Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

DEPARTMENT OF AERONAUTICAL & AUTOMOBILE ENGINEERING
III SEM. B.TECH (AERONAUTICAL ENGG.) DEGREE END SEMESTER EXAMINATIONS NOV/DEC 2015

SUBJECT: MECHANICS OF FLUIDS (AAE- 201)
REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **ANY FIVE FULL** questions.
- Missing data, if any, may be suitably assumed.

1A) State Bernoulli's theorem for compressible flow. Derive an expression for Bernoulli's equation when the process is (i) Isothermal and (ii) Adiabatic. (05)

1B) Assuming the velocity distribution is laminar boundary layer along a flat plate is given by eq. what are the displacement and energy thickness. (05)

$$\frac{u}{U} = 2\frac{y}{\delta} - \left[\frac{y}{\delta}\right]^2$$

2A) Derive an equation of motion for free and forced vortex flow. (05)

2B) Determine the meta centric height of the floating body by analytical method. (05)

3A) A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of pipe. Considering all losses of head which occur, then determine the rate of flow. Take f̀ = 0.01 for both sections of the pipe. (05)

3B) Calculate the pressure due to a column of 0.3m of (a) water and (b) oil of specific gravity 0.8. (02)

3C) Water flows through a Venturi meter, as shown in Fig.1 Determine the discharge coefficient of the venturi meter if the discharge is determined to be 2.12 cfs. (03)

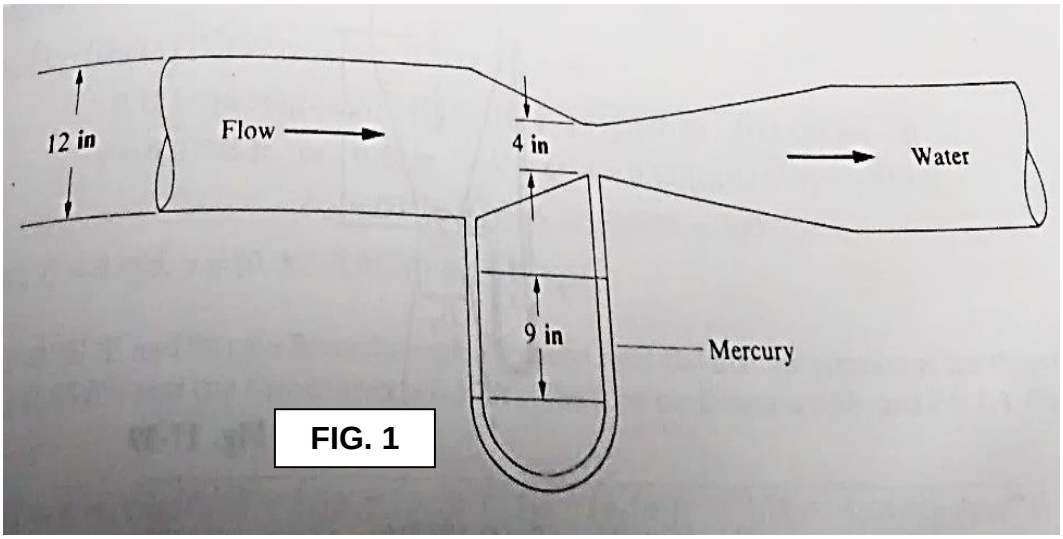

FIG. 1

4A) Derive an expression for the discharge over a triangular notch or weir and prove that for right angled notch $Q = 1.417H^{5/2}$. (04)

4B) A jet plane which weighs 29.43 kN and having a wing area of 20 m^2 flies at a velocity 950 km/hr, when the engine delivers 7357.5 kw power. 65% power is used to overcome the drag resistance of the wing. Calculate the co-efficients of lift and drag for the wing. The density of the atmospheric air is 1.21kg/m^3. (03)

4C) The velocity of water in a 6-in diameter pipe is 12 ft/s. At the end of the pipe is a nozzle whose velocity coefficient is 0.98. If the pressure in the pipe is 10 psi, what is the velocity in the jet? What Is the diameter of the jet? What is the rate of discharge? And What is the head loss? (03)

5A) Derive an expression for the velocity distribution for viscous flow between two parallel plates. Also find the ratio of maximum velocity to average velocity and plot the velocity distribution and shear stress distribution across a section of parallel plates. (05)

5B) The friction factor for turbulent flow through rough pipes can be determined by karman-prandtl equation, (05)

$$\frac{1}{\sqrt{f}} = 2log_{10}\left(\frac{R_0}{k}\right) + 1.74$$

Where f = friction factor, R_o = pipe Radius, K = average roughness.

Two reservoirs with a surface level difference of 20 m are to be connected by 1 m diameter pipe 6 km long. What will be the discharge when a cast iron pipe of roughness k =0.3 mm is used? What will be the percentage increase in the discharge if the cast iron pipe is replaced by a steel pipe of roughness k = 0.1 mm? Neglect all the losses.

6A) A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe. (04)

6B) Find the force required at the top of a circular hatch shown in fig.2 in order to keep it closed against the water pressure outside. The density of water 1050 kg/m^3. (03)

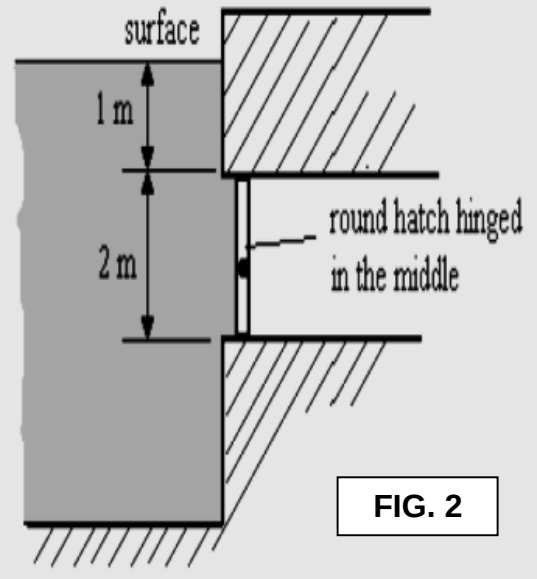

FIG. 2

6C) Determine the intensity of shear of an oil having viscosity = 1poise. The oil is used for lubricating the clearance between a shaft of diameter 10 cm and its journal bearing. The clearance is 1.5 mm and the shaft rotates at 150 RPM. (03)