Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_

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**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **14AE2034** | **Duration :** | **3hrs** |
| **Sub. Name :** | **INTRODUCTION TO HYPERSONIC FLOWS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Define vortical layer. How does it influence the flow field? | CO1 | 10 |
| b. | Explain Viscous-Inviscid Interaction. Explain its implication on the flow field. | CO1 | 10 |
| (OR) | | | | |
| 2. |  | Starting from the Euler equations and oblique shock conditions, show that under hypersonic limit, non-dimensional flow variable are independent of Mach number. | CO2 | 20 |
|  |  |  |  |  |
| 3. |  | Estimate the pressure distribution on the surface of wedge of included angle 2θ at an angle of attack α using Newtonian approximation. Estimate the drag coefficient of wedge taking reference area as projected area facing the flow. | CO2 | 20 |
| (OR) | | | | |
| 4. |  | Estimate the pressure distribution on the surface of cone of included angle 2θ at an angle of attack α using Newtonian approximation. Estimate the drag coefficient of cone taking reference area as projected area facing the flow. | CO2 | 20 |
|  |  |  |  |  |
| 5. |  | Define Viscous Shock layer. How is it different from shock layer? And explain shock induced flow separation. | CO1 | 20 |
| (OR) | | | | |
| 6. |  | State the assumptions and non-dimensional form of variables used in deriving equations for Hypersonic Slender body theory. | CO2 | 20 |
|  |  |  |  |  |
| 7. |  | Consider the hypersonic boundary layer over a flat plate with pressure gradient. Using similarity consideration, derive the equation governing the similar velocity profile. Give the boundary conditions for governing equations. | CO2 | 20 |
| (OR) | | | | |
| 8. |  | Consider the hypersonic boundary layer over a flat plate without pressure gradient. Using similarity consideration, derive the equation governing the similar temperature profile. Give the boundary conditions for governing equations. | CO2 | 20 |
|  | |  |  |  |
|  | | **Compulsory**: |  |  |
| 9. |  | Starting from shock relations for oblique shock, derive the relation between shock wave angle β and flow deflection angle θ for strong shock under hypersonic flow conditions( large Mach number). | CO2 | 20 |