Code No: 07A82105 **R07** **Set No. 2**

IV B.Tech II Semester Examinations,APRIL 2011
HYPERSONICS AERODYNAMICS
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Make a comparative study of 2-D and 3-D shock wave/boundary layer interaction? [16]
2. Explain the mach number independence principle with respect to hypersonic flows. [16]
3. Derive the governing equations for viscous flow? [16]
4. Calculate the local skin-friction coefficient for a flat plate at sea-level conditions at a station 1.4 m from the leading edge. The flow velocity is 70 m/sec. Assume laminar flow and sea-level conditions. [16]
5. What are different rarified gas dynamics flow regimes and how does Knudsen number influence these flow regimes? [16]
6. Explain in detail the Thin-Shock layer and High-Temperature flows in hypersonic flows. [16]
7. In a hypersonic wind tunnel, the flow Mach number is 15 and operating pressure is 2atm. If the flow encounters an expansion corner of 8^0, calculate the Mach number after the expansion, pressure. Assume that Mach number is very large. [16]
8. What are the important parameters governing the Re-entry vehicle Design? Explain any two Reentry vehicles? [16]

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Code No: 07A82105 **R07** **Set No. 4**

IV B.Tech II Semester Examinations,APRIL 2011
HYPERSONICS AERODYNAMICS
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Derive the hypersonic small disturbance equation? [16]
2. Explain the effect of flow through nozzle of hypersonic vehicle? [16]
3. How does Mean Free Path influence Knudsen Number (Kn) and prove that (M/Re)>3 for Hypersonic Free Molecular flow? [16]
4. Consider the variation of lift with angle of attack for an infinitely thin flat plate. Using Newtonian theory, prove that maximum lift occurs at 54.7 deg. [16]
5. Derive the expression for Cp in terms of similarity parameter for flow over an expansion corner. Assume the Mach number to be very large. [16]
6. Write a note on the governing equations and boundary conditions for viscous hypersonic flows. [16]
7. Compare the Experimental and Theoretical Computations for the Hypersonic Shock wave/ Boundary layer interaction over a flat plate at Mach 3?
   (a) Describe a three-dimensional hypersonic shock wave/ boundary layer interaction over a wedge on a flat plate?
   (b) Compare the computational and experimental results using the pressure and heat transfer distributions? [16]
8. A compression corner of angle 10^0 is at sea-level conditions. Calculate pressure, density, temperature, Mach number of air after the shock, if the flow Mach number is 10. [16]

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Code No: 07A82105 **R07** **Set No. 1**

IV B.Tech II Semester Examinations,APRIL 2011
HYPERSONICS AERODYNAMICS
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. With a neat sketch, explain the concept of boundary layer. [16]
2. Describe the hypersonic flow with respect to twin-shock layer and high-temperature flows. [16]
3. Explain the quantitative approach of hypersonic vehicle? [16]
4. Contrast the steady flow over a 2D Airfoil and unsteady flow of a 1D piston using the blast wave analogy. [16]
5. What are the effects of shock wave/boundary layer interaction on
   (a) Pressure distribution
   (b) Shear stress for particular Mach number and turbulent flow over a flat plate. [16]
6. Describe the relation between Knudsen number ,Mach number and Reynolds number.
   Prove that Kn=1.2533 $\sqrt{\gamma}$(M/Re). [16]
7. Describe in detail, the entropy layer effects on Aerodynamic heating of hypersonic vehicles? [16]
8. Explain in detail the Viscous Interaction and Entropy Layer in hypersonic flows. [16]

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Code No: 07A82105 **R07** **Set No. 3**

IV B.Tech II Semester Examinations,APRIL 2011
HYPERSONICS AERODYNAMICS
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the different concepts of Propulsion systems which can be used in hypersonic vehicle design? [16]
2. What is hypersonic equivalence principle? Explain it breifly. [16]
3. Contrast Supersonic & Hypersonic Flow. With neat sketches use the example of Supersonic and Hypersonic flow over a wedge. [16]
4. Explain the blasius equation for incompressible flow over a flat plate with respect to its self-similar nature. [16]
5. Explain in detail the role of CHI (χ) in Hypersonic Strong and Weak Viscous Interactions respectively?
   (a) Show that for Strong Viscous Interactions of hypersonic flow, $\chi > 3$.
   (b) Show that for Weak Viscous Interactions of hypersonic flow, $\chi < 3$. [16]
6. (a) What is rarified gas dynamics and explain it?
   (b) Explain the gas surface interaction in rarified flow regimes? [16]
7. Write a brief note on the Reference Temperature Method and Entropy layer effects on Aerodynamic Heating? [16]
8. In a hypersonic wind tunnel, the flow mach number is 12 and the operating pressure is 2atm. If the flow encounters an expansion corner of 8^0, calculate the mach number after the expansion. Also calculate the pressure after the expansion, assuming that mach number is very large. [16]

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