Hall Ticket No | | | | | | | | | | |

Question Paper Code: AAEB15

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech V Semester End Examinations (Regular), February – 2021

Regulation: IARE–R18

HIGH SPEED AERODYNAMICS

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer any Four Questions from Part A
Answer any Five Questions from Part B

PART – A

1. Classify various flow regimes based on Knudsen number. **[5M]**
2. Enumerate shock boundary layer interactions. **[5M]**
3. What is the effect of friction in downstream flow properties if inlet Mach number is supersonic? **[5M]**
4. What are all the general features we observe for properties of Mach lines and expansion flow? **[5M]**
5. List and explain the different flow visualization techniques used in wind tunnel? **[5M]**
6. Develop the equations for the conservations of mass in integral form with proper assumptions. **[5M]**
7. Mach number downstream of normal shock is always subsonic. Justify? **[5M]**
8. Explain about fanno flow and write its applications. **[5M]**

PART – B

9. Explain the concept of entropy and develop the entropy equations for perfect gas with the help of neat sketch. **[10M]**
10. Determine the differential continuity equation in conservative form for three dimensional cartesian coordinate system by using infinitesimally small fluid element approach. **[10M]**
11. Explain about normal shock and build the Prandtl relation for normal shock in perfect gas? **[10M]**
12. A uniform supersonic stream with $M_1 = 1.5$, $P_1 = 17001\text{b}/ft^2$, and T_1= 460°R encounters an expansion comer which deflects the stream by an angle $\theta_2 = 20°$. Calculate M_2, P_2, T_2, P_{O2}, T_{02},and the angles the forward and rearward mach lines make with respect to the upstream flow direction. **[10M]**
13. What do you understand by area velocity relation and develop an expression for area velocity relation. **[10M]**
14. Consider a convergent-divergent nozzle with an exit-to-throat area ratio of 3. The inlet reservoir pressure is 1 atm and the exit static pressure is 0.5 atm. For this pressure ratio, a normal shock will stand somewhere inside the divergent portion of the nozzle. Calculate the location of the shock wave using i) A trial and error solution ii) The direct solution. Compare the results. **[10M]**
15. Develop the compatibility equation for two dimensional irrotational flows with the neat sketch. **[10M]**
16. Detail about area rule. Give an account of method of characteristics. **[10M]**
17. List industrial domain where wind and fluid tunnels are used. Explain its applications in their respective domain. **[10M]**
18. Explain about high speed (supersonic) wind tunnel and blow down wind tunnel (open circuit type) with suitable diagrams. **[10M]**

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