

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-III Remedial Examination May 2011****Subject code: 130101****Subject Name: Fluid Mechanics****Date: 28-05-2011****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the phenomenon of capillarity. Obtain an expression for capillary rise and capillary fall of a liquid **07**
- (b) State and prove Pascal's law. Also mention its application. **07**
- Q.2** (a) What is Hagen Poiseuille's formula? Derive an expression for Hagen Poiseuille's formula. **07**
- (b) Two parallel plates kept 100 mm apart have laminar flow of oil between them. Maximum velocity of flow is 1.5 m/sec. Calculate **07**
- 1). Discharge per meter width
 - 2). Shear stress at the plate
 - 3). Difference in pressure between two points 20 mm apart
 - 4). Velocity gradient of plates
 - 5). Velocity at 20 mm from the plates
- OR**
- (b) A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/sec. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe. **07**
- Q.3** (a) Air has velocity of 1000 Km/hr at pressure of 9.81 kN/m² vacuum and temperature of 47°C. Compute its stagnation properties and the local Mach number. Take atmospheric pressure = 98.1 kN/m², $R = 287$ J/KgK and $\gamma = 1.4$ **07**
- (b) Derive Darcy-Weisbach equation. **07**
- OR**
- Q.3** (a) A pipe of 25 cm diameter and 900 m long is carrying an oil of mass density 940 kg/m³ and dynamic viscosity 1 Ns/m². The oil flow rate is 0.15 m³/Sec. Due to increase in atmospheric temperature the viscosity of oil changes by a factor of 8. If the same quantity of oil is to be conveyed compare the cost of pumping. **07**
- (b) Prove that the velocity of sound wave in compressible fluid is given by $C = \sqrt{K/\rho}$. **07**
- Q.4** (a) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by propeller. Assume that thrust P depends upon the angular velocity ω , speed of advance V , diameter D , dynamic viscosity μ , mass density ρ , elasticity of the fluid medium which can be denoted by speed of the sound in the medium C . **07**

- (b) State similarity laws. Where are they used? Explain Froude, Euler and Weber model law with applications. 07

OR

- Q.4 (a) Define circulation. Prove that circulation $\Gamma = \oint \xi dA$ with usual notations. 07
- (b) Derive an expression for continuity for three dimensional flow and reduce it for steady, incompressible two dimensional flow. 07

- Q.5 (a) Derive Euler's equation of motion along a streamline and hence obtain Bernoulli's equation clearly state the assumption made. 07
- (b) A wooden block of specific gravity of 0.7 and dimensions 18 cm wide, 30 cm deep and 100 cm long floats horizontally on 18 cm wide surface in water. Calculate the metacentric height and comment on the stability of the block. If the block is given a tilt of 6° in the clockwise direction. Calculate what should be the mass should be kept at a distance from the centre 5 cm on the opposite side of offset the tilt. 07

OR

- Q.5 (a) Show that the distance between the meta-centre and center of buoyancy is given by $BM = I/\nabla$. 07
- (b) The inlet and throat diameters of a vertically mounted venturimeter are 30 cm and 10 cm respectively. The throat section is below the inlet section at a discharge of 10 cm. The specific gravity of the liquid is 900 Kg/m^3 . The intensity of pressure at inlet is 140 KPa and the throat pressure is 80 KPa. Calculate the flow rate in Lps.. Assume that 2 % of the differential head is lost between inlet and throat. Take coefficient of discharge 0.97. 07
