Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **M.Tech**

P2HTCC14

2^{nd} Semester Regular / Back Examination 2017-18
ADVANCED FLUID MECHANICS
BRANCH : HEAT POWER & THERMAL ENGG,
HEAT POWER ENGG, THERMAL ENGG
Time : 3 Hours
Max Marks : 100
Q.CODE : C1076
Answer Question No.1 which is compulsory and any four from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1 **Answer the following questions :** **(2 x 10)**

- **a)** Define laminar and turbulent flow.
- **b)** What is uniform flow?
- **c)** Differentiate between Newtonian and Non-Newtonian fluid.
- **d)** Define vorticity.
- **e)** Stream function given Ψ = xy. Is it representing irrotational flow?
- **f)** Differentiate free vortex and forced vortex motion of fluid.
- **g)** Define rotational flow.
- **h)** What is major loss in pipe flow?
- **i)** Define cavitation.
- **j)** Define kinematic similarity.

Q2 **a)** The velocity distribution in the boundary layer is given by $v/V = 2\eta - \eta^2$ where $\eta = y/\delta$. Find δ^* / δ and θ/δ. **(10)**

b) A smooth two-dimensional flat plate is exposed to a wind velocity of 100 km per hour. If laminar boundary layer exists up to a value of Rex = 3 x 10^5. Find maximum distance upto which laminar boundary layer persists and find the maximum thickness. Assume kinematic viscosity of air 1.49 x 10^{-5} m^2/s. **(10)**

Q3 **a)** If u = y^2, v = -3x, ω = 5z, find angular velocity vector at (1,-1,0). **(10)**

b) Velocity potential function of flow $\phi = x^2 - y^2$. Verify if the flow is incompressible. Determine stream function for the flow. **(10)**

Q4 **a)** Heavy fuel oil flows from A to B through a 100m horizontal steel pipe of 150 mm diameter. The pressure at A is 1.08 MPa and at B is 0.95MPa. Kinematic viscosity is 4.12 x 10^{-6} m^2/s and relative density of oil is 0.918. What is the flow rate? **(10)**

b) Explain different zones of turbulent boundary layers when flow past a wall. **(10)**

Q5 **a)** A. Given a velocity field $V = (y^2 + z^2)\, i + (x^2 + z^2)\, j + (x^2 + y^2)\, k$. at (1,2,3) Find the components of acceleration of a fluid particle. **(10)**

b) A 0.3 m diameter pipe carries water at a velocity of 24.4m/s. At points A and B measurements of pressure and elevation were respectively 361 and 288 kn/m^2, and 30.5 m and 33.5m. For steady flow, find head loss between A and B. **(10)**

Q6 **a)** Explain equivalent pipe and pipes in series (compound pipe). **(10)**

b) A pipeline 16 km long supplies 40 millions of water per day. The first 5 km length is of 1m diameter and remaining is 0.8m diameter. If water to be supplied at 15m of residual head, calculate supply head at inlet of pipe. Neglect minor losses. Assume f = 0.03 for entire pipe. **(10)**

Q7 **a)** Explain Dynamic, Kinematic and Geometric similarity. **(10)**

b) Water at 15 degree centigrade flows at 4 m/s in a 150 mm pipe. At what velocity must oil at 30 degree centigrade flows in a 75 mm pipe for the two flows to be dynamic similar. Kinematic viscosity of water at 15^0 C is 1.145 x 10^{-6} m^2/s and that of oil at 30^0C is 3 x 10 -6 m^2/s. **(10)**