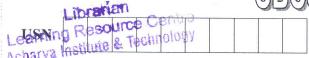
CBCS SCHEME



17AE552

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022 Gas Dynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Gas tables is permitted.

Module-1

1 a. Derive Momentum equation in Integral form.

(10 Marks)

b. Derive Euler's equation and obtain Bernoulli's equation.

(10 Marks)

OR

2 a. Derive Thrust equation for an Uninstalled Engine.

(12 Marks)

b. Consider a turbojet powered Airplane flying at a velocity of 300m/s at an altitude of 10km. Free stream pressure and density are 2.65 × 10⁴ N/m² and 0.414 kg/m³ respectively. Inlet and exit areas of turbojet engine are 2m² and 1m² respectively. The fuel – to – air mass ratio is 0.05. Calculate thrust of the engine.

Module-2

a. With neat sketch, explain about Mach Coke, Mach Wave and Mach Angle. (06 Marks)

b. Obtain the expression for Stagnation pressure, Temperature and Density of Compressible flow.

(08 Marks)

c. Write the expression for maximum heat transfer and draw the graph between Stagnation temperature ratio and Mach number. (06 Marks)

OR

4 a. Explain about Fanno curve and obtain the governing equation for Fanno flow. (10 Marks)

Air at $P_o = 10$ bar, $T_o = 400$ K is supplied to a 50mm diameter pipe. The friction factor is 0.002. If Mach number changes from 3.0 at entry to 1.0 at exit. Determine

i) Length of the pipe

ii) Mass flow rate.

(10 Marks)

Module-3

5 a. Draw the Hugonoit curve and explain about that. Also obtain Hygonoit equation. (10 Marks)

b. The properties at the upstream of normal shock in air is given as $M_1 = 2.5$, $P_1 = 1$ atm, $\rho_1 = 1.225 \text{ kg/m}^3$. Determine the downstream P_2 , T_2 , M_2 , V_2 , P_{02} and T_{02} . (10 Marks)

OR

6 a. Write the governing equation for Oblique shock wave and obtain $\theta - \beta - M$ relation.

(10 Marks)

b. Explain the difference in Pitot – tube for Incompressible and Compressible flow with neat sketch. (06 Marks)

c. Define i) Detonation

ii) Deflagration.

(04 Marks)

Module-4

7 a. Obtain Area – Velocity relation for a Convergent Divergent duct and explain the criteria for Acceleration and Deceleration. (10 Marks)

b. Explain with a neat sketch about Variation of Pressure along De – laval nozzle for various back pressures. (10 Marks)

OR

8 a. A Convergent – Divergent nozzle has to be designed for an exit Mach number at 1.5 with an exit diameter of 200mm. The reservoir conditions are given as $P_0 = 1$ atm, $T_0 = 20^{\circ}$ C. Find the required ratio of throat area to the exit area. Also find the maximum mass flow rate through the nozzle, exit temperature and pressure. (10 Marks)

b. With neat sketch, explain about C - D nozzle with the condition of

i) Normal shock at exit ii) Over expanded condition iii) Under expanded condition (10 Marks)

Module-5

9 a. Consider an aircraft flying at an angle of attack is having aerodynamic force R. The aerodynamic force R depends on the free stream Velocity V_{∞} , Density ρ_{∞} , Viscosity of fluid μ , chord length of airfoil C and the speed of sound a. Obtain the expression for aerodynamic force using dimensional analysis. (12 Marks)

Explain about Similarity Parameters and types of Similarities. Write the condition for Dynamical Similarity. (08 Marks)

OR

10 a. Explain about different types of Flames with neat sketch. (10 Marks)

b. Explain about Experimental methods for measuring Flame Velocity. (10 Marks)