Code No: 07A52102 **R07** **Set No. 2**

III B.Tech I Semester Examinations,May 2011
AERODYNAMICS-II
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Describe the various forces and moments on an aircraft that can be measured in wind tunnel.
   (b) What is a wind tunnel? Describe a subsonic wind tunnel. [8+8]
2. (a) Explain in detail about any six nondimensional parameters and give their significance.
   (b) What are π - parameters (Pi parameters)? Explain its significance in dimensional analysis? [8+8]
3. (a) Explain about intersection of shock waves with neat sketches.
   (b) Write a short notes on
      i. Attached shock
      ii. Incident shock. [8+8]
4. (a) Derive velocity potential equation for a two-dimensional, steady, irrotational, isentropic flow.
   (b) Explain what do you understand by linearization. [8+8]
5. Consider a subsonic flow with an upstream Mach number of M_∞. This flow moves over a wavy wall with a contour given by $y_w = h\cos(2\pi x/L)$, where y_w is the ordinate of the wall, h is the amplitude and L is the wavelength. Assuming h is small and using small perturbation theory derive an equation for velocity potential and surface pressure coefficient. [16]
6. (a) Contrast the boundary conditions in supersonic and hypersonic flows at high altitudes.
   (b) A compression corner of angle 10^0 is at sea-level conditions. Calculate x & y components of velocity of air after the shock, if flow Mach number is 25. Assume the Mach number is very large. [8+8]
7. Explain Choked flow condition with appropriate sketches. Write about your understanding of shock wave and its different types with a suitable sketch. [16]
8. Derive energy equation for a 3 dimensional inviscid, compressible flow. [16]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A52102 **R07** **Set No. 4**

III B.Tech I Semester Examinations,May 2011
AERODYNAMICS-II
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. An oblique shock wave at angle of 35^0 occurs at the leading edge of a symmetrical wedge. Air has mach number of 2.0 , pressure and temperature of 10 bar and 310 K respectively upstream of this wave. Determine the wedge angle, pressure ,temperature and Mach number downstream of the wave. [16]

2. (a) Explain significance of pressure coefficient (C_p) in compressible flows using suitable correlations.
   (b) Obtain an approximate expression for pressure coefficient (Cp) consistent with linear theory and valid for small perturbations for a compressible flow. [6+10]

3. (a) Describe the differences between subsonic and supersonic wind tunnels.
   (b) Explain the continuity equation for a compressible flow. Explain how supersonic flow is generated in a wind tunnel. [8+8]

4. Explain flow in the divergent part of the super sonic C.D Nozzle for various inlet parameters and back pressures. [16]

5. Derive Momentum equation in integral form for a three dimensional flow. [16]

6. (a) What is Similarity role and enumerate its significance with the help of an example? How do you define similarity of flows?
   (b) Explain in detail about various methods for measuring pressures on a model in a wind tunnel. [8+8]

7. (a) Explain your understanding by air-divergence Mach number and Area rule.
   (b) Explain about supercritical airfoil with relevant plots. [8+8]

8. (a) What is the change in entropy for flow past an expansion corner? Explain your answer.
   (b) In a hypersonic wind tunnel, the flow Mach number is 15 and operating pressure is 2 atm. If the flow encounters an expansion corner of 6^0, calculate the Mach number and pressure after the expansion. Assume that Mach number is very large. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A52102 **R07** **Set No. 1**

III B.Tech I Semester Examinations,May 2011
AERODYNAMICS-II
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Discuss briefly with neat sketches about the following
   (a) Thin Shock Layer
   (b) Entropy layer
   (c) Low density flows
   (d) High Temperature flows and
   (e) Viscous interaction [16]
2. Derive $\theta-\beta$ -M relation. [16]
3. (a) Explain, with examples, the differences between internal and external balances.
   (b) Write short notes on
      i. Wall interference
      ii. Correction to drag coefficient for the error arising from upflow
      iii. Two dimensional wing [7+9]
4. Explain about Prandtl-Glauert compressibility corrections. [16]
5. (a) Explain about under and over expansion in Convergent-Divergent nozzle.
   (b) Air flows with T_1 =250K, P_1=3 bar, P_2=3.4 bar and the cross-sectional area A_1=0.4m, the flow is isentropic to a section where A_2=0.3 m. Determine the temperature at the section A_2. Also detrmine the deflection angle, Mach Number and the temperature of the gas at the throat section [8+8]
6. What do you mean by isentropic process. Derive general isentropic relations for static temeperature rise, static pressure rise and Mach number rise across a gas flow.. [16]
7. (a) Discuss about the physical aspects of conical flows and with a schematic illustrate supersonic flow over a cone.
   (b) Enumerate steps involved in the numerical procedure to obtain numerical solution of supersonic flow over a right circular cone. [6+10]
8. (a) Write a short note on
      i. Measurement errors
      ii. Horizontal buoyancy

iii. Flow angularity

(b) Explain in detail about variation of velocity & pressure in a wind tunnel depending on the area of cross section. [9+7]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A52102 **R07** **Set No. 3**

III B.Tech I Semester Examinations,May 2011
AERODYNAMICS-II
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Explain briefly about what happens to flow parameters in the Convergent-Divergent nozzle of a supersonic wind tunnel before entering a diffuser. [16]

2. (a) Mention and explain briefly the properties of hypersonic flows with neat sketches.
   (b) Contrast supersonic & hypersonic flows. With neat sketches explain using the example of supersonic and hypersonic flow over a wedge. [8+8]

3. (a) Describe in detail about various pressure measuring devices.
   (b) What are various measurement errors encountered during the testing a model and how to capture and minimize these errors? [8+8]

4. Write a note on the following
   (a) Perturbation
   (b) Compressibility
   (c) Area rule
   (d) Supercritical airfoil. [4x4]

5. (a) Discuss the variation of linearized pressure coefficient (C_p) with Mach number (M_∞) with a suitable plot.
   (b) A uniform supersonic stream with M_1= 3.0, P_1= 1 atm and T_1= 288 K encounters a compression corner which deflects the stream by an angle θ= 20°. Calculate the shock wave angle and P_2, T_2, M_2, P_{02} and T_{02} behind the shock wave. [6+10]

6. (a) Obtain an expression which relates pressure, density, temperature for an isentropic process.
   (b) Consider a Boeing 747 flying at a standard altitude of 900m. The pressure at this point on the wing is $3N/mm^2$ assuming isentropic flow over the wing, calculate the temperature at this point . [8+8]

7. (a) Explain in detail, how the effects of struts are eliminated while measuring the drag on a model in a subsonic wind tunnel.
   (b) Explain the differences between platform, yoke and pyramid balances. [8+8]

8. What do you understand by regular reflection from a solid boundary. Enumerate the significance of incident shock and reflected shock with appropriate sketches. [16]

Code No: 07A52102 **R07** **Set No. 3**

⋆ ⋆ ⋆ ⋆ ⋆