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First Semester M.Tech. Degree Examination, June 2012
Advanced Fluid Mechanics

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Explain i) Translation ii) Rate of deformation and iii) Rotation. (10 Marks)
b. The velocity components in a two dimensional flow are $u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$ represent a possible case of an irrotational flow. (10 Marks)
- 2 a. Obtain an expression for Euler's equation of motion in differential form along the stream line. (10 Marks)
b. The discharge through 20cm diameter pipe increases linearly from 25 to 100lt/sec in 3 seconds. What pressure gradient must exist to produce this acceleration? Also work out the difference in pressure intensity that exists between the section that lie 7.5m apart. (10 Marks)
- 3 a. What is Hagen-Poiseuille's formula? Derive an expression for Hagen Poiseuille's formula. (10 Marks)
b. Oil with Kinematic viscosity $5 \times 10^{-4} \text{ m}^2/\text{s}$ and density of 800 kg/m^3 is pumped through a pipe 0.1 m in diameter at a rate of 25 lit/sec. What is the pressure drop in 10 m of horizontal pipe? What size pipe would reduce the pressure drop to one third this value for the same flow rate? (10 Marks)
- 4 a. Derive the Universal velocity profile near a wall given by $\frac{u}{u^*} = 2.5 \ln \left(\frac{yu^*}{\gamma} \right) + 5.5$ using Prandtl's mixing length theory. Where $u^* =$ shear velocity
 $y =$ distance from the wall and γ is the kinematic viscosity. (12 Marks)
b. What are the different types of turbulence models? Explain. (08 Marks)
- 5 a. Explain Hydrodynamic theory of lubrication. (12 Marks)
b. Write a note on : i) Parallel flow past a sphere ii) Oseen's approximation. (08 Marks)
- 6 a. Find the Blasius solution for a boundary layer along a flat plate. (10 Marks)
b. The velocity distribution in the boundary layer is given by $\frac{u}{U_\infty} = \frac{u}{U} = \frac{3}{2} \frac{y}{\delta} - \frac{1}{2} \left(\frac{y}{\delta} \right)^2$. $\delta =$ boundary layer thickness, Calculate : i) displacement thickness ii) momentum thickness iii) shape factor. (10 Marks)
- 7 a. Explain the terms :
i) Total drag on a body ii) Resultant force on a body iii) Co-efficient of drag
iv) Co-efficient of lift. (10 Marks)
b. A truck having a projected area of 6.5 square meters traveling at 70 km/hr has a total resistance of 2000N of this 20% is due to rolling friction and 10% is due to surface friction. The rest is due to form drag. Calculate the co-efficient of form drag. Take density of air = 1.25 kg/m^3 . (10 Marks)
- 8 Write short notes on the following :
a. Pressure transducer.
b. Single wire measurement.
c. Estimate of uncertainty.
d. Hot wire anemometer. (20 Marks)