2023-2024

B.TECH. (ODD SEMESTER) EXAMINATION

[FOOD TECHNOLOGY]

ADVANCED ENGINEERING MATHEMATICS

[AMS 2430]

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.	Question	M.M.
1(a)	A particle moves so that its position vector is given $\vec{r} = \hat{\imath}\cos\omega t + \hat{\jmath}\sin\omega t$. Show that the velocity $\vec{v}$ is perpendicular to $\vec{r}$ and $\vec{r} \times \vec{v}$ is constant vector.	[CO-1] [7]
	OR	
1(a')	Find $curl\ curl\ \vec{A}$, where $\vec{A} = x^2y\hat{\imath} - 2xz\hat{\jmath} + 2yz\hat{k}$.	
1(b)	Show that $\vec{F} = (2xy + z^3)\hat{\imath} + x^2\hat{\jmath} + 3xz^2\,\hat{k}$ is a conservative field. Find its scalar potential and also work done in moving a particle from $(2,-4,2)\ to\ (3,1,4)$.	[8]
2(a)	If $\vec{A} = 2y\hat{\imath} - z\hat{\jmath} - x^2\hat{k}$ and S is the surface of the parabolic cylinder $y^2 - 8x = 0$ in the first octant bounded by the planes $y = 2,\ z = 6$, evaluate the surface integral $\iint_S \vec{A}.\hat{n}\,dS$.	[CO-2] [7]
	OR	
2(a')	Use divergence theorem to evaluate the surface integral $\iint_S \vec{F}.\hat{n}\,ds$, where $\vec{F} = x^3\hat{\imath} + x^2y\hat{\jmath} + x^2z\hat{k}$ and S is the surface of the cylinder $x^2 + y^2 = a^2$ bounded by $z = 0,\ z = b$.	
2(b)	Verify the Green's theorem to evaluate the line integral $\int [(2x^2 - y^2)\,dx + (x^2 + y^2)\,dy]$, where C is the boundary of the surface in xy-plane enclosed by the x-axis and the semi-circle $x^2 + y^2 = 1$.	[8]
3(a)	Very whether the function $f(z) = \frac{x^3y(y-ix)}{x^6+y^2}$ $for\ z \neq 0$ $and\ f(z) = 0\ for\ z = 0$. is analytic at $z = 0$.	[CO-3] [7]

Contd....2.

OR

3(a') Show that the function $u(x,y)$ is harmonic and determine the conjugate function if $u = \frac{1}{2}\log(x^2 + y^2)$, where $w = u + iv$.

3(b) Let $P(z) = a + bz + cz^2$ and $\int_C \frac{P(z)}{z}\,dz = \int_C \frac{P(z)}{z^2}\,dz = \int_C \frac{P(z)}{z^3}\,dz = 2\pi i$, [8]

where C is the circle $|z| = 1$. Evaluate $P(z)$ by using Cauchy's Integral formula.

4(a) Determine all the points (x,y) at which the equation: [CO-4] [7]

$$t\frac{\partial^2 u}{\partial t^2} + 2\frac{\partial^2 u}{\partial x \partial t} + x\frac{\partial^2 u}{\partial x^2} + \frac{\partial u}{\partial x} = 0 \text{ is (i) hyperbolic (ii) parabolic (iii) elliptic}$$

4(b) Solve the partial differential equation: [8]

$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0$, by the method of separation of variables.

OR

4(b') Find the solution of wave equation:

$\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$ for which $u(0,t) = u(l,t) = 0$ and

$u(x,0) = a\sin\left(\frac{\pi x}{l}\right)$ and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 0$, by the method of separation of variables.

