique. 5 [CO-2]
- 2 (c) State 4 differences between microencapsulation and liposome technique. 5 [CO-2]

3 (a) Draw flow chart and explain the categorization of process microorganism and the various level of containment at research as well as industry level. 6 [CO-3]

3 (b) Explain the methods of sterilization of a fermenter and air supply with the help of figures. 9 [CO-3]

OR

3' Explain any four types of fermenter reactors. List one major parameter necessary to control and monitor the operation in a fermenter. Explain any 3 types of suitable valves required for control of this parameter. 15 [CO-3]

4 (a) State the factors that influence the choice of nitrogen source for media. 6 [CO-4]

4 (b) Write the causes and behaviour of foam formation. What are antifoam agents? Write the characteristics of ideal antifoam agents. 9 [CO-4]

Time (min)	Activity of Soluble Enzymes (μmol/min)	Activity of Immobilized Enzymes (μmol/min)
0	0.00	0.00
2	0.15	0.15
4	0.30	0.30
6	0.45	0.45
8	0.60	0.60
10	0.75	0.75
12	0.90	0.90
14	1.05	1.05
16	1.20	1.20
18	1.35	1.35
20	1.50	1.50

2023-24
B.TECH. (5th SEMESTER) EXAMINATION
FOOD TECHNOLOGY
FOOD ADDITIVES
FTE3010

Maximum Marks: 60

Credits: 03

Duration: Two Hours

Answer all the questions.

Q No.	Question	Marks	CO covered
1. a)	Differentiate between direct and indirect additives giving examples of both. What are the challenges in the use of food additives?	(08)	[CO-1]
1. b)	Describe in detail the process for obtaining the approval for additives from FDA.	(07)	[CO-1]
2. a)	Give some examples of food emulsions. What are the different types of emulsifiers used to stabilise these emulsions? What is the criterion for selection of emulsifiers for foods?	(7.5)	[CO-2]
2. b)	Explain in detail, the mechanism of action of emulsifiers or antioxidants.	(7.5)	[CO-2]
OR			
2'. b)	Discuss the various nutritive additives used in foods.	(7.5)	[CO-2]
3. a)	Discuss the use of Mono Sodium Glutamate and nucleotides as flavour enhancer.	(7.5)	[CO-3]
OR			
3. a')	What are the types of pungent principles found in foods? Discuss with examples.	(7.5)	[CO-3]
3. b)	What are chelating agents? Discuss their uses in food industry.	(7.5)	[CO-3]
OR			
3. b')	Describe the functions of alkali as food additives. Also discuss the buffer systems and their functions.	(7.5)	[CO-3]
4. a)	What do you mean by antibiotics? Why are they used? Discuss about Nisin and Natamycin antibiotics.	(7.5)	[CO-4]
4. b)	Discuss the role of flour improvers, bleaching agents and dough conditioners giving examples of each.	(7.5)	[CO-4]

contd... 2.

2013-14
B.TECH. (3 SEMESTER) EXAMINATION
FOOD TECHNOLOGY
FOOD ADDITIVES

OR

4. b') Discuss any three of the following sweeteners:

(7.5)

[CO-4]

- i. Saccharin
- ii. Aspartame
- iii. Acesulfame K
- iv. Thaumatin
- v. Miraculin
- vi. Glycyrrhizin

2023-2024

**B.TECH. (AUTUMN SEMESTER) EXAMINATION
MEH-3450: ENGINEERING ECONOMY & MANAGEMENT**

(COMPUTER/ARTIFICIAL INTELLIGENCE/CHEMICAL/PETROCHEMICAL ENGINEERING AND FOOD TECHNOLOGY)

Maximum Marks: 60

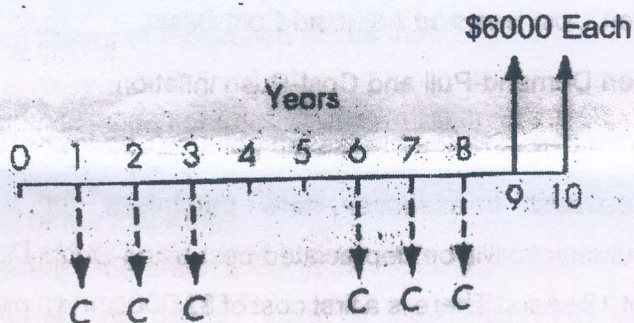
Duration: Two Hours

All questions are compulsory.
Assume data suitably, if required.

