| PRN: | | Course Code : | PAS203 |
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Final Year M. **Tech** End Semester Examination Winter 2024

# Hypersonic Aerodynamics 000468

Day and Date: Wed 4 DEC 2024 Max Marks: **100**

Time : 02:00PM To 05:00PM Duration: **03** hrs

Instructions: All questions are compulsory.

| | | Marks | Bloom's Level | CO |
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| **Q.1** | **Attempt the following** | | | |
| a) | Discuss the condition for the formation of an oblique shock wave. What is meant by the shock angle? | 08 | 2 | 1 |
| b) | Drive the Prandtl's relation | 08 | 2 | 1 |
| | OR | | | |
| b) | Derive the Rayleigh Supersonic Pitot tube equation for measuring the stagnation pressure in a supersonic flow. | 08 | 3 | 1 |
| **Q.2** | **Attempt the following** | | | |
| a) | Explain hypersonic similarity parameters | 08 | 2 | 1 |
| b) | Discuss the formation of thin shock layers and their significance in hypersonic aerodynamics. | 08 | 3 | 2 |
| | OR | | | |
| b) | Drive the Equation of motion for a Hypersonic Flight Path using free body diagram | 08 | 3 | 2 |
| **Q.3** | **Attempt any two from the following** | | | |
| a) | Compare the tangent wedge and tangent cone methods | 08 | 1 | 2 |
| b) | Explain the concept of the shock-expansion method.? | 08 | 3 | 3 |
| c) | Why are local surface inclination methods important in hypersonic aerodynamics? | 08 | 3 | 3 |
| **Q.4** | **Attempt any two from the following** | | | |
| a) | Why is thermal protection necessary for hypersonic vehicles? | 08 | 3 | 3 |
| b) | How does the boundary layer thickness change with increasing Mach number? | 08 | 3 | 4 |
| c) | What is the difference between laminar and turbulent boundary layers in hypersonic flow? | 08 | 2 | 4 |

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| **Q.5** | **Attempt any Two of the following** | | | | |
| | a) | What are the main challenges caused by strong viscous interactions in hypersonic vehicles? | 09 | 3 | 4 |
| | b) | What is meant by shock wave boundary layer interaction? | 09 | 2 | 4 |
| | c) | What are the differences between laminar and turbulent shock wave boundary layer interactions? | 09 | 3 | 5 |
| **Q.6** | **Attempt any Two of the following** | | | | |
| | a) | What is meant by "chemically reacting boundary layers"? | 09 | 2 | 5 |
| | b) | What are the adverse effects of high temperatures on hypersonic vehicle materials? | 09 | 3 | 5 |
| | c) | What is Gibb's free energy? | 09 | 3 | 5 |

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