Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2018 - 19 Examination

Semester: 6 **Date: 04/05/2019**
Subject Code: 03103353 **Time: 10:30am to 1:00pm**
Subject Name: Process Equipment Design **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - **(15)**

1. Write down difference between Chemical Aspects and Mechanical Aspects Equipment.
2. Define : Yield Stress
3 Define: NPSH.
4 Write equation for optimum pipe size for carbon steel pipe for turbulent flow.
5 Give the full name of TEMA.
6 What is the Density of carbon dioxide gas at the discharge pressure of pipe is atmosphere, Temperature of gas is 70^0C?
7 What is Weld Joint Efficiency?
8 List out types of Heads for Unfired pressure vessels.
9 Write down IS code of Unfired pressure vessels.
10 Explain Reflux ratio for distillation.
11. Find out Design pressure if 500 kN/m^2 is operating pressure of unfired pressure vessel.
12. Flow rate of fluid created by pump is known as Capacity of Pump. True/False
13. What is the application of blower?
14. In orifice meter minimum flow area achieved by free flowing jet is known as_____.
15. What is the principle of Orifice meter?

Q.2 Answer the following questions. (Attempt Any Three): **(15)**

A) Define : Stress, Stain, Material of Construction

B) What is Cavitations? How to remove cavitations in the pump?

C) Estimate the optimum pipe diameter for a flow of dry chlorine gas of 10000 kg/h at 6 atm and 200 through carbon steel pipe.

D) List out the difference between (NPSH)A and (NPSH)R.

Q.3 A) Describe general design steps for Distillation column by Mc Cabe method. **(07)**

B) Benzene at 37^0C is pumped through the system at a rate of 9.09 m^3/h with the help of a centrifugal pump. The reservoir at atmospheric pressure. Pressure at the end of discharge line is 345 k pa g. The discharge head 3.05 m and pump suction head is 1.22 m above the level of liquid in reservoir. The friction loss in suction line is 3.45 kpa and that in the discharge line is 37.9 kpa. The mechanical efficiency of the pump is 0.6.The density of benzene is 865 kg/m^3 and its vapour pressure at 37^0C is 26.2 kpa. **(08)**

Calculate: (a) (NPSH) A (b) Power required by centrifugal pump.

OR

B) A process vessel is to be designed for the maximum operating pressure of 500 kN/m^2.The vessel has the nominal diameter of 1.2 m and tangent to tangent length of 2.4 m. The vessel is made of IS: 2002 – 1962 Grade 2B quality steel having allowable design stress value of 118 MN/ m^2 at working temperature. The corrosion allowance is suggested to be 2 mm for the life span expected for the vessel. The vessel is to be fabricated according to class-II of Indian standard specifications which stipulate the weld joint efficiency of 0.85. **(08)**

1) What will be the standard plate thickness (Cylindrical) to fabricate this vessel?

2) If a spherical vessel having the same diameter and thickness is Fabricated the same quality steel, what maximum internal pressure the sphere will withstand safely?

Q.4 **A)** Design an orifice meter based on the following data : **(07)**

Name of fluid= Water,
Flow rate =1000kg/h,
Inside Diameter of pipe =154 mm(SCH-40 pipe)
Operating temperature=32^0C
Density of water =995 kg/m^3
Viscosity of water=0.765 Centipoise
Manometer fluid=Mercury
Density of mercury=13516 kg/m^3
Dia of Orifice =d_o =77 mm
Take C_0 = 0.6055,g=9.81,g_c =1

OR

A) A process vessel is to be designed for the maximum operating pressure of 500 kN/m^2.The vessel has the nominal diameter of 1.2 m and tangent to tangent length of 2.4 m. The vessel is made of IS: 2002 – 1962 Grade 2B quality steel having allowable design stress value of 118 MN/ m^2 at working temperature half apex angle 30^0,determine the conical thickness of the head, take Z=1.35 **(07)**

B) Lube oil is to be cooled from 65 ^{o}C to 45 ^{o}C by using cooling water in fixed tube sheet type shell and tube heat exchanger where lube oil is circulated on shell side and water is on tube side. The design data are as follows. **(08)**
Lube oil flow rate = 450 L/min, Density of lube oil =869 kg/m^3,
Specific heat of lube oil =2.1413 kJ/kg^{o}C, Thermal conductivity of lube oil =0.13 W/m^{o}C, Viscosity of lube oil =15 CP, Cooling water inlet temp. = 35^{o}C, Cooling water outlet temp. =39 ^{o}C, Specific heat of water = 4.1868 kJ/kg^{o}C, Viscosity of water = 0.73 CP. Thermal conductivity of water = 0.628 W/m^{o}C, Density of Water =993.32 kg/m^3

Specification of fixed tube sheet heat exchanger:
Shell inside diameter = 418 mm , Tube O.D. = 15.875 mm, Type of baffle = 25% segmental, Tube I.D. = 13.3858 mm, Baffle spacing = 83.6 mm, Tube length = 3.048 m,
Tube pitch=1.25do, Type of tube arrangement =Triangular, Nos. of tube side passes =4, LMTD correction factor (Ft) =0.95,
Assume Overall heat transfer Coefficient - 400 W/m^{2o}C.
For Pt/do =1.25 and Triangular Pitch

No. of tube passes	**1**	**2**	**4**	**6**	**8**
k1	0.319	0.24	0.17	0.074	0.0365
n1	2.14	2.20	2.28	2.49	2.67

Calculate :(i) Number of tubes (ii) Tube side heat transfer coefficient