Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – OCT. / NOV. 2017

SUBJECT: FLUID FLOW OPERATIONS (CHM 231)

(CHEMICAL ENGINEERING)

Friday, 10 November 2017

T ime: 3 Hours **Max. Marks: 100**

Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed

1A. How can we prove that the pressure at any point in a static fluid is independent of direction?

1B. The liquids chlorobenzene and wash liquid are to be separated in a tubular centrifugal bowl with an inside diameter of 150 mm, rotating at 8000 r/min. The free-liquid surface inside the bowl is 40mm from the axis of rotation. If the centrifugal bowl is to contain equal volumes of the two liquids, what should be the radial distance from the rotational axis, to the top of the overflow dam for heavy liquid? Density of chlorobenzene= 1109 kg/m^3 and that of wash liquid is 1020 kg/m^3.

1C. For a simple U-tube manometer derive a relation between R_m and (P_a-P_b)

(10+5+5)

2A. With the help of a neat diagram explain the rheological behavior of fluids.

2B. A Continuous gravity decanter is to separate CCl_4, with a density of 1109 kg/m^3, from an aqueous wash liquid having a density of 1020 kg/m^3. If the total depth in the seperator is 1m and the interface is to be 0.6 m from the vessel flowwr, (a) what should the height of the heavy –liquid overflow be? (b) how much would an error of 50mm in this height affect the position of the interface?

2C. For the following sitiuations of steady flow, determine whether flow is laminar or turbulent ? (a)water at 10^0C flowing at an average velocity of 2m/s in a 100mm pipe with viscosity 1.310 cp (b) air at 2 atm pressure flowing at 50 ft/s in a 12 inch duct with density 0.124 lb/ft^3 and viscosity 0.02 cp .(c) oil with a specific gravity of 0.78 and viscosity of 20cp flowing at 5ft/s in a 2 in pipe(d) polymer melt with a density of 900 kg/m^3 and a viscsity of 1 Pa-s flowing at 0.2 m/s in a 15mm tube.

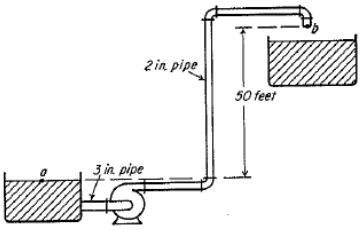
(5+5+10)

1. 3A. What is Reynold's number? What are its units? How do we describe various types of
2. flow using N_{Re}.

3B. Define Momentum Correction factor, Mass velocity and a boundary layer. What is the formula for equation of continuity?

3C. A pump draws a solutrion of speicic gravity1.84 from a storage tank through a 75 mm steel pipe. The effiency of the pump is 60 %. The velocity in the suction line is 0.914 m/s. the pupm discharges through a 50 mm pipe to an overhead tank. The end of the discharge is 15.2 m above the level of the solution in the feed tank. The friction losses in the system are 29.9 J/kg. what pressure must the pump develop? What is the power of the pump?the cross sectional areas of 75 mm and 50 mm pipes are 0.0513 and 0.0233 ft^2 respectively.

(5+5+10)



4A. Derive the Bernoulli's Equation for incompressible fluids when corrected for pump work.

4B. Explain about friction losses by sudden expansion of the cross section with the help of a neat diagram. **(10+10)**

5. What is Mach number? Air enters a convergent- divergent nozzle at a temperature of 555.6K and a pressure of 20 atm. The throat area is one-half that of the discharge of the divergent section. (a) Assuming the mach number in the throat is 0.8, what are the values of the flowing quantities at the throat: pressure, temperature, linear velocity, density and mass velocity? (b) What are the values of p*, T*, u* and G* corresponding to the reservoir conditions. . For air γ =1.4 and M=29. Taking R=82.056x10^{-3} atm-m^3/kg-mol-K and 1atm= 1.01325x10^5 N/m^2.

(**20)**

6A. Write the formulae for Hagen-poiseuille's equation, Von-Karman Equation, and Kozeny-carmen Equation. What is Couette flow?

6B. Describe about reciprocating and rotary pumps with the help of a neat diagram.

6C. Water at 20^0C is pumped at a constant rate of 9 m^3/h from a large reservoir resting on the floor to the top of an absorption tower. The point of discharge is 5 m above the floor, and the frictional losses in the 50 mm pipe is 2.5 J/Kg. at what height in the reservoir must the water level be kept if the pump can develop only 0.1kW. Consider α_a and α_b =1

(5+10+5)

7A. Explain about the working of Venturi meter. Derive the equation for volumetric flowrate for this meter.

7B. A Venturi meter is to be installed in a 100mm pipe to measure the flow of water. The maximum flowrate is expected to be 75m^3/h. the manometer used to measure the differential pressure is filled with Hg, and water is to be filled the leads above the surface of Hg.(a) If the maximum manometer reading is to be 1.25m and the venturi coefficient is 0.98, what throat diameter should be specified for the venturi? (b) what will be the power to operate the meter at full load if the pressure recovery is 90% of the differentil pressure. Specifi gravity of Hg = 13.6 and that of water is 1.0.

(10+10)

8A. Write in detail about different types of blowers and compressors.

8B. Explain about various impellers.

8C. With the help of a neat diagram explain in detail about the working of rotameter and vortex shredding meters.

(5+5+10)