Hall Ticket No: **Question Paper Code :**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)
II/IV B. Tech II- Semester Regular Examinations April – 2017
Chemical Engineering Thermodynamics-I
(Chemical)

Time: 3 hours **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered at one place only

UNIT-I

1) a) Define work, potential and kinetic energy along with their units. (6M)
b) A steel casting weighing 2 kg has an initial temperature of 773.15 K; 40 kg of water initially at 298.15 K is contained in a perfect insulated steel tank weighing 5 kg. The casting is immersed in the water and the system is allowed to come to equilibrium. What is its final temperature? Ignore any effect of expansion or contraction and assume constant specific heats of 4.18 kJ/kg for water and 0.5 kJ/kg for steel. (6M)

(OR)

2) a) With a neat sketch explain Joule's experiment. (5M)
b) Three moles of nitrogen at 303.15 K contained in a rigid vessel is heated to 523.15 K. How much heat is required if the vessel has a negligible heat capacity? If the vessel weights 100 kg and has a heat capacity of 0.5 kJ/kg-K, how much heat is required? Assume C_v = 20.8 and C_p = 29.1 J/mol-K for nitrogen. (7M)

UNIT-II

3) a) Explain PV diagram for a pure substance with a neat diagram. (4M)

b) An ideal gas with C_p=5/2 R and C_v=3/2 R, is changed from P_1 = 1 bar and V_1 = 12 m^3 to P_2 = 12 bar and V_2 = 1 m^3 by the following mechanically reversible processes.
(i) Isothermal compression
(ii) Adiabatic compression followed by cooling at constant pressure.
Calculate Q, W, ΔU and ΔH for each of these processes. (8M)

(OR)

4) a) Write short notes on Van der Waals and Redlich/Kwong equation of state. (4M)

b) Calculate Z and V for ethane at 323.15 K and 15 bar by the following equations:
(i) Virial equation (B=-156.7 cc/mol and C=9650 cm^6/mol^2)
(ii) Redlich/Kwong equation (T_c= 305.3 K and P_c=48.72 bar) (8M)

UNIT-III

5) a) Define sensible heat and latent heat. (4M)
b) For steady flow in a heat exchanger at approximately atmospheric pressure, what is the heat required / produced?
(i) When 10 mol of SO_2 is heated from 473.15 to 1373.15 K.
(ii) When 12 mol of propane is heated from 523.15 to 1473.15 K. (8M)

Compound	A	B	C	D
SO_2	5.699	0.801×10^{-3}	0	-1.015×10^{5}
Propane	1.213	28.785×10^{-3}	-8.824×10^{-6}	0

(OR)

6) a) What do you mean by theoretical flame temperature? (2M)

b) Determine the heat of reaction for the following reaction at 873.15 K.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ (10M)

Compound	ΔH^0_0 (J/mol)	A	B	C	D
N_2	0	3.28	0.593×10^{-3}	0	0.04×10^{5}
H_2	0	3.249	0.422×10^{-3}	0	0.083×10^{5}
NH_3	-46110	3.578	3.02×10^{-3}	0	-0.186×10^{5}

UNIT - IV

7) a) Explain different statements of second law of thermodynamics. (4M)

b) A particular power plant operates with a heat source reservoir at 623.15 K and a heat sink reservoir at 303.15 K. It has a thermal efficiency equal to 55% of the Carnot engine thermal efficiency for the same temperatures.

(i) What is the thermal efficiency of the plant?

(ii) To what temperature must the heat source reservoir be raised to increase the thermal efficiency of the plant to 35%? Again efficiency is 55% of the Carnot engine value. (8M)

(OR)

8) a) State and prove Carnot's theorem (6M)

b) One mole of an ideal gas with C_p=7/2 R and C_v=5/2 R is compressed adiabatically in a piston/cylinder device from 2 bar and 298.15 K to 7 bar. The process is irreversible and requires 35% more work than a reversible, adiabatic compression from the same initial state to the same final pressure. What is the entropy change of the gas? (6M)

UNIT-V

9) a) What do you mean by residual properties? Give their uses. (4M)

b) Describe Mollier diagram and TS diagrams in detail with neat sketches. (8M)

(OR)

10) a) What are different types of compression process equipments? (4M)

b) Show that for a nozzle, the pressure ratio at throat is equal to $\frac{P_2}{P_1} = \left(\frac{2}{¥+1}\right)^{\frac{¥}{¥-1}}$. (8M)

