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CBCS SCHEME

USN | | | | | | | | | |

15AE552

Fifth Semester B.E. Degree Examination, June/July 2019
Gas Dynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module
2. Use of 'Gas Tables' for compressible flows by S.M.Yahya is permitted.

Module-1

1 a. Derive Momentum equation in Integral form. **(08 Marks)**

b. Using Euler's equation, derive the relation of Bernoulli's equation for both incompressible and compressible flow. **(08 Marks)**

OR

2 a. Derive the equation for uninstalled engine thrust of jet propulsion device. **(12 Marks)**

b. Derive steady flow energy equation. **(04 Marks)**

Module-2

3 a. With neat sketch explain the formation of Mach cone and write the relation for Mach angle. **(08 Marks)**

b. A combustion chamber in a gas turbine plant receives air at 350K, 0.55 bar and 75m/s. Stagnation enthalphy rise due to combustion of 1 kg of fuel is 1395.67 kJ/kg of air-fuel. Take $\nu = 1.4$, R = 287 J/kg-K. Determine:

i) Initial and final Mach number
ii) Final pressure, temperature and velocity
iii) % of stagnation pressure loss in combustion chamber
iv) Maximum stagnation temperature. **(08 Marks)**

OR

4 a. Draw and explain about Fanno flow and its curve and Rayleigh flow and its curve. **(08 Marks)**

b. A ling pipe having 25.4mm diameter has a mean coefficient of friction 0.003. Air enters the pipe at a Mach number of 2.5, stagnation temperature 310K and static pressure 0.507 bars. Determine for a section at which the Mach number reaches 1.2,

i) Static pressure and temperature
ii) Stagnation pressure and temperature
iii) Velocity of air
iv) Mass flow rate of air. **(08 Marks)**

Module-3

5 a. Derive Prandtl relation for normal shock. **(08 Marks)**

b. The flow properties upstream of a normal shock are 500m/s, 100kPa and 300K. Determine the velocity, pressure and temperature of the gas downstream of the shock and increase in entropy. Take $\nu = 1.4$ and R = 287 J/kg-K. **(08 Marks)**

OR

6 a. Explain about pitot-tube measurement difference in incompressible and compressible flow. Write the equations for pressure. **(08 Marks)**

b. Explain about shock polar and sketch hodograph plane. **(08 Marks)**

Module-4

7 a. Derive Area-velocity relation and explain the criteria for acceleration and deceleration in subsonic and supersonic flow. **(08 Marks)**

b. A nozzle in a wind tunnel gives a test section Mach number of 2.0. Air enters the nozzle from a large reservoir at 0.69 bar and 310K. The cross-sectional area of throat is $1000cm^2$. Determine the following for one-dimensional isentropic flow.

i) Pressure, temperature and velocities at throat and test section
ii) Area of cross section of test section
iii) Mass flow rate
iv) Power required to drive the compressors. **(08 Marks)**

OR

8 a. Explain the criteria to obtain shock-free supersonic flow in nozzle. Also draw and explain for various pressure ratio and velocity in C-D nozzle. **(08 Marks)**

b. A De-Laval nozzle has to be designed for an exit Mach number of 1.5 with an exit diameter of 200mm. Find the required ratio of throat area to exit area. The reservoir conditions are given as P_0 = 1atm. T_0 = 20°C. Find also maximum mass flow rate, exit pressure and temperature. **(08 Marks)**

Module-5

9 a. A supersonic fighter jet is flying at a Mach number of 3.0 at 10km altitude. The thrust produced by a turbofan engine in fighter jet is depends on angular velocity (W), Velocity (V), diameter (D), dynamic viscosity(μ), Density (ρ) and speed of sound (a). Find the suitable parameters to represent thrust (T) by dimensional analysis. **(08 Marks)**

b. Explain about:

i) Reynold's number and Reynold's model law
ii) Mach number and Mach model law

Also write the application. **(08 Marks)**

OR

10 a. Define flame propagation and explain about diffusion and pre-mixed flames. **(08 Marks)**

b. Explain about methods of flame stabilization technique. **(08 Marks)**

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