Exercise for Module – 4

Answer the following questions

1) Behind the bow shock in front of a hypersonic blunt body, the flow is rotational. Why?
2) Why is the shock layer thin in hypersonic flows?
3) What makes the hypersonic boundary layers thicker?
4) What are the effects of thicker boundary layers on hypersonic bodies
5) What are the high temperature effects when the flight Mach number increases to higher values?
6) What is 'communication black out'
7) Define Knudsen number. What are the ranges of Knudsen number in different density regimes?
8) Why are air heaters required in hypersonic wind tunnels?
9) Differentiate between straight through and reflected modes of shock tunnels.
10) Explain how to calculate the stagnations of flow in straight through and reflected modes of shock tunnels.
11) What purpose is served by the second diaphragm in the shock tunnels?
12) Sketch and explain a gun tunnel.
13) What is the operating principle of a Stalker tube?
14) Sketch and explain a Stalker tube?
15) Which facility is used for testing the high temperature properties of aerospace materials? Sketch the facility and mark the parts.
16) write down the merits and demerits of 'free flight' testing.

Work out the following numerical problems

1) In a shock tube experiment, shock velocity in air was found to be 1650m/s. The initial temperature of air was 27^{o}C. If the shock tube is to be converted to a shock tunnel of straight through mode, what is the required area of the section to get a Mach number of 5.5. The shock tube inner diameter is 50mm.

2) The shock velocity in a shock tube run in air is measured as 1620m/s.The initial driven conditions in the shock tube are 310K and 60Torr.Is this run suitable for the hypersonic tunnel? With an area ratio of 22 between the shock tube cross sectional area and the shock tunnel nozzle exit, what is the test section Mach number?

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