2023-24

(6454)

II YEAR B.TECH. EXAMINATION
CHEMICAL ENGINEERING
FOOD CHEMISTRY AND NUTRIENTS
ACS2010

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

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

Q. No.	Questions	CO	MM
1 (a)	What do you understand by the water content of food? Discuss the types of water in food and also differentiate between free water and bound water of food.	CO1	5
1 (b)	Explain the phase diagram of water. Write the applicability of triple point and critical point in food products.		5
1 (c)	What is the water activity of food products? Explain how is water activity related to the growth of microorganisms in food.		5
	OR		
1 (c')	Write the classification of colloidal systems considering examples of food products.		
2 (a)	Explain the bioavailability of vitamins. Discuss the factors that influence the bioavailability of vitamins.	CO2	5
	OR		
2 (a')	What are vitamins? Write factors that affect vitamin stability. Discuss the availability of vitamins concerning food product shelf-life.		
2 (b)	What are essential minerals in food? Write the function of essential minerals in foods.		5
2 (c)	What are lipids? Write the properties and functions of lipids.		5
3 (a)	Write down the various alterations that can occur during the handling, processing and storage of food.	CO3	4
3 (b)	Classify proteins on the basis of solubility.		3
3 (c)	Explain the modification of food using the following enzymes **(Any two)**. (i) Amylase (ii) Triacylglycerol hydrolase (Lipase) (iii) Phytase		4 x 2
4 (a)	Explain the following color preservation technologies in food: (i) Acid neutralization to retain chlorophyll. (ii) Enzymatic conversion of chlorophyll to chlorophyllides to retain the green color.	CO4	4 x 2
4 (b)	Explain the food and pharmaceutical-grade minerals and vitamins. Also explain the recommended daily intake (RDI) of minerals and vitamins for human beings.		7

Code: 6460

2023-2024
B. TECH (AUTUMN SEMESTER) EXAMINATION
(CHEMICAL / PETRO-CHEMICAL ENGINEERING)
AMS-2410 (HIGHER MATHEMATICS)
Credits-04

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

Answer all questions:

1(a) Find the values of the constants a, b, c so that the directional derivatives of $f = axy^2 + byz + cz^2x^3$ at (1, 2,-1) has a maximum magnitude 64 in the direction parallel to z-axis. **[CO-1]**

OR

(a') Find n such that $\vec{F} = \frac{\vec{r}}{r^n}$ is solenoidal, (where $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$, $r = |\vec{r}|$).

(b) Show that the vector field $\vec{A}$, where $\vec{A} = (2xy + z^2)\hat{\imath} + (2yz + x^2)\hat{\jmath} + (2zx + y^2)\hat{k}$ is irrotational. Find scalar function f such that $\vec{A}$=grad f.

[8, 7]

2.(a) Show that $\vec{F} = (2xy + z^3)\hat{\imath} + x^2\hat{\jmath} + 3z^2x\hat{k}$ is a conservative field. Find its scalar potential and also the work done in moving a particle from the points $(1, -2, 1)$ to$(3, 1, 4)$. **[CO-2]**

(b) Use divergence theorem to evaluate the surface integral $\iint_s \vec{F}.\overrightarrow{ds}$, where $\vec{F} = x^3\hat{\imath} + x^2y\hat{\jmath} + x^2z\hat{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$

OR

(b') If $\vec{F} = y\hat{\imath} + (x - 2zx)\hat{\jmath} - xy\hat{k}$, evaluate $\iint_s (\nabla \times \vec{F}).\hat{N}\,\overrightarrow{ds}$, where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$, above the xy plane.

[8, 7]

Contd....2.

3.(a) If $f(z)$ is an analytic function of z, prove that [CO-3]

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2.$$

OR

(a') If $f(z) = u + iv$ is an analytic function of z and $u + v = \frac{2Sin2x}{e^{2y}+e^{-2y}-2Cos2x}$, find $f(z)$ in terms of z.

