(b) What is perfect gas ? Discuss its specific heat nature at constant pressure and constant volume. 6

Section–V

9. (a) A man of weight 80 kg floats in water with 400 cub. cm of its body above the surface. What is his volume ? 2

(b) Define the following :

(i) Principle of Archimedes.

(ii) Force of buoyancy.

(iii) Perfect fluid.

(iv) Surface force. 2

(c) Specific gravities of gold and copper are 19.3 and 8.62 respectively. Find the specific gravity of alloy when gold and copper are mixed in the ratio 11:1 by volume. 2

(d) Find the centre of pressure of a rectangle immersed in a homogeneous liquid with one side in the free surface. 2

(e) Define the following :

(i) Meta centre

(ii) Surface of equal pressure. 2

(f) Define Boyle's law for gases. 2

B.Sc. 4th Semester (Hons.) (Common with ID No. 60347 B.Sc. Old Scheme) Examination, May–2016

MATHEMATICS

Paper–BHM–244

(Hydro-Statics)

Time allowed : 3 hours] *[Maximum marks : 60*

Note : *Attempt **five** questions in all, selecting **one** question from each section. **Question No. 9 (Section–V) is compulsory.***

Section–I

1. (a) Derive pressure equation at any point of a fluid, at rest, under the action of given forces in spherical co-ordinates. 6

(b) A given volume of fluid (liquid) is at rest on a fixed hemisphere of radius 'a', under the action of a force, to a fixed point in the plane of hemisphere, varying as the distance. Find the pressure at any point of the liquid and the total pressure on the base of hemisphere. 6

2. (a) A mass of fluid is, at rest, under the forces $X = (y + z)^2 - x^2$; $Y = (z + x)^2 - y^2$; $Z = (x+y)^2 - z^2$; find the density and prove that the surfaces of equal pressure are hyperboloids of revolution. 6

(b) State and prove the necessary condition of equilibrium of a elastic fluid in a given field of force. 6

Section–II

3. (a) Find the centre of pressure (C.P.) of a triangular area immersed in a homogeneous liquid with one side in the free surface. 6

(b) A square lamina is just immersed vertically in water and then lowered through depth 'h', if 'a' is the length of square, prove that the distance of the C.P. from centre of square is $\frac{a^2}{6a+12h}$. 6

4. (a) Show that the forces represented by $X = \mu (y^2 + yz + z^2)$; $Y = \mu (z^2 + zx + x^2)$; $Z = \mu (x^2 + xy + y^2)$ will keep a mass of liquid, at rest, if the density is proportional to $\frac{1}{(\text{distance})^2}$ from the plane $x + y + z = 0$ and the curves of equal pressure and density will be circles. 6

(b) A cylinder floats vertically with 8 cm of its length, above the fluid. Find the whole length of cylinder, the specific gravity of fluid being three times that of cylinder. 6

Section–III

5. (a) Discuss that the equilibrium of floating bodies is stable or unstable according as the metacentre is above or below the centre of gravity of the body. 6

(b) Show that a uniform cylinder of specific gravity $\frac{1}{2}$, can not be in stable equilibrium when floating upright in water, if its length exceeds three quarters $\left(\frac{3}{4}\right)$ of its diameter. 6

6. (a) Show that the tangent plane at any point of the surface of buoyancy is parallel to the corresponding plane of floatation. 6

(b) A solid cone is floating with its axis vertical and vertex downwards. Discuss its stability of equilibrium. 6

Section–IV

7. (a) Find the work done is compressing a gas when change is adiabatic. 6

(b) State and prove Charle's law for gases. 6

8. (a) A heavy gas at constant temperature is confined in a vertical cylinder of height 'h'. If 'ρ_0' be the density at the base, find its mean density. 6