2023-24

B.TECH. (AUTUMN SEMESTER) EXAMINATION
CHEMICAL/PETROCHEMICAL ENGINEERING/FOOD TECHNOLOGY
BASIC PRINCIPLES OF CHEMICAL ENGINEERING
CHC2010/ PKC2010/CHA2010

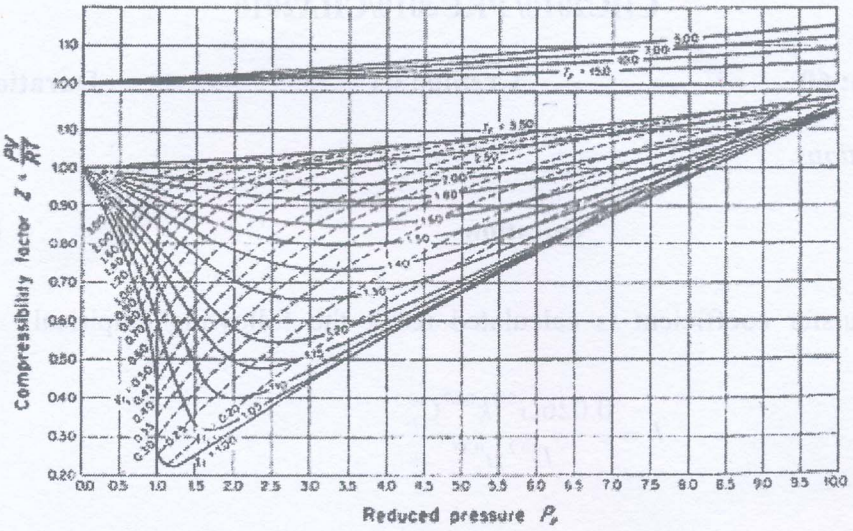
Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.

Q No	Question	Marks	CO covered
1(a)	The heat transfer coefficient is calculated using the following empirical equation. $$h = \frac{0.026 G^{0.8} k^{0.67} C_p^{0.5}}{D^{0.2} \mu^{0.47}}$$ where h is heat transfer coefficient in Btu/hr ft^2 °F; G is mass velocity of liquids in lb/ft^{2}s; k is thermal conductivity in Btu/ft.hr. °F; C_p is specific heat in Btu/lb °F; D is diameter of tube in ft; μ is viscosity of liquid in lb/ft s. what is the unit of the constant 0.026? Hence convert the equation into SI units.	[06]	CO-1
1(b)	Ammonia is oxidized to nitric oxide in the following reaction: $$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$ If 50.0 kg of ammonia and 100.0 kg of oxygen are fed to a batch reactor, determine the limiting reactant, the percentage by which the other reactant is in excess, and the extent of reaction and mass of NO produced (kg) if the reaction proceeds to completion.	[09]	CO-1
	OR		
1'(a)	An aqueous solution of K_2CO_3 is prepared by dissolving 43 kg K_2CO_3 in 100 kg water at 293 K. The density of the solution is 1.3 kg/L. Find the molarity, normality and molality of the solution.	[05]	CO-1
1'(b)	A gas contains 10.0 mole%, CO_2, 40.0 mole% CH_4, and 50.0 mole% C_2H_4. It is desired to distribute 14.2 kg of this gas per cylinder. Cylinders are to be designed so that the maximum pressure will not exceed 150 atm when the temperature is 80 °C. Using Kay's rule to calculate the volume of the cylinder required. The critical temperature and pressures of CO_2, CH_4, and	[10]	CO-1

Contd ... 2

C_2H_4 are 304.2 K and 72.9 atm; 190.7 K and 45.8 atm; and 283.1 K and 50.5 atm respectively.



2(a) Define a batch, a semi batch, and a continuous process. Write down the form of material balance for these processes. **[05]** **CO-2**

2(b) Fresh air containing 4.00 mole% water vapor is to be cooled and dehumidified to a water content of 1.70 mole% H_2O. A stream of fresh air is combined with a recycle stream of previously dehumidified air and passed through the cooler. The blended stream entering the unit contains 2.30 mole% H_2O. In the air conditioner, some of the water in the feed stream is condensed and removed as liquid. A fraction of the dehumidified air leaving the cooler is recycled and the remainder is delivered to a room. Taking 100 mol of dehumidified air delivered to the room as a basis of calculation, calculate the moles of fresh feed, moles of water condensed, and moles of dehumidified air recycled **[10]** **CO-3**

OR

2(b') Pure propane is burnt in an excess of air to give the following analysis of combustion products in volume percent: CO_2 – 5%, CO – 3.5%, H_2O – 11.4%, O_2 – 7%, N_2 – 73.1%. Calculate the composition of the flue gas on dry basis and the percentage excess air. **[10]** **CO-3**

3(a) A turbine discharges 200 kg/h of saturated steam at 10.0 bar absolute. It is desired to generate steam at 250°C and 10.0 bar by mixing the turbine discharge with a second stream of superheated steam of 300°C and 10.0 bar. The enthalpy of saturated steam at 10 bar is 2776.2 kJ/kg and the enthalpy of superheated steam at 10 bar and 250 °C and 300 °C is 2443 kJ/kg and 3052 kJ/kg respectively. **[06]** **CO-2**

Contd .... 3.

