Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, xxx 2021

SUB: HYPERSONIC AEROTHERMODYNAMICS [AAE 4003]

REVISED CREDIT SYSTEM
(xx/xx/2021)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- Data tables will be given.

1A. Explain the major historical developments of Hypersonic vehicles. **(4)**

1B. For the velocity profile for laminar boundary layer flows given as $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Find an expression for boundary layer thickness, shear stress, and coefficient of drag in terms of Reynolds number. **(6)**

2A. Derive the expression for Von Karman momentum integral equation. **(4)**

2B. With the suitable equations, explain the concept of 'Reference Temperature method' and 'Traditional method' to calculate the aerodynamic heating of hypersonic vehicle. **(6)**

3A. Describe the following with suitable equations (a) Stream function (b) Thin shock layer theory. **(4)**

3B. Explain the hypersonic vehicle aerodynamics forces, coefficients, and aerodynamic heating terms. **(6)**

4A. With the help of neat diagrams explain the concept of the tangent wedge and tangent cone methods **(4)**

4B. Explain the full Navier-stokes equations of Hypersonic viscous interactions flow field **(6)**

5A. With the help of neat diagrams describe the basic hypersonic shock relations and hypersonic expansion wave relations. **(4)**

5B. Explain Newtonian theory for hypersonic flows. Also, explain the applications of Newtonian theory **(6)**