- 1(a) Write one practical implication of the Equilibrium Point on the supply-demand curve. [CO1] [01]
- 1(b) On the Cost-Revenue Curve, show the regions of Profit and Loss. [CO1] [01]
- 1(c) Write in brief, how the equilibrium point changes if variable cost is decreased. [CO1] [02]

OR

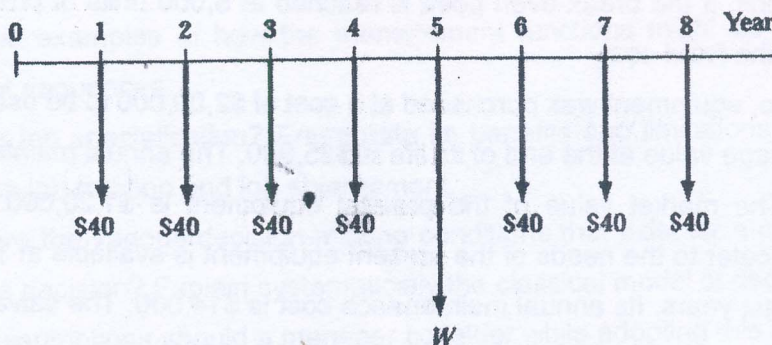
- 1(c') Differentiate between Monopoly and Oligopoly. [CO1] [02]
- 1(d) Differentiate between Nominal and Effective Interest Rates. [CO1] [02]
- 1(e) From the cash flow diagram, find the value of C (in \$) that will establish the economic equivalence between the deposit series and the withdrawal series at an interest rate of 8% compounded annually. [CO1] [04]



OR

- 1(e') For the cash flow diagram shown, determine the value of W that will render the equivalent future worth in 8 years equal to \$500 at an interest rate of 10% per year. [CO1] [04]

$i = 10\%$ per year



Contd...2

1(f) Two alternative machines are being considered for a manufacturing process. Machine 'A' has a first cost of \$75,200 and its salvage value at the end of 6 years of estimated service life is \$21,000. The operating costs of this machine are estimated to be \$6,800 per year. Extra income taxes are estimated at \$2,400 per year. Machine 'B' has a first cost of \$44,000 and its estimated salvage value at the end of 6 years' of service is estimated to be negligible. The annual operating costs will be \$11,500. Compare these two alternatives by the present worth method at $i=13%$ per year. [CO1] [05]

OR

1(f) The purchase of a truck with an operator's platform on a telescoping hydraulic boom will reduce labour costs for sign installations by \$15,000 per year. The price of the boom truck is \$ 93,000 and its operating costs will exceed those of present equipment by \$250 per month. The resale value is expected to be \$18,000 in 8 years. Should the boom truck be purchased when the current available interest rate is 7%? [CO1] [05]

2(a) Define "Profitability Index" in the context of B/C Analysis. [CO2] [01]

2(b) Define Debt-Equity Ratio. [CO2] [01]

2(c) Differentiate between Cost Basis and Adjusted Cost Basis. [CO2] [01]

2(c) Differentiate between Demand-Pull and Cost-Push inflation. [CO2] [02]

2(d) On the Cost-Volume curve, how the breakeven point can be lowered? [CO2] [02]

2(e) Underwater electroacoustic transducers were purchased for use in SONAR applications. The equipment will be depreciated best using Double Declining Balance Method over a life of 12 years. There is a first cost of \$25,000 and an estimated salvage of \$2500. Calculate the depreciation and book value for 1st & 4th years. [CO2] [03]