(b) Use Cauchy's integral formula to evaluate

(i) $\int_C \frac{e^{3z}}{(z+1)^4}dz$, where C is a circle $|z| = 2$.

(ii) $\int_c \frac{z}{(z^2-6z+25)}dz$, where C: $|z-3-4i| = 4$.

[8, 7]

4.(a) Form the partial differential equations by eliminating the arbitrary constants and arbitrary function from the following relations: [CO-4]

(i) $z = ae^{-b^2t}cosbx$

(ii) $f(x^2+y^2,\ z-xy) = 0$

(b) Use the method of separation of variables, to solve the partial differential equation:

$$\frac{\partial^2 z}{\partial x^2} + 4\frac{\partial^2 z}{\partial y^2} = 0$$

OR

(b') A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x, 0) = y_0 \sin(\frac{\pi x}{l})$. If it released from rest from this position, find the displacement y at any distance x from one end at any time t.

[7, 8]

2023-24
B.TECH ODD (III SEMESTER) EXAMINATION
CHEMICAL ENGINEERING
BIOLOGY FOR ENGINEERS
CHA-2020

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

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

MM

1(a) Production of single cell protein is described by following reaction [10]

$$C_{16}H_{38} + aO_2 + bNH_3 \rightarrow cCH_{1.66}O_{0.28}N_{0.5} + dCO_2 + eH_2O$$

Where, Respiratory quotient R.Q.= your class serial no./10. Find the stoichiometric coefficients a, b, c, d and e. [CO1]

1(b) What are enzymes? Discuss the factors on which enzyme activity depends? [05]

OR

1(b') Write salient features of Eukaryotic and prokaryotic cell. [05] [CO1]

2(a) What are lipids? Give a complete classification of lipid along with its biological importance? [07] [CO2]

2(b) Write short notes on **any two** of the following? [08]

i) Functions of Proteins

ii) Carbohydrates and its applications

iii) Nucleic Acids [CO2]

3(a) What do you understand by Recombinant DNA technology? Write down the basic steps involved in r-DNA technology? [10] [CO3]

OR

contd....2.

3(a')	What do you understand by Polymerase Chain Reaction? Explain in detail the different stages of PCR with the help of neat diagram? [CO3]	[10]
3(b)	Explain the importance and applications of GMOs in Chemical industries? [CO3]	[05]
4(a)	Write the key features of Effective microorganisms? [CO4]	[06]
4(b)	What is the role of biotechnology in the field of chemical engineering? Explain with the help of suitable example. [CO4]	[09]

OR

4(b')	Describe in detail the industrial production of Lactic acid. Also explain the reaction mechanism involved in it? [CO4]	[09]

END

2023-24

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

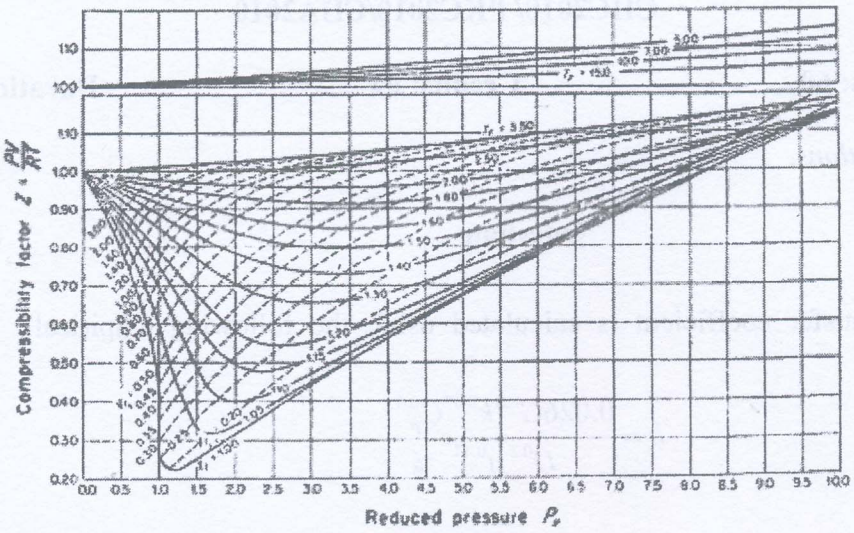
Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

