KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Marks scored:

Level : B.E.
Year : III

Course : MEEG 301
Semester: I

Exam Roll No. :

Time: 30 mins.

F.M. : 20

Registration No.:

Date : MAR 16 2018

SECTION "A"

[12 Q. × 1 = 12 marks]

Choose the most appropriate answer/s.

1. What is the effect of change in Reynold's number on friction factor in turbulent flow?
   [ ] As the Reynold's number increases the friction factor increases in turbulent flow
   [ ] As the Reynold's number increases the friction factor decreases in turbulent flow
   [ ] Change in Reynold's number does not affect the friction factor in turbulent flow
   [ ] As the Reynold's number increases the friction factor behaves asymptotically in turbulent flow

2. Which of the following sentences are true for Bernoulli's equation?
   i. Bernoulli's principle is applicable to ideal incompressible fluid
   ii. The gravity force and pressure forces are only considered in Bernoulli's principle
   iii. The flow of fluid is rotational for Bernoulli's principle
   iv. The heat transfer into or out of fluid should be zero to apply Bernoulli's principle
   [ ] (i), (ii) and (iii) [ ] (i), (iii) and (iv) [ ] (i), (ii) and (iv) [ ] (i), (ii), (iii) and (iv)

3. Which acceleration has a nonzero value in uniform flow?
   [ ] Local acceleration
   [ ] Convective acceleration
   [ ] Both local as well as convective acceleration
   [ ] Angular acceleration

4. The fluid will rise in capillary when the capillary is placed in fluid, if
   [ ] the adhesion force between molecules of fluid and tube is less than the cohesion between liquid molecules
   [ ] the adhesion force between molecules of fluid and tube is more than the cohesion between liquid molecules
   [ ] the adhesion force between molecules of fluid and tube is equal to the cohesion between liquid molecules
   [ ] the cohesive force exceeds the viscous force of the liquid.

5. If viscosity of fluid is more, the thickness of boundary layer is
   [ ] more [ ] less
   [ ] not affected by change in viscosity [ ] zero

6. Minor losses do not make any serious effect in the total losses in
   [ ] short pipes [ ] long pipes
   [ ] both the short as well as long pipes [ ] big diameter pipes

7. The location of the centre of pressure over a surface immersed in a liquid is
[ ] always above the centroid
[ ] will be at the centroid
[ ] will be below the centroid
[ ] for higher densities it will be above the centroid and for lower densities it will be below the centroid

8. When a body floating in a liquid, is displaced slightly, it oscillates about
[ ] C.G. of body [ ] Center of pressure
[ ] Center of buoyancy [ ] Metacentre

9. According to Darcy's formula, the loss of head due to friction in the pipe is _____ (where f = Darcy's coefficient, l = Length of pipe, v = Velocity of liquid in pipe, and d = Diameter of pipe)
[ ] $flv^2/2gd$ [ ] flv^2/gd [ ] $3flv^2/2gd$ [ ] $4flv^2/2gd$

10. Flow of exhaust gas in a large chimney (for example, a brick kiln) can be measured by
[ ] orifice plate [ ] venturimeter [ ] Rotameter [ ] Pitot tube

11. The unit of dynamic viscosity in S.I. units is
[ ] $N\text{-}m/s^2$ [ ] $N\text{-}s/m^2$ [ ] Poise [ ] Stoke

12. The wall shear stress _____ in the flow direction within the entrance region (before the fully developed region starts)
[ ] remains constant [ ] increases [ ] decreases [ ] will be zero

SECTION "B"

[8 Q.× 1= 8 marks]

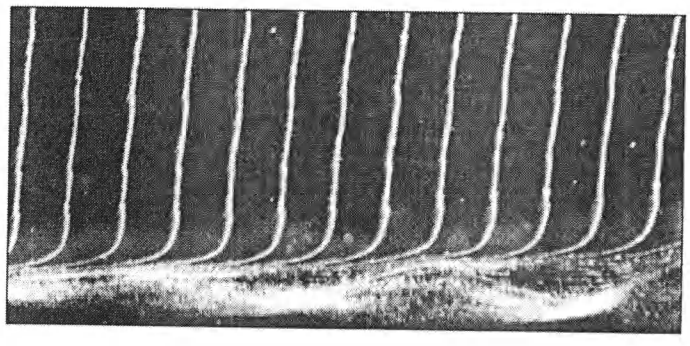
Fill in the blanks.

