No. of Printed Pages : 03 **Roll No. .....**

19AA1301

M. Tech. EXAMINATION, 2020

(First Semester)

(C Scheme)

(Re-appear Only)

ME

MEM501C

ADVANCED FLUID MECHANICS

Time : 3 *Hours*] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **9** is compulsory. All questions carry equal marks. Draw neat diagrams wherever applicable. Assume missing data, if any.

Unit I

1. (a) State Reynolds Transport Theorem. Derive the following relation of momentum flux() passing through the one dimensional cross-section of duct. **5**

(b) A source of volume flow 100π m^3/s per meter depth at (0, 0) and a sink of volume flow 80 m^1/s per meter depth at (3, 0) are combined with a uniform flow of 10 m/s in the positive x-direction. What is the velocity induced at the point P (3, 4). **10**

Or

2. (a) Find a relation between nozzle discharge velocity V_2 and tank free surface height h. Assume unsteady flow condition caused by draining the tank through nozzle. **5**

(b) A free stream flow at 5 m/s is superimposed on a source placed at the origin. If the stagnation point occurs at (– 0.32, 0). Find the strength of source, maximum width of Rankine half body and the flow velocity at point P (0.5, $\pi/2$) in the flow field. **10**

Unit II

3. (a) What are the semi-empirical theories of turbulence ? Explain the concept of mixing length introduced by Prandtl and prove the relationship that exists between the turbulent shearing stress and mixing length. **5**

(b) A smooth pipe of diameter 75 mm and length 500 m carries water at the rate of 0.075 m^3/s. Determine the head lost due to friction, wall shear stress, centre line velocity and thickness of laminar sub layer. ν = 0.0195 stokes. **10**

Or

4. (a) What is meant by smooth boundary, transitional boundary and rough boundary ? Do they depend upon the boundary surface or on flow condition also ? Give explanation. **5**

(b) A rough pipe is of diameter 8 cm. The velocity at a point 3 cm from pipe wall is 30% more than the velocity at a point 1 cm from pipe wall. Determine the average height of the roughness. **10**

Unit III

5. (a) A source of disturbance travels in air alternatively at subsonic, sonic and supersonic velocities. Sketch and explain the propagation of disturbance in each of the above cases. **8**

(b) A nozzle of throat diameter 25 mm is fitted in the side of a tank. The air pressure within the tank is 8.44 bar and the temperature is 15°C. Determine the back pressure for maximum discharge. Also calculate the maximum flow rate of air through nozzle. **7**

Or

6. (a) Derive Rankine Hugoniot equation for shock wave. **8**

(b) A hydraulic pipeline 3 km long and 50 cm diameter is used to convey water with a velocity of 1.5 m/s. Determine the pressure growth if the valve provided at the outflow end is closed in (i) 20 seconds (ii) 3.5 seconds. Consider pipe is to be rigid and take Bulk modulus of water K = 2×10^9 N/m^2. **7**

Unit IV

7. (a) Derive the following relations for viscous flow between two parallel plates separated by a small gap *h*. The bottom plate is fixed and upper plate is moving with a velocity of U_f .

Velocity distribution equation

with usual notations.

Where *u* is the velocity at a point *y* from the bottom plate. **10**

(b) At what distance *r* from the centre of pipe of radius R does the average velocity occur in laminar flow ? **5**

Or

8. (a) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. **10**

(b) Show that the coefficient of friction is inversely proportionate to Reynolds number for laminar flow through a circular pipe. **5**

(Compulsory Question)

9. (a) Show that stream lines and equipotential lines are crossed at each other at right angle. **3**

(b) Fill in blanks :

Transition from laminar flow to turbulent flow is affected by (i).....(ii)..... (iii).....(iv).....(v)..... **3**

(c) Define Mach Number. Classify fluid flow according to the variation of Mach Number. **3**

(d) Derive basic equation for one dimensional compressible fluid flow. **3**

(e) Show comparison of loss coefficient with respect to diameter ratio (of orifice, flow nozzle and diffuser (15^o cone angle and 7^o cone angle). **3**