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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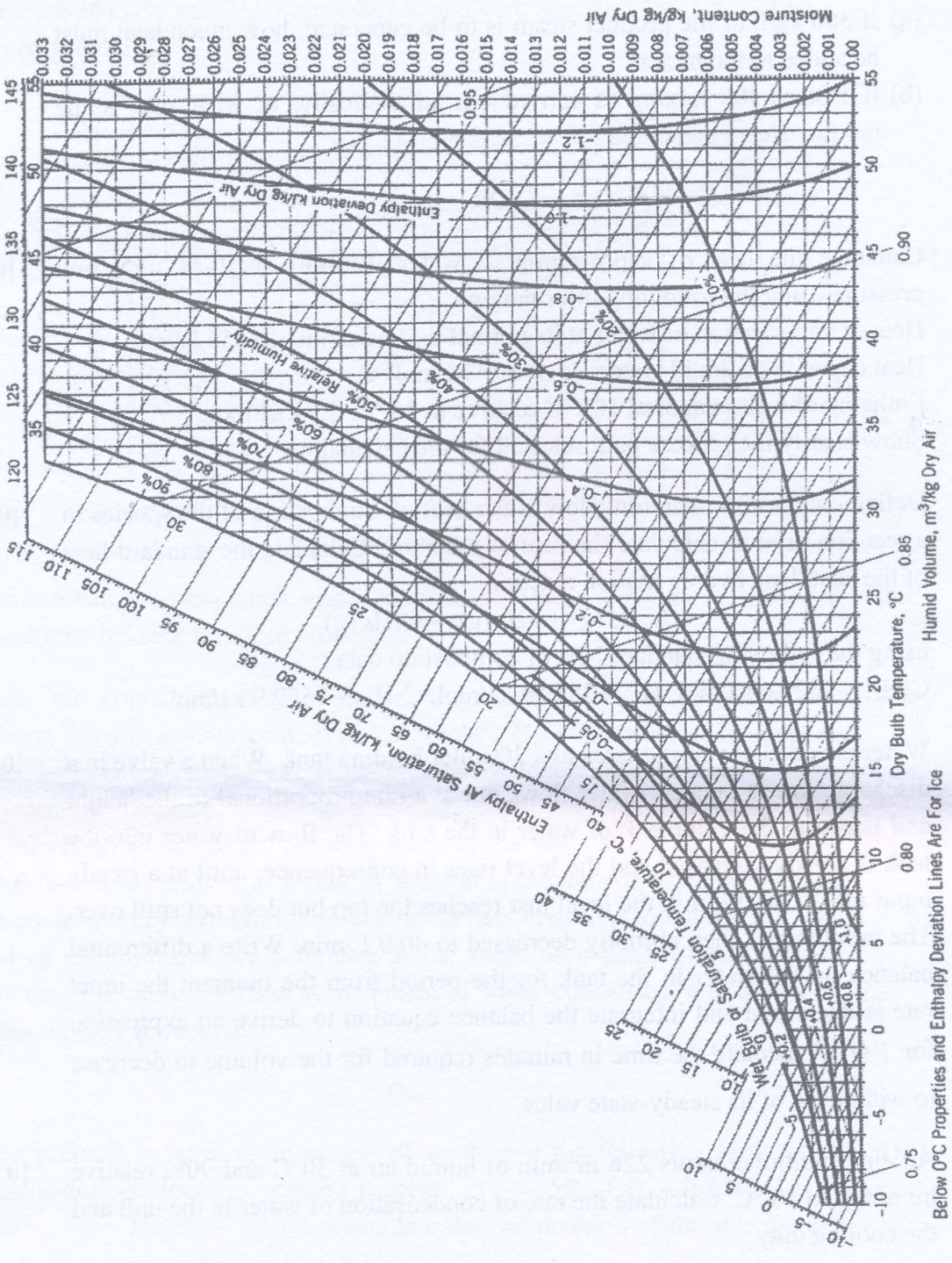