13. _____ is also called form drag because of its strong dependence on the form or shape of the body.

14. For a flow over flat plate the drag coefficient is equal to _____

15. The pumping power requirement for a laminar flow piping system can be reduced by a factor of _____ by doubling the pipe diameter.

16. The velocity profile shown in the following figure is the _____ generated by a single discharge of bubbles from the wire



17. The magnitude of the resultant force acting on a plane surface of a completely submerged plate in a homogeneous (constant density) fluid is equal to the product of the pressure at the _____and the area A of the surface.

18. As a non-Newtonian fluid, the common synthetic paint is an example of _____ or _____.

19. Surface tension of water decreases with increasing _____ and _____.

20. The _____ are used to alter the shape of the wings of an aeroplane during takeoff and landing to maximize lifts at low speeds.

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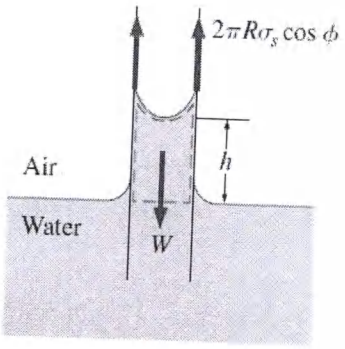
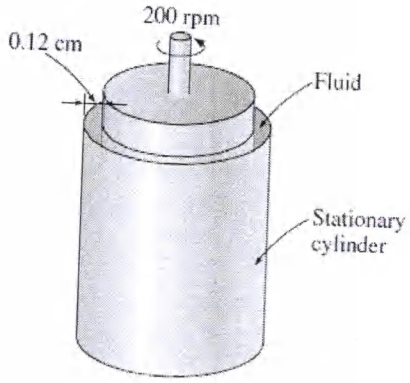
F.M. : 55

SECTION "C"

Answer *ALL* the questions.

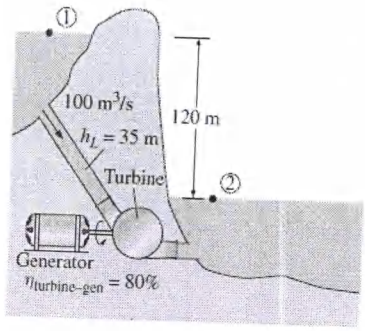
1. i. What are non-Newtonian fluids? Explain various types of such fluids with appropriate examples.
   ii. Write a short note on 'Modeling in Fluid Mechanics'. [4]
   iii. A 0.6-mm-diameter glass tube is inserted into water at 20°C in a cup. Determine the capillary rise of water in the tube. Consider the surface tension of water at 20°C to be 0.073 N/m. [4] [3]





2. i. The viscosity of a fluid is to be measured by a viscometer constructed of two 75-cm-long concentric cylinders (above right figure). The outer diameter of the inner cylinder is 15 cm, and the gap between the two cylinders is 0.12 cm. The inner cylinder is rotated at 200 rpm, and the torque is measured to be 0.8 N. m. Determine the viscosity of the fluid. [5]
   ii. Discuss about hydrostatic forces on submerged curved surfaces. [3]
   iii. Explain Eulerian and Lagrangian approach in fluid mechanics, with relevant examples and applications. [3]

3. i. What are hydraulic grade line (HGL) and energy grade line (EGL)? Explain the various things that can be noted from those lines. [4.5]
   ii. In a hydroelectric power plant, 100 m^3/s of water flows from an elevation of 120 m to a turbine, where electric power is generated. The total irreversible head loss in the piping system from point 1 to point 2 (excluding the turbine unit) is determined to be 35 m. If the overall efficiency of the turbine–generator is 80 percent, estimate the electric power output. [4.5]



iii. What are the assumptions while deriving the Bernoulli's equation. [2]