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Hall Ticket No: **Question Paper Code :**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)
II/IV B. Tech II- Semester Regular Examinations April – 2017
Engineering Mathematics-IV
(MECH, CHEMICAL)

Time: 3 hours **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered at one place only

UNIT-I

1. (a) Find the regular function $f(z) = u + iv$ if $u - v = (x - y)(x^2 + 4xy + y^2)$ [6]

   (b) Obtain the Taylor's series expansion of $e^{(1+z)}$ in the powers of $(z-1)$ [6]

(OR)

2 (a) If $f(z)$ is an analytic function then prove that $\left\{\frac{\partial}{\partial x}|f(z)|\right\}^2 + \left\{\frac{\partial}{\partial y}|f(z)|\right\}^2 = |f'(z)|^2$ [6]

(b) Define removable singularity and find the nature of the function $\frac{z - \sin z}{z^2}$ [6]

UNIT-II

3 (a) Prove with the usual notations that $(E^{1/2} + E^{-1/2})(1+\Delta)^{1/2} = 2 + \Delta$ [6]

(b) From the following table, estimate the number of students who obtained marks between 40 and 45 [6]

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

(OR)

4 (a) Show that $\Delta + \nabla = \frac{\Delta}{\nabla} - \frac{\nabla}{\Delta}$ [6]

(b) Given the values

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

Evaluate *f(9)* using Newton's divided difference formula [6]

UNIT-III

5 (a) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's $3/8^{th}$ rule taking *h=1/6* [6]

(b) Given that

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y	7.989	8.403	8.781	9.129	9.451	9.750	10.031

find $\frac{dy}{dx}, \frac{d^2y}{dx^2}$ at $x=1.1$ [6]

(OR)

6. (a) Use Simpson's 1/3rd rule to find $\int_0^{0.6} e^{-x^2} dx$ by taking seven ordinates. [6]

(b) Evaluate $\int_0^1 \frac{dx}{1+x}$ applying Trapezoidal rule [6]

UNIT-IV

7. (a) A problem in mechanics is given to three students A,B and C, whose chances of solving it are 1/2 ,1/3,1/4 respectively. What is the probability that the problem will be solved. [6]

(b) If X is a normal variate with mean 30 and S.D 5, find the probabilities that

(i) $26 \le X \le 40$ (ii) $X \ge 45$ (iii) $|X - 30| > 5$ [6]

(OR)

8. (a) State and prove Baye's theorem [6]

(b) A random variable X has the following probability function

x	0	1	2	3	4	5	6	7
$P(x)$	0	k	2k	2k	3k	K^2	$2k^2$	$7k^2+k$

[6]

(i) Find the value of K (ii) Evaluate P(X<6), P(X≥6) (iii) P(0<X<5)

UNIT-V

9. (a) Two independent samples of 7 items respectively had the following values

Sample-I	11	11	13	11	15	9	12	4
Sample-II	9	11	10	13	9	8	10	-

Is the difference between the means of samples of significant? [6]

(b)A die was thrown 264 times with the following frequency results

No. of appeared on the die	1	2	3	4	5	6
Frequency	40	32	28	58	54	52

Test whether the die is un-biased?. [6]

(OR)

10. (a) Find the student's t for the following variable values in a sample of eight:-4,-2,-2,0,2,2,3,3; taking the mean of the universe to be zero. [6]

(b)A machinist is making engine parts with axle diameter of 0.7inch. A random sample of 10 parts shows mean diameter 0.742 inch with a standard deviation of 0.04inch.On the basis of this sample, would you say that the work is inferior? [6]

Hall Ticket No: **Question Paper Code :**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)
II/IV B. Tech II- Semester Regular Examinations April – 2017
Mechanical Operations
(Chemical)

Time: 3 hours **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered at one place only

UNIT-I

1) a) Explain the following (4M)
   (i) Sphericity
   (ii) Volume surface mean diameter
   b) With a neat diagram explain the working of a Blake jaw crusher. Compare its working with that of a gyratory crusher (8M)

(OR)

2) a) Explain the equipment operation with respect to open and closed circuit grinding. (4M)
   b) A crushing mill reduces lime stone from a particle size of 25 mm to a product having a mean size of 1 mm consuming 5 kW h/ton of material crushed. Calculate the power required to crush the same material at the same rate from a mean size of 10 mm to a product size whose size analysis is given below. (8M)

