Seat No.: _____

Ganpat University

B.Tech. Mechatronics Semester IV, Regular Examination, May/June, 2012

2MC405 Fluid Mechanics and Machines

Show all work clearly and in order.
Attempt all questions.
Figure to the right indicates full marks.

Marks: 70 Time: 3 H

Section I

Q. 1 [12]

Define Compressibility and Bulk modulus. Explain when are these properties important and other aspects worth noting about them.

Attempt any one

(a) Define weight density and relative density. The weight of an object measured on ground level where $g_e = 9.81m/s^2$ is $35,000N$. Calculate its weight at the following locations (i) Moon, $g_m = 1.62m/s^2$ (ii) Sun, $g_s = 274.68m/s^2$ (iii) Mercury, $g_m e = 3.53m/s^2$ (iv) Jupiter, $g_j = 26.0m/s^2$ (v) Saturn, $gs_a = 11.2m/s^2$ and (vi) Venus, $g_v = 8.54m/s^2$.

(b) A balloon is filled with 6 kg of hydrogen at 2 bar and $20°C$. What will be the diameter of the balloon when it reaches an altitude where the pressure and temperature are 0.2 bar and $60\,°C$. Assume that the pressure and temperature inside are the same as that at the outside at this altitude. Use characteristic equation for gases $PV = mRT$. For hydrogen, molecular mass = 2.

Q. 2 [11]

Define 1) Hydrostatic condition and 2) Centre of pressure. Use diagrams if necessary.

Attempt any one

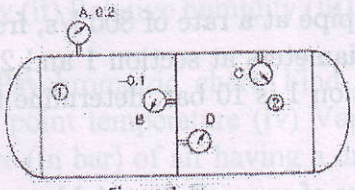

Figure 1

(a) Four pressure gauges A, B, C and D are installed as shown in figure 1 in chambers 1 and 2. The outside pressure is 1.01 bar. The gauge A reads 0.2 bar, while the gauge B reads 0.1 bar. Determine the pressures in chamber 1 and chamber 2 and the reading of gauge C and D.

(b) An open cylindrical vertical container is filled with water to a height of 30 cm above the bottom and over that an oil of specific gravity 0.82 for another 40 cm. The oil does not mix with water. If the atmospheric pressure at that location is 1 bar, determine the absolute and gauge pressures at the oil water interface and at the bottom of the cylinder.

Q. 3

Discuss floating body stability. What is metacentre? Derive its relation with moment of inertia of the body and the displaced volume. [12]

Section II

Q. 4

Explain Newtons second law as applied to 1) a single body and 2) control volume. [12]

Attempt any one

(a) A blade turns the jet of diameter 3 cm at a velocity of 20 m/s by 60 degree. Determine the force exerted by the blade on the fluid.

(b) An area of reducing cross section in the horizontal plane has an inlet area = 0.02 sq. m and the outlet area = 0.01 sq. m. The velocity at the inlet is 4 m/s. The pressures are 40 kPa at inlet and 10 kPa of outlet. Determine the force exerted by the reducer on the fluid.

Q. 5

Attempt any one [11]

(a) Define steady flow giving examples. What are the features of laminar and turbulent flow? Lubricating oil at a velocity of 1 m/s (average) flows through a pipe of 100 mm diameter. Determine whether the flow is laminar or turbulent. What should be the velocity for the flow to turn turbulent? Density $\rho = 930 kg/m^3$. Dynamic viscosity $\mu = 0.1 Ns/m^2$.

(b) Which are the forms of energy encountered in fluid flow? What is the difference between Euler's equation of motion and Bernoulli equation? A liquid of specific gravity 1.3 flows in a pipe at a rate of 800 l/s, from point 1 to point 2 which is 1 m above point 1. The diameters at section 1 and 2 are 0.6 m and 0.3 m respectively. If the pressure at section 1 is 10 bar, determine the pressure at section 2.

Q. 6

Which are the various types of pumps? A variable-speed pump is delivering 3,000 cubic m/s of water with a total head of 200 m when operating at 1,550 rpm and an efficiency of 83%. The brake horsepower is 182 kw. The outside diameter of the impeller is 12 cm. Calculate the performance of the pump if the impeller outside diameter is increased to 12.5 cm and the speed increased to 1,600 rpm. [12]

End of Paper