Code No: 45046 **R07** **Set No - 1**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
AERODYNAMICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Contrast subsonic & supersonic flows. With neat sketches explain using the example of subsonic and supersonic flow over a wedge.
   (b) Derive the velocity potential equation for a 3D steady, irrotational isentropic flow. [6+10]
2. What do you understand by one dimensional flow? Derive momentum equation for quasi-one-dimensional flow. [16]
3. Explain about following briefly
   (a) Intersection of shocks of opposite families
   (b) Intersection of shocks of same families
4. Derive expression for Prandtl-Glauert compressibility correction. [16]
5. (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]
6. (a) What are different rarified gas regimes? Explain the changes in boundary conditions over hypersonic vehicles at very high altitudes.
   (b) A compression corner of angle 6^0 is at sea-level conditions. Calculate pressure, density, temperature, Mach number of air after the shock, if the flow Mach number is 10. [7+9]
7. A high speed subsonic Mc.Douglas DC 10 airliner is flying at 10 km, a pitot tube on the wing tip measures a pressure of 4.24×10^4 N/m^2. Calculate the mach number at which the airplane is flying and the static air temperature is 230K, Find the air speed. Also write what do you understand by True air speed. [16]
8. (a) Explain the major differences between the low subsonic and high subsonic wind tunnels.
   (b) Explain the working of a three component balance and a six component balance. [8+8]

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Code No: 45046 **R07** **Set No - 2**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
AERODYNAMICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Contrast subsonic & supersonic flows. With neat sketches explain using the example of subsonic and supersonic flow over a wedge.
   (b) Derive the velocity potential equation for a 2D steady, irrotational isentropic flow. [6+10]
2. For flow over an airfoil at subsonic speed derive velocity potential equation. [16]
3. (a) Define stagnation enthalpy and stagnation temperature do these quantities define the stagnation state. Derive expressions for speed of sound.
   (b) Argon is stored in a reservoir at 300K ; Determine stagnation enthalpy and velocity of sound in it γ=1.658 and the molecular weight of argon is 39.94. [8+8]
4. (a) Describe the method for measuring pressure distribution on a model.
   (b) Describe the turbulence sphere. Explain how turbulence of a tunnel is measured. [8+8]
5. (a) Derive expressions for alternative forms of one-dimensional energy equation.
   (b) Derive normal shock relation. [8+8]
6. (a) Explain the parameters to be simulated in a wind tunnel so that the data is useful for the design of an aircraft.
   (b) Define Mach number. Explain the major differences between subsonic and supersonic wind tunnels. [8+8]
7. What do you understand by regular reflection from a solid boundary. Enumerate the significance of incident shock and reflected shock with appropriate sketches.[16]
8. (a) Write a note on the Mach number independence principle in hypersonic flows.
   (b) Consider an infinitely thin flat plate at an angle of attack 12^0, 16^0, 25^0 in Mach 3 flow. Calculate the wave drag by Newtonian and Modified Newtonian theories. [8+8]

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Code No: 45046 **R07** **Set No - 3**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
AERODYNAMICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe two practical situations where oblique shocks waves are produced. How are strong and weak shocks are generated and how they effect the flow. [16]

2. Write about quasi-one-dimensional flow. Air flowing in a duct has a velocity of 300 m/s, pressure 1.0 bar and temperature 290 K taking γ=1.4, R=287 J/kgK. Determine
   (a) Stagnation pressure and temperature
   (b) Velocity of sound in the dynamic and stagnation conditions.
   (c) Stagnation pressure assuming constant density. [16]

3. Briefly write about following
   (a) Velocity of sound
   (b) Mach number
   (c) Flow regimes. [16]

4. (a) A wedge with half angle 10^0 is placed in a flow of Mach 10 at sea-level conditions. Calculate pressure, density, temperature, Mach number of air after the shock.
   (b) Explain in detail thin-shock layer and high-temperature flows in hypersonic flows. [8+8]

5. (a) Explain the working principle of six component strain gauge balance.
   (b) Write short notes on
      i. Wall interference
      ii. Solid blockage effect
      iii. Two dimensional wing [7+9]

6. (a) Derive velocity potential equation for a two-dimensional, steady, irrotational, isentropic flow.
   (b) Explain what do you understand by linearization. [8+8]

7. (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]

8. (a) Write a short note on
   i. Measurement errors
   ii. Horizontal buoyancy
   iii. Flow angularity

   (b) Describe the methods used for measuring flow angularity in a supersonic wind tunnel. [9+7]

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Code No: 45046 **R07** **Set No - 4**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
AERODYNAMICS-II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Write short notes on
   i. Wall interference
   ii. Correction to drag coefficient for the error arising from upflow
   iii. Correction to lift coefficient for the error arising from supports of the model.
   (b) Explain methods to eliminate the effect of supports on Lift and Drag of a model. [9+7]
2. Derive $\theta-\beta$ -M relation. [16]
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. (a) Discuss about linearized subsonic flow over an airfoil using perturbation velocity potential equations for a compressible flow.
   (b) Obtain the Prandtl-Glauert similarity rule for lift coefficient (C_l) and moment coefficient (C_m) relating incompressible flow to subsonic compressible flow over a 2D profile. [6+10]
5. (a) Write a note on choked flow condition in a Convergent-Divergent nozzle with relative plots.
   (b) A normal shock wave is standing in the test section of a supersonic wind tunnel, upstream of this wave M_1=3, P_1=0.5 atm, T_1=200 K. Find the flow variables after the shock wave. [6+10]
6. (a) Explain in detail the high-temperature effects and viscous interaction in hypersonic flows.
   (b) Explain in detail the viscous interaction and entropy layer in hypersonic flows. [8+8]
7. Derive energy equation for a 3 dimensional inviscid, compressible flow. [16]
8. (a) Explain your understanding by air-divergence Mach number and Area rule.
   (b) Explain about supercritical airfoil with relevant plots. [8+8]

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