R17

Code No: 5421AC

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech I Semester Examinations, December – 2018/January - 2019

ADVANCED FLUID MECHANICS

(Thermal Engineering)

Time: 3hrs Max.Marks:75

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) Show that stream lines and equipotential lines intersect orthogonally. [5]
b) Explain what is meant by Hagen poisoulle flow and its significance. [5]
c) Explain the principle of drag force due to boundary layer. [5]
d) What is meant by prandtl mixing length model? Explain. [5]
e) Explain Fanno and Raleigh lines. [5]

PART-B

5 × 10 Marks = 50

2.a) Derive Euler's equation of motion.
b) A pipe of diameter 200 mm converges to a diameter of 100 mm. The pipe conveys water, the pressure intensities being 400 kPa and 250 kPa at the larger and the smaller sections. Ignoring energy losses find the discharge. [5+5]

OR

3.a) Compare and contrast circulation and vorticity.
b) Water flows down an inclined tapering pipe 45 meters long at a slope of 1 in 10. The areas at the upper and lower ends of the pipe are 8 metres^2 and 3 metre^2 respectively. If the velocity at the lower end is 4.5 meters per second and the pressure at the upper end is 100 kPa, calculate the pressure at the lower end and the rate of flow through the pipe. Ignore energy losses. [5+5]

4.a) Obtain the relation between shear stress and pressure gradient.
b) Oil of specific gravity 0.90 flows at 11.30 liters/sec through a 75 mm diameter horizontal pipe. If the pressures drop per 300 m length of the pipe is 415 kPa. Find the viscosity of the oil. Verify if the flow is laminar. [5+5]

OR

5.a) Derive the Navier stokes equation from the fundamentals.
b) Crude oil of dynamic viscosity 0.15 Ns/m^2 and specific gravity 0.9 flows through a 20 mm diameter vertical pipe. Two pressure gauges have been fixed at 20 m apart. The pressure gauge fixed at higher level reads 200 kPa and that at the lower roads 600 kPa. Find the direction and the rate of flow through the pipe. [5+5]

6.a) Explain the Prandtl boundary layer theory and its significance.

b) In a stream of oil specific gravity 0.95 and kinematic viscosity 0.92 stoke moving at 5.75 meters/second, a plate of 500 mm length and 250 mm width is placed parallel to the direction of motion. Calculate the friction drag on one side of the plate. Find also the thickness of the Boundary layer and the shear stress at the trailing edge of the plate.[5+5]

OR

7.a) Derive the equation for local and mean drag coefficients for different flat plate velocity profiles.

b) A plate is placed at zero angle of incidence in a fluid of approach velocity U. The thickness of the boundary layer 2.5 m from the leading edge is 0.15 cm. Find the thickness of the boundary layer at a distance of 4 m from the leading edge. [5+5]

8.a) Explain K- epsilon model and its significance.

b) In a stream of oil of specific gravity 0.85 and kinematic viscosity 0.82 stoke, moving at 5 meters per second a plate of 450 mm length and 250 mm width is placed parallel to the direction of motion. Calculate the frictional drag on one side of the plate. Find also the thickness of the boundary layer and the shear stress at the trailing edge of the plate.[5+5]

OR

9.a) Explain Moody's diagram in detail.

b) A plate 3 m × 1.5 m is held in water moving at 1.25 meter per second parallel to its length. If the flow in the boundary layer is laminar at the leading edge of the plate,
i) Find the distance from the leading edge where the boundary layer flow changes from laminar to turbulent flow.
ii) Find the thickness of the boundary layer at this section, and
iii) Find the frictional drag on the plate considering both its sides. [5+5]

10.a) Derive the equation for Mach number and Area relation.

b) A projectile travels in air of pressure 0.68 kg/ cm^2 and temperature - 80^0C. If the Mach angle is 30^0C find the velocity of the projectile. Take k=1.4, and R= 29.27 m/^{0}K. [5+5]

OR

11.a) Obtain the general equation for supersonic wave drag.

b) A rocket travels in air of pressure 1.033 kg/cm^2 at 15^0C at a velocity of 1650 km/ hour. Find the Mach number and the Mach angle. Take k= 1.4 and R= 29.27 m/^{0}K. [5+5]

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