(a) If 300 kg/h of the product steam is to be generated, how much heat must be added to the mixer?

(b) If instead the mixing is carried out adiabatically, at what rate is the product steam generated?

OR

3(a') Calculate the heat of vaporization of water (kJ/mol) at 50 °C and low pressure using the following information. **[06]** **CO-2**

Heat of vaporization of water at its normal boiling point: 40.656 kJ/mol

Heat capacity of liquid water: 75.4×10^{-3} kJ/mol·°C

Enthalpy of water vapor at 100 °C relative to 25 °C: 2.54 kJ/mol

Show clearly the process path selected for the calculation.

3(b) Define combustion reaction. How is the heat of combustion of the species in a reaction used to calculate the heat of reaction? Calculate the standard heat of the acetylene hydrogenation reaction **[09]** **CO-3**

$$C_2H_2\,(g) + 2H_2\,(g) \rightarrow C_2H_6\,(g)$$

using the following standard heat of combustion data

C_2H_2: −1299.6 kJ/mol; H_2: −285.84 kJ/mol; C_2H_6: −1559.9 kJ/mol

4(a) Water is added at varying rates to a 300-liter holding tank. When a valve in a discharge line is opened, water flows out at a rate proportional to the height and hence to the volume V of water in the tank. The flow of water into the tank is slowly increased and the level rises in consequence, until at a steady input rate of 60.0 L/min the level just reaches the top but does not spill over. The input rate is then abruptly decreased to 40.0 L/min. Write a differential balance on the water in the tank for the period from the moment the input rate is decreased and integrate the balance equation to derive an expression for $V(t)$. Calculate the time in minutes required for the volume to decrease to within 1% of its steady-state value. **[08]** **CO-3**

4(b) An air conditioner cools 226 m^3/min of humid air at 30°C and 90% relative humidity to 10 °C. Calculate the rate of condensation of water in the unit and the cooling duty. **[07]** **CO-4**

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(Paper Code:6504)

2023-24
B.TECH. (3RD SEMESTER) EXAMINATION
FOOD TECHNOLOGY
FOOD PRESERVATION AND PROCESSING
FTC2020

Maximum Marks: 60 **Credits: 03** **Duration: Two Hours**

Answer all the questions.

Q No.	Question	Marks	CO covered
1. a)	What is fermentation? What is starter culture and why is it used? Discuss the various types of fermentation.	(7.5)	[CO-1]
1. b)	What do you mean by water activity? Differentiate between moisture content and water activity. Explain the concept of Moisture Sorption Isotherm.	(7.5)	[CO-1]
2. a)	Discuss any three of the following: i. Hurdle Technology ii. Mold inhibitors iii. Rehydration iv. Case hardening and shrinkage	(2.5x3=7.5)	[CO-2]
2. b)	Explain the different phases of drying curve.	(7.5)	[CO-2]
	OR		
2. b')	Discuss the role of acids in food processing and preservation.	(7.5)	[CO-2]
3. a)	Explain in detail the Pulse electric field technology for food processing and preservation.	(7.5)	[CO-3]
	OR		
3. a')	Describe in detail the technology of microwave heating of foods.	(7.5)	[CO-3]
3. b)	Explain the freezing curve for food products.	(7.5)	[CO-3]
	OR		
3. b')	Define Decimal reduction time, z-value and F-value. Discuss the relationship between F-value, z-value and D-value. Cans were heated for sterilization from Clostridium botulinum.	(7.5)	[CO-3]

contd...2.

F_0 = 2.5 mins.
z = 18°F
Heating was done in three stages and the temperature of the cans were measured with time as follows:
25 mins. at 160°F
30 mins. at 210°F
35 mins. at 230°F
Determine whether the process is adequate or not.

