Code No: 5221AC **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Semester Examinations, February - 2017
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) Distinguish between convective acceleration and local acceleration with examples. [5]
b) What is a coutte flow? Explain. [5]
c) What is meant by boundary layer? Why does it increase with distance from the upstream edge? [5]
d) Describe the factor which effect the transition of flow from laminar to turbulent. [5]
e) Prove that the temperature at the stagnation point is greater than the temperature in the free stream. [5]

PART - B
5 × 10 Marks = 50

2.a) Define stream function and clearly bring out its physical significance. Enumerate some of the silent features of the stream function.
b) Distinguish between vorticity and circulation in detail. [5+5]

OR

3.a) Develop the continuity equation in Cartesian coordinates for a three dimensional flow.
b) State Bernoulli's theorem. Mention the assumptions made. How is it modified while applying in practice? List out its engineering applications. [5+5]

4.a) Derive the Hagen-Poisoulle formula for the discharge through a pipe.
b) The average velocity of water flowing through a pipe of 32 cm diameter is 1.12 m/s. Find the velocity of water at the radial distance of 10 cm from the axis of the pipe line. [5+5]

OR

5.a) Sketch and explain the distribution of velocity and shear stress across the flow in a pipe of circular section.
b) A horizontal pipe 50 mm diameter carrying glycerin has shear stress at the pipe boundary as 196.2 N/m^2. Determine the pressure gradient, mean velocity and Reynolds number. [5+5]

6.a) What are the methods preventing the separation of boundary layer flow. Explain.

b) Oil with free stream velocity of 2 m/s flows over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and the shear stress at the trailing end point and determine the total surface resistance of the plate. Take specific gravity as 0.96 and kinematic viscosity as 10^{-5} cm/sec. [5+5]

OR

7.a) How will you determine whether a boundary layer flow is attached flow, detached flow or on the verge of separation? Explain.

b) The 3m by 1.2 m rectangular plate is held in water moving at 1.2 m/s parallel to its length. Assuming laminar conditions in the boundary layer at the leading edge of the plate, find i) location where the boundary layer of law changes from laminar to turbulent, and ii) estimate the thickness of the boundary layer at this point and iii) compute the friction drag of the plate. [5+5]

8.a) What do you understand by term boundary layer control? Explain in detail.

b) Why do pipes behave as a hydrodynamically smooth or rough when turbulent flow, takes place through them? [5+5]

OR

9.a) In what way does the flow through a rough pipe differ from that in a smooth pipe?

b) If in turbulent flow through smooth pipe, the velocity distribution is given by one-seventh power law. Find the value of y/r_0 in a pipe, where the point velocity equals the average velocity. [5+5]

10.a) Obtain an expression in differential form for continuity equation for one dimensional flow.

b) What is the slope of the Rayleigh's line? With the help of T-s diagram explain the different flow parameters on Rayleigh's line. [5+5]

OR

11.a) How does the velocity and pressure vary with area for (i) subsonic flow ii) supersonic flow? Explain in detail.

b) Write short note on:

i) Isothermal flow in long ducts and

ii) Supersonic wave drag. [5+5]

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