CBCS SCHEME

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18AE/AS52

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Aerodynamics – II

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. Write the principle of energy equation and derive the relation for energy equation in differential form. **(10 Marks)**

b. A supersonic wind tunnel nozzle is to be designed for M = 2.5 with a test-section $1m^2$ in area. The supply pressure and temperature at the nozzle inlet are $7 \times 10^5 N/m^2$ and 27°C respectively where the velocity is negligible. Assume that the flow is isentropic with $\gamma = 1.4$. Also consider flow is one-dimensional at throat and test-section. Calculate :

i) Throat area
ii) Temperature at throat
iii) Velocity of flow at test section
iv) Mass flow rate through the test section. **(10 Marks)**

OR

2 a. How will you obtain supersonic flow in a De-Laval nozzle? Explain the performance for various back pressure using necessary curves. **(10 Marks)**

b. Derive an expression for steady flow energy equation. **(05 Marks)**

c. Derive area-mach number relation for De-Laval nozzle. **(05 Marks)**

Module-2

3 a. Write the equations of motion for normal shock wave and obtain Prandtl-relation for normal shock wave. **(10 Marks)**

b. The Upstream properties of normal shock in air is given as $M_1 = 2.5$, $P_1 = 1$atm, $P_1 = 1.225$ kg/m^3. Determine the values of downsteam pressure, temperature, mach number, velocity and stagnation temperature. Verify the values with relation and gas tables. **(10 Marks)**

OR

4 a. Obtain the relation for moving shock speed interms of speed of sound for moving normal shock. **(10 Marks)**

b. Explain about Hugonoit curve and obtain relation for Hugonoit equation. **(10 Marks)**

Module-3

5 a. Draw an oblique shock and obtain its relation for θ-β-M relation and explain its importance. **(10 Marks)**

b. With neat sketch explain about reflection and inter section of shocks and expansion waves for same and opposite family. **(10 Marks)**

OR

6 a. With neat sketch of expansion wave, derive the relation for Prandtl-Meyer function as a function of mach number. **(10 Marks)**

b. Draw Rayleigh curve and write the governing equation for Rayleigh flow, summarize the flow property changes in subsonic and supersonic region. When heat is added. **(10 Marks)**

Module-4

7 a. Derive small-perturbation theory applicable for compressible flow. (10 Marks)
b. Briefly write about solution of non-linear potential equation. (05 Marks)
c. Derive relation for pressure co-efficient for linearized compressible flow. (05 Marks)

OR

8 a. Derive Prandtl-Glauert rule for supersonic flow. (10 Marks)
b. Derive relation for von-Karman rule for transonic flow and write the uses of karman rule. (10 Marks)

Module-5

9 a. Write about types of wind tunnel and explain with neat sketch. (10 Marks)
b. Write and explain about various pressure measurement devices used in wind tunnels. (10 Marks)

OR

10 a. Draw neatly and explain about working of :
i) Schlieren system
ii) Shadowgraph technique. (10 Marks)
b. Draw and explain about shock-tubes. (05 Marks)
c. The test-section area of a Mach 2.5 tunnel is half of the nozzle inlet area. If the test section pressure is 100KPa, determine the pressure and Mach number at the nozzle inlet. (05 Marks)

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