4. a)	Discuss the classification of unfermented beverages. Also mention the various methods used for clarification of juices.	**(08)**	**[CO-4]**
4. b)	Explain the processing of tomato paste, puree and ketchup.	**(07)**	**[CO-4]**

OR

4.b')	Describe the extrusion technology for foods and give some examples of food products prepared by extrusion.	**(07)**	**[CO-4]**

Code No. 6626

2023-24

B.TECH. (ODD SEMESTER) EXAMINATION

PETROCHEMICAL ENGINEERING / CHEMICAL ENGINEERING / FOOD TECHNOLOGY

FLUID- PARTICLE OPERATIONS / MECHANICAL OPERATIONS IN FOOD INDUSTRY

PKC – 2090 / CHC – 2040 / FTC – 2010

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions
Assume suitable data if missing
Notations and symbols used have their usual meaning
Use of Graph paper is allowed

Q.No.	Questions	CO	M.M
1(a)	Answer the following: (i) Discuss the significance of sphericity. (ii) Find out the sphericity, shape factor, and volume shape factor of a cylinder having geometry h=3D and assume its diameter as equivalent diameter?	(CO1)	[07]
1(b)	Data on screening operation is presented in below table. Particle size distributions of feed, overflow, and underflow are given as cumulative frequency. The screen used for separation has an aperture size of 460 μm and 1000 kg/h of feed are processed obtaining 650 kg/h of overflow. Calculate efficiency of the operation.	(CO1)	[08]

Table 1

Mesh	D_p (mm)	Cumulative Fraction		
		Feed	Coarse	Fine
4	4.699	0	0	-
6	3.327	0.025	0.071	-
8	2.362	0.150	0.43	0
10	1.651	0.470	0.85	0.195
14	1.168	0.730	0.97	0.58
20	0.833	0.885	0.99	0.83
28	0.589	0.940	1.00	0.91
35	0.417	0.960	-	0.94
65	0.208	0.980	-	0.975
Pan		1.00	-	1.00

Contd.... 2

1(b') (i) Explain with diagram the following bulk solid storage systems (CO1) [05]

- Silos
- Hoppers

(ii) Discuss the different flow patterns of solid from silo/hopper. (CO1) [03]

2(a) Discuss **ANY TWO:** (CO2) [2 × 2]

(i) Kick's Law with example.
(ii) Work Index
(iii) Crushing Efficiency and Mechanical Efficiency (in context of size reduction)

2(b) Define Bond's Law. Derive the equation for the work required to reduce the solid particle as per bond's law. (CO2) [05]

OR

2(b') Discuss attrition mill and highlight its main industrial applications. (CO2) [05]

2(c) Discuss the working principle of fluid energy mill with the help of suitable diagram. (CO2) [06]

3(a) Differentiate between classification and jigging. (CO3) [03]

3(b) Describe the working of the following: (CO3) [06]

(i) Hydro cyclone
(ii) Disk Centrifuges

OR

3(b') With the help of proper diagrams, differentiate between axial and radial flow type of impellers for low viscosity liquids. (CO3) [06]

3(c) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the condition of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 ms^{-2}, density of the particle = 1180 kg m^{-3}, and density of the fluid = 1000 kg m^{-3}. Calculate the diameter (mm) of the largest sphere that settles in the stokes' law regime (Reynolds number ≤ 0.1). (CO3) [06]

4(a) Discuss any two type of packing materials in packed bed. (CO4) [02]

Contd....3.

4(b) Drive *Ergun's equation* for the pressure drop across the packing in packed bed column (CO4) [06]

