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Total No. of Printed Pages: 1

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**B. Tech. (Aerospace Engg.) (Semester – 7<sup>th</sup>)**

**HYPERSONIC AERODYNAMICS**

**Subject Code: BASES1702**

**Paper ID: [19113032]**

**Time: 03 Hours**

**Maximum Marks: 60**

**Instruction for candidates:**

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

**Section – A**

**(2 marks each)**

Q1. Attempt the following:

- a) Define hypersonic flow.
- b) What is a thin shock layer?
- c) Differentiate between low-density and high-density hypersonic flows.
- d) Explain hypersonic flight path.
- e) Define entropy layer.
- f) What are hypersonic flight similarity parameters?
- g) What is tangent cone method?
- h) What is an expansion wave?
- i) Define the term "inviscid flow."
- j) What is the significance of entropy in hypersonic flows?

**Section – B**

**(5 marks each)**

- Q2. Explain the modified Newtonian Law and its application in hypersonic aerodynamics.
- Q3. A hypersonic vehicle follows a tangent wedge profile with a wedge angle of  $20^\circ$ . Calculate the surface pressure using Newtonian theory (assume freestream pressure is 40 kPa).
- Q4. Describe the concept of shock expansion methods for surface flow property calculations.
- Q5. Explain how the tangent cone method is used to determine surface flow properties.
- Q6. A hypersonic flow has a Mach number of 8. Calculate the pressure coefficient using modified Newtonian Law (assume freestream pressure is 30 kPa).

**Section – C**

**(10 marks each)**

- Q7. Discuss the characteristics of hypersonic flight paths and their importance in aerospace engineering.
- Q8. A hypersonic aircraft experiences a shock wave with a pressure increase from 40 kPa to 120 kPa. Calculate the change in entropy assuming isentropic flow conditions.
- Q9. Explain the shock wave and expansion wave relations for inviscid hypersonic flows in detail.