

B. MECHANICAL ENGG. (EVENING) 1ST YR. 2ND SEM. EXAM 2018 (OLD)

FLUID MECHANICS II

Time: 3 hrs Full Marks: 100

Answer Q no. 1 and any four from rest

1. Show that for isentropic flow of an ideal gas through a converging nozzle the sonic flow conditions can exist only at the throat and this occurs when discharge is maximum. 20

2. a) Obtain an expression for the velocity of sound in a gaseous medium.

Mention the relevant assumptions. 6

- b) Explain why a subsonic nozzle has a converging cross section. 4

- c) Air flowing isentropically through a converging nozzle discharges to the atmosphere. At any section where the absolute pressure is 170 kPa, the temperature is 39° C and the air velocity is 177 m/s. Determine the nozzle throat pressure. 10

3. a) Show that for a 2-D incompressible irrotational flow the iso-stream function lines normally intersect the iso-potential lines. 6

- b) For the stream function $\psi = 3x^2y - y^3$, calculate the velocity at a point (2, 3). 4

- c) The value of velocity potential is given by $\phi = x + y + 3$. Determine the corresponding value of stream function ψ . 6

- d) Verify whether the following is a valid potential function:

$$\phi = 5 \cos x \quad 4$$

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4. a) State Buckingham's Pi theorem and explain its significance in the study of fluid mechanics. 5
- b) The resistance force F of a ship is a function of its length L , velocity V , acceleration due to gravity g and fluid properties like density ρ and viscosity μ . Write the relationship in a dimensionless form. 15
5. a) Distinguish between static and stagnation conditions. 4
- b) Obtain the relation between critical and stagnation pressure, temperature and density ratios. 12
- c) What are the significances of non dimensional numbers in the study of fluid mechanics? Explain with suitable examples? 4
6. a) Discuss the salient features of the boundary layer theory. 6
- b) How is a Rankine body obtained? Obtain expressions for velocity components in the flow field for a Rankine body and hence obtain the equation of the body streamline. 14