

M.E. MECHANICAL ENGINEERING EXAM 2017

FIRST YEAR SECOND SEMESTER

GAS DYNAMICS

Time: Three hours

(Answer any FIVE questions)

Marks: 100

*Different parts of the same question should be answered together.
All symbols carry their usual meanings unless otherwise mentioned.
Assume any relevant data if necessary.*

1. a) What do you mean by Mach wave and Mach angle? Explain with suitable diagram. 8
 b) In an isentropic flow of air through duct whose area is decreasing. Determine the percentage changes in velocity, density and pressure induced by a 2 percentage reduction in area for Mach number 0.2 and 0.8. 12
2. a) A pitot tube is placed in a subsonic air flow. The static pressure and temperature in the flow are 100 kPa and 285 K respectively. Determine the air velocity and the Mach number if the differential mercury manometer shows a reading of 200mm. 10
 b) In one dimensional isentropic flow, air flows through a nozzle of inlet area 10 cm^2 . At the inlet velocity, temperature, pressure are 100 m/s, 30°C and 700kPa. Determine the mass flow rate through the nozzle if exit pressure is 300kPa. Also determine the exit velocity of the nozzle. 10
3. a) What is normal shock wave? Explain with example. 8
 b) Derive normal shock wave relations in terms of Mach number. 12
4. a) What is oblique shock wave? Discuss with example. 7
 b) Explain the limiting cases of an oblique shock wave. 6
 c) What do you mean by reflection of oblique shock wave? 7
5. a) What do you mean by expansion waves? Explain it. 10
 b) Discuss about reflection and interaction of expansion waves with suitable diagram. 10

6. a) Explain the flow through a convergent divergent nozzle with under expanded condition. 10
- b) Gas flows from a large reservoir through a convergent-divergent nozzle, the pressure and temperature in the reservoir being respectively 500kPa and 45°C respectively. The throat area of the nozzle is 10^{-4} m^2 and exit pressure is 120kPa. Determine the mass flow rate through the isentropic nozzle and the exit area of the nozzle. 10
7. a) Discuss the effect of friction on flow variables in an adiabatic flow in a constant area duct. 10
- b) Discuss the effect of heat addition and rejection on flow variables in a constant area duct neglecting viscosity. 10
8. Write short notes on: 4 X 5 20
- a) Flow over a bodies involving shock and expansion waves
- b) Fanno Line
- c) Hot wire anemometer
- d) Pitot Tube