OR

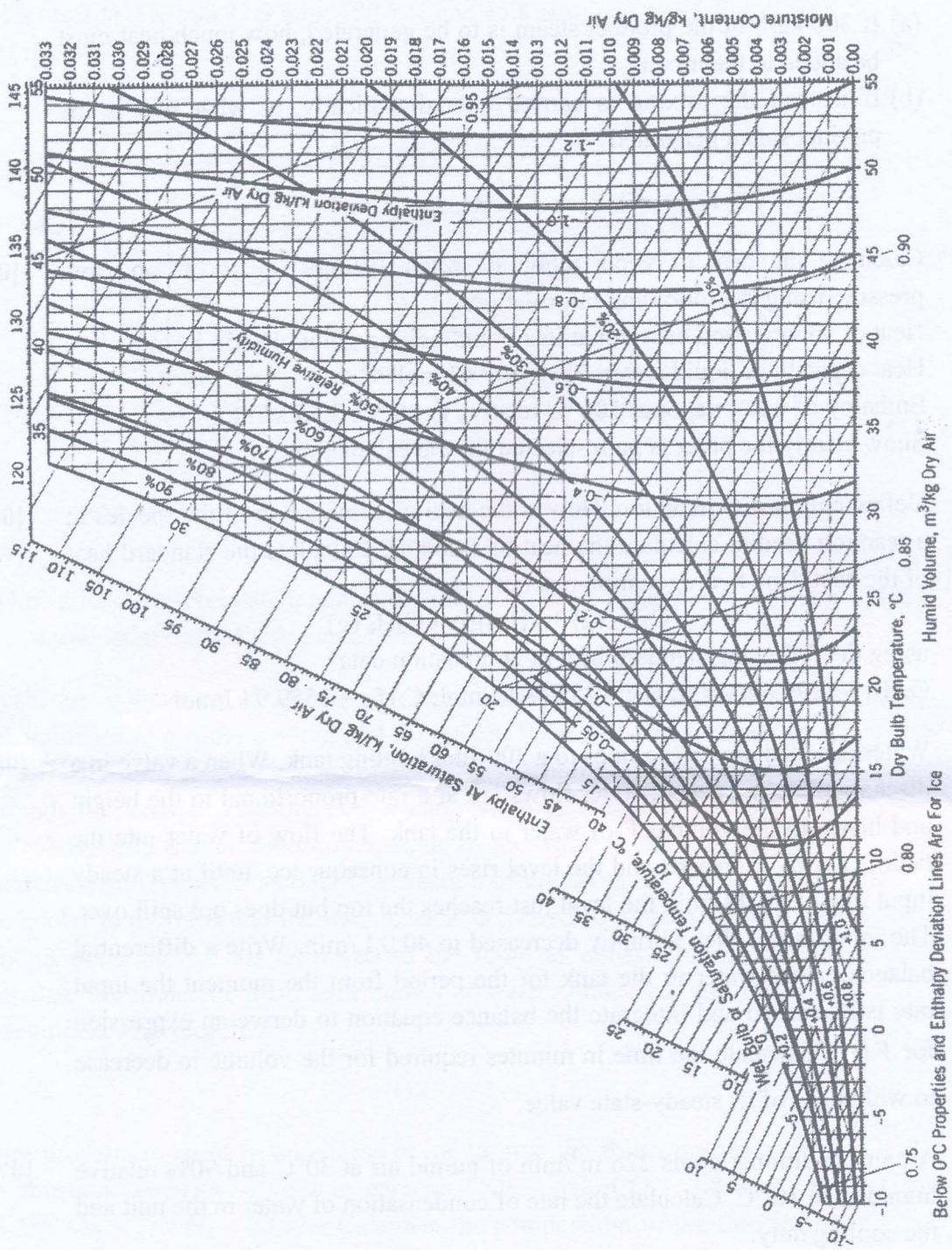
4(b') Drive the equation for the pressure drop across the incompressible filter cake. (CO4) [06]

4(c') A packed bed of solid particles of density 2000 kg/m^3, occupies a depth of 0.6 m in a cylinder vessel of inside diameter 0.1 m. The mass of solids in the bed is 5 kg and the surface volume mean diameter of the particles is 300 μm. A liquid of density 1000 kg/m^3 and viscosity 0.001 Pa.s flows upwards through the bed. (CO4) [07]

(i) What is the voidage of packed bed?

(ii) Determine the bed pressure drop when fluidized (Use force balance over the bed)

(iii) Determine the minimum fluidization velocity (Assume laminar flow and the voidage at incipient fluidization is the same as the packed bed).



Psychrometric Chart, Ref: H_2O (l, 0 °C, 1atm); Dry Air (0 °C, 1atm)