OR

2(e) For a manufacturing firm, when the volume of production is 3,000 units, the average cost is \$4 per unit and when the volume of production is 4,000 units, the average cost is \$3.50 per unit. If the break-even point is reached at 5,000 units of production and sale, find out the fixed cost. [CO2] [03]

2(f) Two years ago, equipment was purchased at a cost of \$2,00,000 to be useful for eight years. Its salvage value at the end of its life is \$25,000. The annual maintenance cost is \$25,000. The market value of the present equipment is \$1,20,000. Now, new equipment to cater to the needs of the present equipment is available at \$1,50,000 to be useful for six years. Its annual maintenance cost is \$14,000. The salvage value of the new equipment is \$20,000. Using an interest rate of 12%, find whether it is worth replacing the present equipment with the new equipment. [CO2] [05]

OR

Contd... 3.

2(f) In the past, the Afram Foundation has awarded many grants to improve the living and medical conditions of people in war-torn and poverty-stricken countries throughout the world. In a proposal for the foundation's board of directors to construct a new hospital and medical clinic complex in a deprived central African country, the project manager has developed some estimates. These are developed in a manner that does not have a major negative effect on prime agricultural land or living areas for citizens. [CO2] [05]

Award amount: \$20 million (end of) first year, decreasing by \$5 million per year for 3 additional years; local government will fund during the first year only.

Annual costs: \$2 million per year for 10 years, as proposed.

Benefits: Reduction of \$8 million per year in health-related expenses for citizens.

Disbenefits: \$0.6 million per year for the removal of arable land and commercial districts.

Use the conventional and modified B/C methods to determine if this grant proposal is economically justified over a 10-year study period. The foundation's discount rate is 6% per year.

3(a) *Fill in the blanks*

[CO3] [1x3]

- i) The Herzberg theory of motivation states that.....
- ii)is a statement of the organization's fundamental purpose.
- iii) Power granted through the organizational hierarchy is called

3(b) *Answer any TWO of the following:*

[CO3] [2x2]

- i) Draw and define wide and narrow span of management.
- ii) Define organizational goals? What is their importance in the management process?
- iii) Differentiate between line and staff authority with suitable examples.

3(c) *Answer any TWO of the following:*

[CO3] [4x2]

- i) What are the fundamental functions that comprise the management process? Describe examples of how the management functions might be performed in different sequences.
- ii) What is job specialization? Enumerate its benefits and limitations. Differentiate between job rotation and job enlargement.
- iii) What are the various decision-making conditions that exist for a manager while taking a decision? Explain systematically the classical model of decision-making. What assumptions should a manager consider while adopting this model?

Contd...4.

4(a) *Fill in the blanks:*

[CO4] [1x3]

- i) A list of important managerial positions in the occupation, who occupies it, how long he/she will remain in position and who is/will be a qualified replacement is known as
- ii) The four P's of marketing mix are
- iii)is a business that transcends national boundaries and is not committed to a single host country.

4(b) *Answer any TWO of the following:*

[CO4] [2x2]

- i) Differentiate between Q/R inventory system and periodic inventory system.
- ii) Demand for part number 1012 was 210 in January, 100 in February and 150 in March. The forecast for January was 140 units. With a smoothing constant of 0.30 and using first order exponential smoothing, what is the April forecast?
- iii) What is a "Market"? List the types of markets that are used by sellers and buyers in a modern exchange economy.

4(c) *Answer any TWO of the following:*

[CO4] [4x2]

- i) What procedures do the human resource managers adopt while planning for human resources? How are the forecast and human resource demand and supply matched? Explain.
- ii) Describe the four basic levels of international business activity. Do you think any organization will achieve the fourth level? Why?
- iii) Define Quality. Discuss the two aspects of quality. Name some quality control tools and explain any one of them in detail.

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