

2056
M.E. (Mechanical Engineering)
Second Semester
Elective - II
MME-205(a): Fluid Dynamics

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Part.

x-x-x

Part-A

Q.1 a) Write a short note on Hydrodynamics. Also write a note on continuum hypothesis.

b) Derive the Pressure equation from Euler's equations of motion. (04+06)

Q.2 An infinite mass of fluid is acted on by a force $\mu/r^{3/2}$ per unit mass directed to the origin. If initially the fluid is at rest and there is a cavity in the form of sphere $r=c$ in it, show that the cavity will be filled up after an interval of time $(2/5\mu)^{1/2}c^{5/4}$. (10)

Q.3 Derive the Navier-stokes equations in Cartesian co-ordinates and simplify the equations when, i) Fluid is incompressible and dynamic viscosity is constant; ii) Fluid is incompressible and viscous effects are negligible. (10)

Q.4 a) The velocity profile for laminar boundary is given as $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Find the thickness of boundary layer at the end of the plate and the drag force on one side of a plate 1.5 m long and 1 m wide when placed in water flowing with a velocity of 0.12 m/s. Find the value of co-efficient of the drag. Take viscosity of water=0.001 Ns/m².

b) Write short note transformation of circle into aerofoil. (06+04)

Part-B

Q.5 a) State and prove Kelvin's minimum energy theorem.

b) A circular cylinder is placed in a uniform stream; find the forces acting on the cylinder. (05+05)

Q.6 A stream of water of great depth is flowing with uniform velocity V over a plane level bottom. An infinite cylinder, of which the cross-section is a semi-circle of radius r , lies on its flat side with its generating lines making an angle α with the undisturbed streamlines. Prove that the resultant fluid pressure per unit length on the curved surface is $2aP - \left(\frac{5}{3}\right)\rho aV^2 \sin\alpha$, where, P is the fluid pressure at a great distance from the cylinder. (10)

Q.7 a) An aeroplane is flying at 1000 km/hr through still air having a pressure of 78.5 KN/m² (absolute) and temperature -8°C. Obtain on the stagnation point on the nose of the aeroplane: stagnation temperature, stagnation pressure, and stagnation density. Take for air, $R=287$ J/kgK.

b) Discuss Fanno, Rayleigh and Isothermal flow through pipes. (06+04)

Q.8 a) Define dynamic similarity, write short note on inspection analysis.

b) Write short notes on: Free and Forced convection; Crocco's integral; Prandtl number; and Nusselt number. (02+08)

x-x-x