CBCS SCHEME

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15AE61

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Aerodynamics – II

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 is permitted.

Module-1

1 a. 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 the throat is $1000cm^2$. Determine the following quantities for the tunnel for one – dimensional isentropic flow.
i) Pressures, temperatures and vebcities at the throat and test section
ii) Area of cross-section of the test section
iii) Mass flow rate
iv) Power required to drive the compressor. **(08 Marks)**

b. A reservoir whose temperature can be varied in a wide range of temperature receives air at a constant pressure of 1.5 bar. The air is expanded isentropically in a nozzle to an exit pressure of 1.015 bar. Determine (without using gas tables) the values of the temperature to be maintained in the reservoir to produce the following velocities at the nozzle exit :
i) 100m/s ii) 250 m/s. **(08 Marks)**

OR

2 a. A supersonic wind tunnel settling chamber expands air or Freon – 21 through a nozzle from a pressure of 10 bar to 4 bar in the test section. calculate the stagnation temperature to be maintained in the settling chamber to obtain a velocity of 500m/s in the test section for
i) Air, C_P = 1.025 kJ/kg-k, C_V = 0.735kJ/kg-k
ii) Freon – 21, C_P = 0.785 kJ/kg-k, C_V = 0.675 kJ/kg-k
What is the test section mach number in each case? **(08 Marks)**

b. A conical diffuser has entry and exit diameters of 15cm and 30cm respectively. The pressure, temperature and velocity of air at entry are 0.69 bar, 340 k and 180 m/s respectively.
Determine :
i) The exit pressure
ii) The exit velocity
iii) The force exerted on the diffuser walls.
Assume isortropic flow, C = 14, C_P = 1.00 kJ/kg-k. **(08 Marks)**

Module-2

3 a. Deduce $\Delta T_0^{!} = \dfrac{C_x(C_x - C_y)}{C_p}$ using moving normal shock waves. **(08 Marks)**

b. Consider the flow properties at the point in the flow, where the temperature is 320k and the velocity is 1000m/s. Calculate the Mach number at this point. **(04 Marks)**

c. Calculate the ratio of kinetic energy to internal energy at a point in an airflow where the Mach number is
i) M = 2 ii) M = 20. **(04 Marks**

OR

4 Obtain the normal shock-wave properties ratios in terms of upstream Mach number. **(16 Marks)**

Module-3

5 a. Deduce $\tan\theta = 2\cot\beta \dfrac{M_1^2 \sin^2 \beta^{-1}}{M_1^2(\gamma + \cos 2\beta) + 2}$ using oblique shock relations. **(08 Marks)**

b. With a neat sketch, explain shock interactions and reflections in oblique shock waves. **(08 Marks)**

OR

6 Derive the following :

a. Rankine – Hugoniot equation

b. Prandtl – Meyer expansion waves. **(16 Marks)**

Module-4

7 a. Obtain the Linerarized velocity potential equation for two dimensional, irrotational and isentropic flows. **(08 Marks)**

b. Define compressibility corrections? Obtain the expression for Prandtl – Glavert rule. **(08 Marks)**

OR

8 a. Write a short note on the following :

i) Diamond – shaped airfoil

ii) General curved airfoil. **(08 Marks)**

b. Derive the linerazied supersonic pressure coefficient. **(08 Marks)**

Module-5

9 a. With a neat sketch explain the following :

i) The schlieren method

ii) Interferometer method. **(08 Marks)**

b. What are the classifications of wind tunnel balance? **(02 Marks)**

c. Bring out the essential features of a strain gauge based six component internal wind balance and explain how the six components are measured using the balance. **(06 Marks)**

OR

10 With a neat sketch explain the following :

a. Supersonic wind tunnel

i) Continuous wind tunnel

ii) Blow down tunnel

b. Hypersonic wind tunnel. **(16 Marks)**

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