4. i. Explain the following Moody chart? What important points on pipe flows can be observed from the Moody chart? [4]

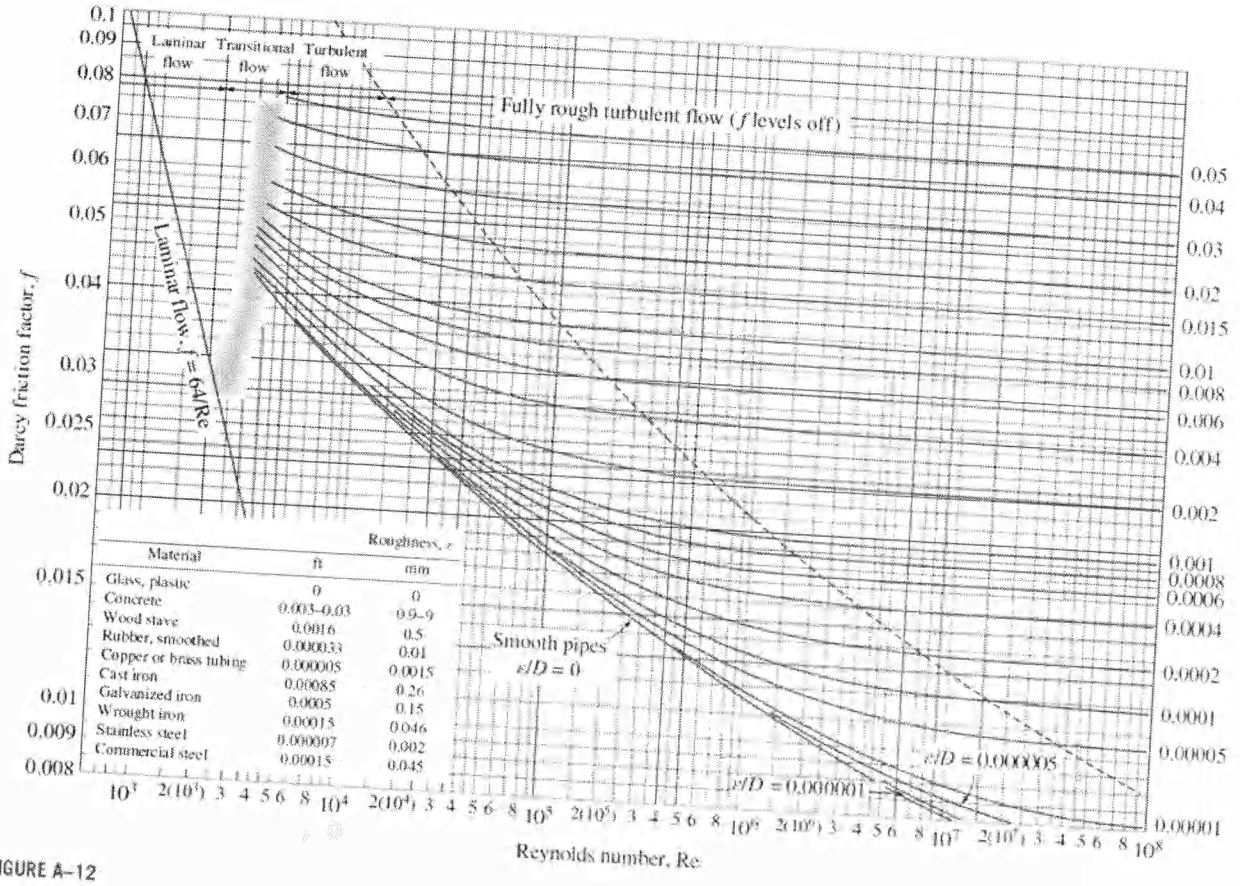
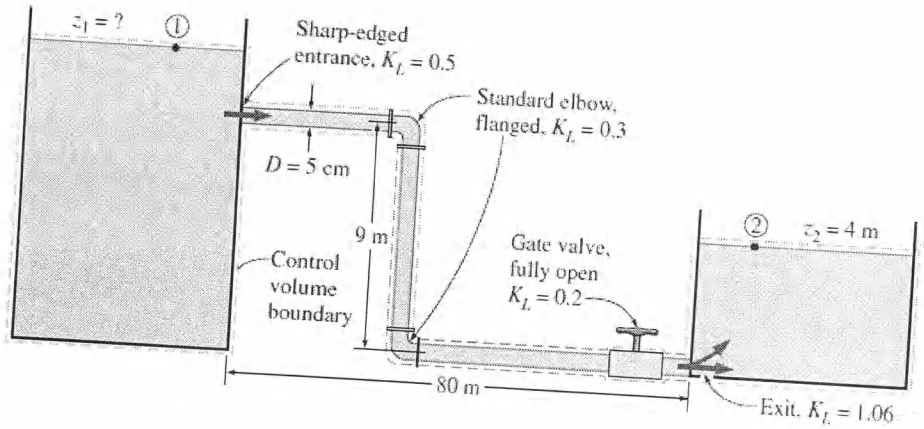


