Total No. of printed pages = 2

SUBJECT CODE = MEE024103

Roll No. of candidate | | | | | | | | | | |

2017

End Semester M.Tech Examination

1st Semester

ADVANCED FLUID MECHANICS

Full Marks- 70 Pass Marks- 21 Time- 3 hours

The figures in the margin indicate full marks.

PART – A

Q.1. Answer all questions: **1 x 16 = 16**

a) State the limitations of the Bernoulli's theorem.
b) State differences between Steady and Unsteady flow.
c) Define Rotational flow.
d) What is stream and potential functions?
e) Write Two Dimensional N-S equation for laminar sub boundary layer.
f) Write expression for the loss of head of a viscous flow through a circular pipe.
g) What is Reynolds number?
h) What is fully developed pipe flow?
i) What is meant by boundary layer?
j) Define displacement thickness.
k) Write von Karman momentum integral equation.
l) Explain the phenomenon of boundary layer separation.
m) Differentiate between Static and Stagnation pressure.
n) What is Mach number?
o) Calculate velocity of sound in air at 40℃.
p) Define the terms: subsonic flow and supersonic flow.

PART – B

Q.*2.* Answer all questions: **3.5 x 4 = 14**

a) Explain a uniform flow with source. Obtain expression for stream and velocity potential functions.

b) Laminar flow takes place in a circular tube. At what distance from the boundary the local velocity equal to the average velocity?
c) Find displacement thickness and momentum thickness for Atmospheric Boundary Layer (ABL).
d) Find a relation between Static Temperature and Critical Temperature for compressible flow.

PART – C

Answer all questions: **10 x 4 = 40**

Q.3. Two sources of strength m/2 are placed at (±a, 0). Show that at any point on the circle $x^2 + y^2 = a^2$, the velocity is parallel to the y-axis and is inversely proportional to y.

OR

A point $p(1,2)$ is situated in the flow field of a doublet of strength 10 m^2/s. Calculate the velocity at this point and the value of the stream function.

Q.4. Derive the relationship between the average velocity and maximum velocity in case of flow between two fixed parallel plates.

OR

An oil of viscosity 10 poise and specific gravity 0.6 flows a horizontal pipe of 30 mm diameter. If the pressure drop in 50 m length of the pipe is 3000 kN/m^2, Determine i) the rate of flow of oil in cumsec ii) the center line velocity iii) the total frictional drag over 50 m length of pipe iv) the power required to maintain the flow.

Q.5. What do you understand by the term boundary layer? Explain the terms laminar sub-layer, turbulent boundary layer and point of separation. Describe with reference to flow over a flat plate.

OR

Find the displacement thickness, momentum thickness and energy thickness for flow over a flat plate. When instantaneous velocity is $u = A + By^2 + Cy^3$, where A, B and C are constants.

Q.6. Show that if p_1 and p_2 are the pressure at upstream and downstream of a normal shock wave

$$\frac{p_2}{p_1} = \frac{2\gamma}{\gamma + 1} {M_1}^2 - \frac{\gamma - 1}{\gamma + 1}$$

OR

The ratio of the exit to entry area in subsonic diffuser is 3.0. The Mach number of a jet of air approaching the diffuser at $p_0 = 1.013\ bar$, $T = 290\ K$ is 2.5. There is a standing normal shock wav just outside the diffuser entry. The flow in diffuser is isentropic. Determine at the exit of the diffuser. i) Mach number, ii) Temperature and iii) Pressure.