A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 53903

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Third Semester

Chemical Engineering

15UCH303 - FLUID MECHANICS FOR CHEMICAL ENGINEERING

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Cohesion and molecular interaction are responsible for the fluid property called_____. CO1- R

   (a) Specific gravity (b) Density (c) Viscosity (d) Capillarity

2. Surface tension is CO1- R

   (a) Line force (b) Surface force (c) Volume force (d) Both (b) and (c)

3. For Newtonian fluids the stress – strain relation curve is _____ CO2- R

   (a) Parabolic (b) Linear (c) Elliptical (d) None of the above

4. Manometric liquid have specific gravity _____ than that of the process fluid whose pressure is to be measured. CO2- R

   (a) Less than (b) Equal to (c) Greater than (d) Both (a) and (b)

5. The dimension of dynamic viscosity is CO3- R

   (a) $ML^{-1}T^{-1}$ (b) L^2T^{-1} (c) LT^{-2} (d) $ML^{-1}T^{-2}$

6. Which of the following is not a dimension-less parameter? CO3- R

   (a) Euler number (b) Specific gravity

   (c) Fanning friction factor (d) None of the these

7. If a thin plate is held immersed in a fluid parallel to the direction of flow, then θ is equal to CO4- R

   (a) Zero (b) 1 (c) -1 (d)<1

8. Pressure drag does not depend upon the CO4- R

(a) Roughness of surface of the body (b) Pressure of main flow only

(c) Length of the body in flow direction (d) All (a), (b) and (c)

9. Which of the following valves will incur maximum pressure drop for the same discharge of water? CO5- R

(a) Globe valve (b) Gate valve (c)Needle valve (d) Butterfly valve

10. In order to have cavitation – free operation of a pump, CO5- R

(a) Available NPSH greater than required NPSH

(b) Available NPSH less than required NPSH

(c) Available NPSH equal to required NPSH

(d) Available NPSH not equal to required NPSH

PART – B (5 x 2= 10 Marks)

11. Classify flow based on the Reynolds number. CO1- R

12. Write any four requirements to be satisfied by a good manometric liquid. CO2- R

13. Sketch the relationship between hydraulic or effective diameter and wetted perimeter. CO3- R

14. Differentiate free settling from hindered settling. CO4- R

15. What do you understand by the term diaphragm pump? Where it is used? CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) Why fluid flow studies are required in Chemical engineering? Classify fluids based on the relation between shear stress and velocity gradient. Sketch the graph between shear stress and velocity gradient for fluids. CO1-App (16)

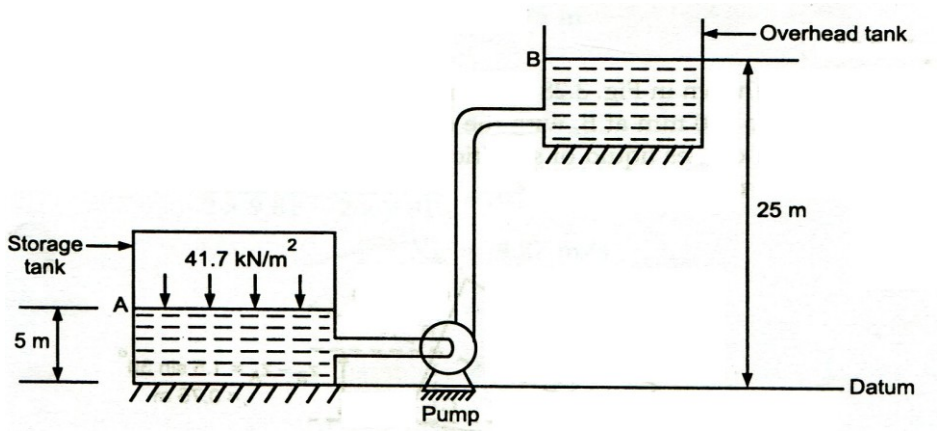
Or

(b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60cm. The thickness of the oil film is 12.5mm. The upper plate, which moves at 2.5 meter per sec, requires a force of 98.1N to maintain the speed. Determine the Dynamic viscosity of the oil in poise, Kinematic viscosity of the oil in stokes and the specific gravity of the oil is 0.95. CO1-App (16)

17. (a) A simple U – tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. CO2-App (16)

Or

(b) A 15 kW pump is used to discharge oil of specific gravity 0.85 to the overhead tank as shown in Figure. If the head loss in the entire system is 1.75 m of oil, find the discharge of the oil from pump, if efficiency of pump is 80% (neglect velocity heads). CO2- Ana (16)



18. (a) The power require P for an agitator depends upon the propeller diameter D, the rotational speed N of the agitator, the liquid density ρ, the viscosity μ, and the gravitational acceleration g. Find by a dimensional analysis, the correct representation for the power requirement in terms of dimensionless groups. CO3-Ana (16)

Or

(b) Explain Buckingham's π theorem with its application for dimensionless analysis. CO3-Ana (16)

19. (a) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take f = 0.009 in the formula, $h_f = 4 f L V^2 / 2 g D$. CO4-App (16)

Or

(b) Find the diameter of a particle of specific gravity 2.65 which will havea terminal velocity of 0.5 m/s in water. Take $\mu_w = 10^{-3}$ kg m/ s. Assume $N_{Re,P} = 100$. CO4-App (16)

20. (a) Derive the flow equation for venturi meter with a neat schematic sketch of venturimeter. Also write the characteristics of venturi meter. CO5- U (16)

Or

(b) A centrifugal pump pumps brine from the bottom of the supply tank and delivers it into the bottom of another tank. The level of the brine in the receiving tank is 50 m above that in the supply tank. The tanks are connected by a 180 mm pipe of length 200 m. The flow rate of brine is $0.05 m^3/s$. The pipeline between the tanks has two gate valves and 8 other pipe fittings. What is the energy cost for running this pump for a 24-h day? CO5-App (16)

Data:

Density of brine = 1180 kg/m^3

Viscosity of brine = 1.2 mPa s

One gate valve is equivalent to 7 pipe diameters and each of the fittings is equivalent to 60 pipe diameters.

Energy costs Rs.0.80 per kWh and the overall efficiency of the pump – motor set is 60%.