FIGURE A–12

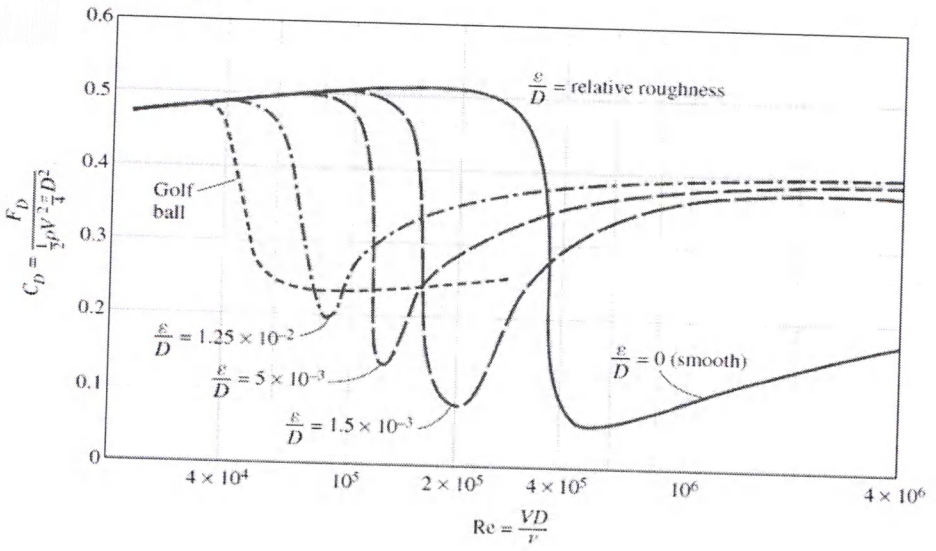
The Moody chart for the friction factor for fully developed flow in circular pipes for use in the head loss relation $h_L = f\frac{L}{D}\frac{V^2}{2g}$. Friction factors in the turbulent flow are evaluated from the Colebrook equation $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{\mathrm{Re}\sqrt{f}}\right)$.

ii. Why is the Colebrook equation of friction factor difficult to apply? What is the best way to use it?

iii. Water at 10 °C flows from a large reservoir to a smaller one through a 5-cm diameter cast iron piping system, as shown the following figure. Determine the elevation z_1 for a flow rate of 6 L/s. The density and dynamic viscosity of water at 10°C are $\rho = 999.7$ kg/m^3 and $\mu = 1.307\times10^{-3}$ kg/m · s. The roughness of cast iron pipe is $\varepsilon = 0.00026$ m. [2] [5]



5. i. Explain the following figure. [3]



ii. How is trailing edge vortex formed by an aircraft wings in the flight? Why is it necessary to minimize it? How is it minimized in modern aircrafts? [3]

iii. A small aircraft has a wing area of 30 m^2, a lift coefficient of 0.45 at takeoff settings, and a total mass of 2800 kg. Determine (*a*) the takeoff speed of this aircraft at sea level at standard atmospheric conditions, and (*b*) the required power to maintain a constant cruising speed of 300 km/h for a cruising drag coefficient of 0.035. [5]