Module 1 : Basic Concepts

ASSIGNMENTS

1. Define all the statements of second law of thermodynamics.

2. If a system changes its state from 1 to 2 during an isentropic process then derive the relation between temperature and pressure ratios.

3. Comment about the statement "Adiabatic and reversible process is the only isentropic process".

4. Compare isothermal and isentropic compressibilities of a gas and explain why isothermal compressiilty is more than isentroipc one.

5. Derive the expression for substantial or total derivative.

Module 2 : One Dimesional Compressible Flow

ASSIGNMENTS

1. If static temperature and pressure for a Mach 3 flow are 150 K and 1 bar respectively, then calculate total pressure, total density and total temperature of the air flow.

2. If total pressure is 10 bar and static pressure is 1 bar calculate the Mach number of the air.

3. A Mach 4 helium flow has static pressure 1 bar and temperature 200 K. If this flow experiences a normal shock then evaluate all the static and total properties behind the shock. Also calculate the entropy rise in this process.

4. Calculate amount of heat required to get the sonic state for a Mach 3.5 of air flow having 1 bar static pressure and 300 K static temperate.

5. If the above flow (example 4) is to be brough to Mach 2.5 then evaluate the amount of heat addition required.

6. A pipe has diameter 0.1 m and length 25 m. The inlet flow condition for this pipe is 0.4 Mach with 1 bar and 273 K pressure and temperature respectively. If friction coefficient is 0.005 the evaluate the exit properties.

7. Calculate the length of the pipe for same inlet conditions mentioned above (example 6) and the diameter if sonic state is expected at the exit.

Module 3 : Two-Dimensional Flows

ASSIGNMENTS

1. If supersonic Mach 3 flow of air having static temperature and pressure 150 K and 1 bar respectively, flows over a wedge of 15 degree then calculate the pressure on the wedge and also static and total properties of the flow behind the shock. Also evaluate the shock angle.

2. Calculate the angle of the wedge if a Mach 3 flow gets compressed to Mach 2 for air flow.

3. A Mach 3.5 air flow experiences expansion at a 5 dergree corner where initial conditions are 1 bar and 300 K in terms of pressure and temperature respectively, then calculate the pressure and temperature of the flow after expansion.

4. Derive the experssion for entropy rise acorss the normal shock.

5. Compare the compression process using a shock and by an isentropic compression.

Module 4 : Quasi-One Dimesional Flows

ASSIGNMENTS

1. Derive the expression for choked mass flow rate of a nozzle.

2. A nozzle is connected with a reservoir of pressure 20 bar pressure and 1000 K temperature. If area ratio for the nozzle is 5 the calculate the exit properties for air flow.

3. If a nozzle is to be designed for exit Mach number 3.7 then calculate the area ratio for the same. If exit conditions expected are 0.1 bar pressure and 150 K temperature then evaluate the porperties of reservoir.

4. If a convergent divergent nozzle has area ratio 4 and if a normal shock appears at location where area ratio is 3 the caluclate the pressure ratio between exit to the reservoir.

Module 5 : Linearised Flows

ASSIGNMENTS

1. Explain the necessity of linearisation and concerned assumptions for the compressible flow linearisation.

2. Derive expression for pressure coefficient for linearised flow.

3. A supersonic flow of Mach 4 passes over a cone of semi-apex angle 12 degree. Calculate the shock angle and pressure on the cone if the freestream total pressure is 2 bar.

4. Wrie a program to solve the Taylor Maccol equation.

5. Evaluate the shape of a nozzle using method of characteristics for exit flow of Mach 5.

Module 6 : Unsteady Wave Motion

ASSIGNMENTS

1. If the moving shock Mach number is 1.5 then calculate the driven to driven pressure ratio and also the pressure across this primary shock wave for air as driver and driven gas.

2. Use any monoatomic, diatomic and triatomic gases as driver gases for air as driven gas and comment your observation.

3. A shock tube operates with helium driver of pressure 25 bar and 300 K temperature and air as driven gas with 0.1 bar pressure and 300 K temperature. Calculate the properties behind reflected shock.

4. A shock tube operates with helium driver of pressure 25 bar and 300 K temperature and air as driven gas with 0.1 bar pressure and 300 K temperature. Evaluate primary shock numbers if driver gas temperature is raised in the steps of 100 K till 700K.

Module 7 : Introdution to Experimental Facilities

ASSIGNMENTS

1. Explain different calibration techniques of a supersonic wind tunnel.

2. Explian the working princple of thermocpuple.

3. What are the advantages of pressure sensetive paints in their application for pressure measurements?

4. What is a typical arrangement of Planar Laser Induced Fluroscence method and state its advantages.