CBCS SCHEME

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17AE552

Fifth Semester B.E. Degree Examination, July/August 2021
Gas Dynamics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Derive an expression for equation of continuity for 3D unsteady compressible flow. **(10 Marks)**

b. Derive the energy equation.

$$\frac{a^2}{\gamma-1}+\frac{1}{2}C^2=\frac{1}{2}C_{max}^2=\frac{a_0^2}{\gamma-1}=h_o$$

Stating the assumptions used. **(10 Marks)**

2 a. State and explain thrust function. **(10 Marks)**

b. Briefly explain the energy equation for a run-flow process and flow process. **(10 Marks)**

3 a. Define Mach number and Mach angle. **(10 Marks)**

b. Air flowing in a duct has a velocity of 300m/s pressure 1.0 bar and temperature 290K. taking $\gamma = 1.4$ and $R = 287 J/kg\ K$. Determine:

i) Stagnation pressure and temperature.
ii) Velocity of sound in dynamic and stagnation conditions.
iii) Stagnation pressure assuming constant density. **(10 Marks)**

4 a. Write a short note on Acoustic velocity and different regime of speed. **(10 Marks)**

b. Explain Fanno curve and Rayleigh curve with suitable graph and the assumptions made during the analysis of Fanno and Rayleigh process. **(10 Marks)**

5 a. Show that the Mach number of the flow in a gas which has been transversed by an isentropic finite amplitude pressure wave (pressure ratio P_r) is given by $M=\frac{2}{\gamma-1}\left(1-Pr^{\frac{\gamma-1}{2\gamma}}\right)$. **(10 Marks)**

b. Describe with the aid to sketches the development of a finite amplitude rarefaction wave show the directions of flow and the wave propagation. **(10 Marks)**

6 a. Derive the Rankine-Hugoniol relation for a norwal shock wave. **(10 Marks)**

$$\frac{P_y}{P_x}=\frac{\frac{r+1}{r-1}\frac{\rho_y}{\rho_x}-1}{\frac{r+1}{r-1}+\frac{\rho_y}{\rho_x}}$$

b. Explain briefly Non-Steep and steep pressure waves. **(10 Marks)**

7 a. Derive an expression for area ratio as function of Mach number. **(08 Marks)**

b. Describe the behavior of flow in a convergent divergent nozzle for

i) Variation of throat pressure ratio

ii) Variation of exit pressure ratio

iii) Variation of mass flow parameter. **(12 Marks)**

8 a. Show that for the critical state in isentropic flow

$$\frac{T^*}{T} = \frac{2}{\gamma+1} + \frac{\gamma-1}{\gamma+1}M^2$$

$$\frac{P^*}{P} = \left(\frac{2}{\gamma+1} + \frac{\gamma-1}{\gamma+1}M^2\right)^{\frac{\gamma}{\gamma-1}}$$

$$\frac{\rho^*}{\rho} = \left(\frac{2}{\gamma+1} + \frac{\gamma-1}{\gamma+1}M^2\right)^{\frac{1}{\delta-1}}$$

(15 Marks)

b. Write a short note on the effect of back pressure on nozzle flow. **(05 Marks)**

9 a. Explain the need of dimensional analysis and its significance as applied to fluid flow problems. **(10 Marks)**

b. Define similitude and its types to complete similarity of fluid phenomenon. **(10 Marks)**

10 Write a short note on:

a. Flame propagation

b. Theories of flame propagation

c. Diffusion flames

d. Premixed flames. **(20 Marks)**

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