Psychrometric Chart, Ref: H_2O (l, 0 °C, 1atm); Dry Air (0 °C, 1atm)

2023-24

B. TECH. AUTUMN (III SEMESTER) EXAMINATION
(CHEMICAL ENGINEERING)
FLUID MECHANICS
(CHC2030/PKC2050/CHA2030)

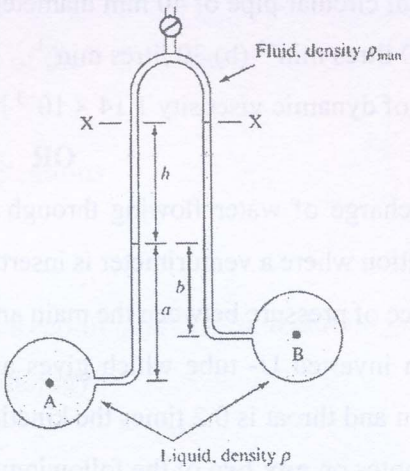
Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

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

1(a) Explain the Newtonian and non-Newtonian fluids with the help of shear stress vs rate of shear graph. Also give an example of each. [04] [CO1]

1(b) A hydraulic press has a diameter ratio between the two pistons of 8:1. The diameter of the larger piston is 600 mm and it is required to support a mass of 3500 kg. The press is filled with a hydraulic fluid of specific gravity 0.8. Calculate the force required on the smaller piston to provide the required force (a) when the two pistons are at the same level, (b) when the smaller piston is 2.6 m below the larger piston. [05] [CO1]

1(c) An inverted U-tube of the form shown in Figure given below, is used to measure the pressure difference between two points **A** and **B** in an inclined pipeline through which water is flowing ($\rho_{H2O} = 10^3$ kg m^{-3}).The difference of level **h = 0.3** m, **a = 0.25 m** and **b = 0.15 m**. Calculate the pressure difference $P_B - P_A$ if the top of the manometer is filled with oil of relative density 0.8. [06] [CO1]



Contd..... 2.

2(a)	Define the following terms:	[03]	
	a. Pathline b. Streamline c. Streakline	[CO2]	
2(b)	Derive Bernoulli's equation for flow of an incompressible fluid. State clearly the assumptions made.	[07]	[CO2]
2(c)	Given a velocity field $\vec{v} = (4 + xy + 2t)\hat{\imath} + 6x^3\hat{\jmath} + (3xt^2 + z)\,\hat{k}$. Find the acceleration of a fluid particle at (2,4, -4) and time t = 3.	[05]	[CO2]
	OR		
2(c')	A two-dimensional incompressible flow is given by the velocity field V= 3yi + 2xj, in arbitrary units. Does this flow satisfy continuity? If so, find the stream function (x, y).	[05]	[CO2]
3(a)	State the Buckingham pi theorem also write the steps involved in solving a problem using Buckingham pi theorem.	[07]	[CO3]
3(b)	The power input **P** to a centrifugal pump is a function of the volume flow **Q**, impeller diameter **D**, rotational rate **Ω**, and the density **ρ** and viscosity **μ** of the fluid: $P = f(Q, D, \Omega, \rho, \mu)$ Using (Ω, ρ, D) as repeating variables, Rewrite this as a dimensionless relationship.	[08]	[CO3]
4(a)	Calculate the loss of head due to friction and the power required to maintain flow in a horizontal circular pipe of 40 mm diameter and 750 m long when water flows at a rate: (a) 4.0 litres min^{-1} (b) 30 litres min^{-1} (Coefficient of dynamic viscosity 1.14×10^{-3} N s m^{-2})	[07]	[CO4]
	OR		
4(a')	Find the discharge of water flowing through a pipe 30 cm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 15 cm. The difference of pressure between the main and throat is measured by a liquid of *sp. gr.* 0.6 in an inverted U- tube which gives a reading of 30 cm. The loss of head between main and throat is 0.2 times the kinetic head of the pipe.	[07]	[CO4
4(b)	Write short notes on **any two** of the following: (i) Orificemeter (ii) Rotameter (iii) Centrifugal Pumps	[08]	[CO4]