Size (mm)	4.7	2.36	1.17	0.59	0.3	0.15	0.1	0.07
Weight % retained	0	11.3	29.6	27.5	17.3	9.8	2.8	1.6

UNIT–II

3) a) Explain the following (6M)
   (i) Trommels
   (ii) Grizzlies

   b) Calculate the effectiveness of 48 mesh for which the data are given below. (6M)

Retained mesh	**Weight % retained**		
	Feed	**Overflow**	**Underflow**
20	0.4	0.9	---
28	8.9	18.9	---
35	18.6	38.9	2.9
48	25.8	33.7	16.4
65	28.2	6.6	43.6
100	9.2	1.0	18.3
150	6.3	---	13.2
200	2.3	---	5.6

(OR)

4) a) Explain the principle and working of (6M)

(i) Magnetic separators (ii) Electrostatic separators

b) Explain the principle and the reagents used in froth floatation technique in separating mixture of particles. (6M)

UNIT-III

5) a) Explain the following (4M)

(i) Washing of cakes (ii) Filter aid

b) With a neat sketch explain the operation of a rotary drum filter. . (8M)

(OR)

6) a) Explain the following. (4M)

(i) Clarifiers (ii) Specific cake resistance

(ii) Incompressible sludges (iv) Constant pressure filtration

b) Laboratory filtration conducted at a constant pressure drop of 194 kPa on slurry of $CaCO_3$ in water gave the following data: (8M)

Filtrate volume, L	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Time, s	6.3	14.0	24.7	37.0	51.7	69.0	88.8

The filter area available is 440 cm^2, the mass of solid per unit volume of filtrate is 23.5 g/l and the viscosity of water is 0.89 cP. Estimate the filter medium resistance and specific cake resisitance.

UNIT - IV

7) a) Explain the following . (4M)

(i) Free and hindered settling (ii) Drag and drag coefficient

b) (i) Derive the relation for the terminal velocity of a spherical particle falling freely in Stoke's law region. (4M)

(ii) Calculate the terminal velocity of spherical droplets of coffee extract 45 µm in diameter falling through air. The specific gravity of the coffee extract is 1.06 and that of air is 8.35×10^{-4} and the viscosity of air is 0.028 cP. (4M)

(OR)

8) Explain the following (12M)

(i) Sink and float method (ii) Cyclone separator (iii) Thickener

UNIT-V

9) a) Explain the following (4M)

(i) Belt conveyer (ii) Mixing index

b) Explain the working of various mixers for dry powders. (8M)

(OR)

10) a) Explain the following (4M)

(i) Kneaders (ii) Axial flow impellers

b) With a neat sketch, explain the features of an agitation tank. What is swirling motion and how is it prevented? (8M)

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(AUTONOMOUS)
II/IV B. Tech II- Semester Regular Examinations April – 2017

Momentum Transfer

(Chemical)

Time: 3 hours **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
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UNIT - I

1) a) Define compressible and incompressible fluids. (2M)

b) In an orifice meter, a flat disk with a central opening of diameter D_0 is set across a pipe of diameter D, and the pressure drop ΔP across the opening is measured. It is postulated that ΔP is a function of the average fluid velocity 'v' in the pipe, the density of the fluid ρ, the fluid viscosity μ and the diameters of the pipe and the opening D and D_0 respectively. Thus $\Delta P = \Phi(v, \rho, \mu, D, D_0)$. Find an acceptable set of dimensionless groups which relate these various factors. (10M)

(OR)

2) a) What do you mean by a decanter? State its applications. (4M)

b) Derive barometric equation from hydrostatic equilibrium with a neat sketch. (8M)

UNIT-II

3) a) Differentiate between Newtonian and non-Newtonian fluids with examples. (6M)

b) Explain in detail about the boundary layer separation and wake formation for a flat and a perpendicular plate to flow. (6M)

(OR)

4) a) Discuss in short about the continuity balance in one dimension. (3M)

b) Water at 20 ^{0}C is pumped at a constant rate of 9 m^3/h from a large reservoir resting on the floor to the open top of an experimental absorption tower. The point of discharge is 5m above the floor and friction losses in the 50 mm pipe from the reservoir to the tower amount to 2.5 J/kg. At what height in the reservoir must the water level be kept if the pump can deliver only 0.1 kW. (9M)

