CBCS SCHEME

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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 2.65×10^4 N/m^2 and 0.414 kg/m^3 respectively. Inlet and exit areas of turbojet engine are 2m^2 and 1m^2 respectively. The fuel – to – air mass ratio is 0.05. Calculate thrust of the engine. **(08 Marks)**

Module-2

3 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)**

b. Air at P_o = 10bar , T_o = 400K 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 , $\rho_1 = 1.225$ kg/m^3. Determine the downstream P_2 , T_2 , M_2 , V_2 , Po_2 and To_2. **(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_o = 1 atm , T_o = 20°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)**

b. 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)**

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