2023-2024

B. TECH. (ODD SEMESTER) EXAMINATION
(CHEMICAL ENGINEERING)
ELECTRICAL ENGINEERING
(EEA2030)

Maximum Marks: 60 **Duration: 2 Hours**

Note:
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Q.No.	Question	COs	M.M.
Q1(a)	Discuss in brief the principle of operation of a 3-φ induction motor. Advantages of squirrel-cage type induction motors.	CO1	[05]
Q1(b)	Discuss the construction and operation of a universal motor. Write two applications of the universal motor.	CO1	[05]
Q1(c)	A 3-phase, 50 Hz induction motor has eight poles. If the slip is 2% at a particular load, determine a) Synchronous speed b) Speed of the rotor c) Frequency of the induced e.m.f. in the rotor.	CO1	[05]
Q2(a)	Draw the speed-torque characteristics for DC series and DC shunt motors. A DC shunt motor is fed from a source voltage of 250 V. The line current drawn by the motor is 50 A. The armature and the shunt field resistances are 0.5 Ω and 125 Ω, respectively. Calculate a) Induced back emf b) Current drawn by the armature winding c) Power developed by the motor d) Copper losses in the armature and the field winding e) Total copper losses in the motor	CO2	[07]
	OR		
Q2(a')	Explain the significance of Back emf for controlling the armature current in a DC motor. A DC series motor from a 250 V supply runs at 1200 rpm, drawing a line current of 10 A. The armature and series field resistances are 0.5 Ω and 4.5 Ω, respectively. Calculate the speed of the motor when it is connected to an external resistance of 15 Ω and draw the same value of the line current at the same supply voltage.	CO2	[07]

Contd....2.

Q2(b)	Discuss various methods used for the speed control of DC shunt motors. A 180 V DC shunt motor runs at 900 rpm under the given load condition, drawing a line current of 33 A. The shunt-field and armature winding resistances are 60 Ω and 0.5 Ω. Find the no-load speed of the motor when drawing a no-load line current of 13 A.	CO2	**[08]**
	OR		
Q2(b')	What is the need for starters in DC motors? Explain the working of a 3-point starter for the DC shunt motor.	CO2	**[08]**
Q3(a)	Explain the three phase power measurement by two wattmeter method. Also, derive expression for power factor angle (ϕ).	CO3	**[08]**
Q3(b)	Draw and briefly explain the Moving iron attraction type instruments.	CO3	**[07]**
Q4(a)	Using a block diagram, explain the microprocessor-based computer system showing the address, data, and control bus.	CO4	**[07]**
	OR		
Q4(a')	With the help of a simplified block diagram, explain various components of the 8085 microprocessor.	CO4	**[07]**
Q4(b)	Write an instruction code (with proper comments) to add two 8-bit numbers in the 8085 microprocessor.	CO4	**[08]**
	OR		
Q4(b')	Describe various registers used in the 8085 microprocessor and explain the function of a program counter and the stack counter.	CO4	**[08]**

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:	(CO1)	[07]
	(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?		
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.

(66

1(b')	(i)	Explain with diagram the following bulk solid storage systems • Silos • Hoppers	(CO1) (CO1)	[05] [03]
	(ii)	Discuss the different flow patterns of solid from silo/hopper.		
2(a)	Discuss **ANY TWO:** (i) Kick's Law with example. (ii) Work Index (iii) Crushing Efficiency and Mechanical Efficiency (in context of size reduction)		(CO2)	[2 × 2]
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: (i) Hydro cyclone (ii) Disk Centrifuges		(CO3)	[06]
	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).