UNIT-III

5) a) What do you mean by skin friction and form friction? (4M)
b) Water at 60 ^{0}C is pumped from a reservoir to the top of a mountain through a 0.15 m schedule 120 pipe at an average velocity of 4 m/s. The pipe discharges into the atmosphere at a level 1000 m above the level in the reservoir. The pipeline itself is 1500 m long. If the overall efficiency of the pump and the motor is 70 %, what is the hourly energy requirement for pumping the water? (8M)

(OR)

6) a) Define Mach number and acoustical velocity. (4M)

b) Discuss in detail about the isentropic flow through nozzle with a neat sketch. (8M)

UNIT-IV

7) a) Differentiate between free and hindered settling. (4M)

b) The pressure drop through a particle bed can be used to determine the external surface area and average particle size. Data for a bed of crushed ore particles show $\Delta P/L$ is 1.9 MPa/m for airflow at a superficial velocity of 0.0046 m/s. The measured void fraction is 0.47 and the estimated spericity is 0.7. Calculate the average particle size and the surface are per unit mass if the solid has a density of 4100 kg/m^3. (8M)

(OR)

8) a) What is fluidization and state the applications of fluidization (4M)

b) Urea pellets are made by spraying drops of molten urea into cold gas at the top of a tall tower and allowing the material to solidify as it falls. Pellets 6 mm in diameter are to be made in a tower 25 m high containing air at 20 ^{0}C. The density of urea is 1330 kg/m^3.

(i) What would be the terminal velocity of the pellets, assuming free settling conditions?

(ii) Would the pellets attain 99% of this velocity before they reach the bottom of the tower? (8M)

UNIT-V

9) a) With a neat sketch, explain the function of stuffing boxes and mechanical seals. (6M)

b) A horizontal venture meter having a throat diameter of 20 mm is set in a 75 mm ID pipe line. Water at 15 ^{0}C is flowing through the line. A manometer containing mercury under water measures the pressure differential over the instrument. When the manometer reading is 500 mm, what is the flow rate in m^3/h? If 12% of the differential is permanently lost, what is the power consumption of the meter? (6M)

(OR)

10) a) Differentiate between blowers and compressors. (4M)

b) Discuss in detail about the working of a centrifugal pump drawing a neat sketch. Draw the characteristic curves. (8M)

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ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)
II/IV B. Tech II- Semester Regular Examinations April – 2017

Process Instrumentation

(Chemical)

Time: 3 hours **Max Marks: 60**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered at one place only

UNIT-I

1) a) Explain the following (4M)
   (i) Time constant (ii) Reproducibility
   (iii) Circular charts (iv) Recording instruments
   b) What are dynamic characteristics of an instrument? Explain. (8M)

(OR)

2) a) Explain the following. (4M)
   (i) 1^{st} order instruments (ii) Dead zone
   (iii) Drift (iv) Signaling instruments
   b) What is control centre? Draw the different layouts of control centre and plant. (8M)

UNIT–II

3) a) Explain the following (4M)
   (i) Head effect (ii) Thermal well
   b) With a neat sketch explain the working of a pressure spring thermometer. (8M)

(OR)

4) a) Explain the following (6M)
   (i) Thermocouple lead wires (ii) Peltier effect
   (ii) Thermocouple joints
   b) With a neat sketch, explain the working of a multivoltmeter. (6M)

UNIT-III

5) a) Explain the following (4M)
   (i) Callendar equation (ii) Stefan-Boltzman law
   b) Explain resistance thermometer circuits with specific reference to Wheatstone bridge and Callender – Griffiths bridge. . (8M)

(OR)

6) a) Explain the following (4M)
   (i) Thermopile (ii) Fery sphere
   b) Explain the different radiation receivers with neat sketches. (8M)

UNIT-IV

7) a) Explain the following . (4M)
   (i) Beer's law (ii) pH
   (iii) Absolute humidity (iv) Dew point

   b) With a neat schematic diagram explain the principle and working of IR absorption spectrometer. (8M)

(OR)

8) a) Explain the following (4M)
   (i) Gas Chromatography
   (ii) Wet bulb and dry bulb temperatures
   b) With a neat sketch explain the working of a mass spectrometer. (8M)

UNIT-V

9) a) Explain the following (6M)
   (i) Inclined manometer
   (ii) Pressure spring gage
   (iii) McLeod gage

   b) Explain the measurement of pressure in corrosion fluids. (6M)

(OR)

10) a) Explain the following (4M)
   (i) Float and tape gage
   (ii) Hydrometer
   b) Explain the Bubbler system for liquid level measurement. (8M)

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