Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: HIGH SPEED AERODYNAMICS [AAE 429]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. What are the effects of shock wave/boundary layer interaction on **(06)**
(a) Pressure distribution
(b) Shear stress for particular Mach number and turbulent flow over a flat plate.

1B. Discuss in detail about the Thwaites' Integral method for Laminar Incompressible Boundary Layers. **(04)**

2A. Explain the conceptual design procedure of hypersonic vehicle? **(05)**

2B. Derive the Momentum Equation for Turbulent Boundary Layer. **(05)**

3A. Compare the Space Shuttle wind-ward ray heat transfer distributions using Entropy layer effects of hypersonic aerodynamic heating? **(06)**

3B. Explain the idea of wave cancellation used in Busemann Biplane with the help of neat sketches. **(04)**

4A. Derive the basic hypersonic shock relations. **(04)**

4B. Consider a flat plate at zero angle of attack in an airflow at standard sea-level conditions. The chord length of the plate (distance from leading edge to trailing edge) is 2m. The planform area of the plate is 40m2. At standard sea-level conditions, μ_∞ = 1.7894 x 10^{-5}kg/ms. Assume the wall temperature is the adiabatic-wall temperature T_{aw}. Assuming laminar flow, calculate the local shear stress on the plate using reference temperature method at the location 0.5 m downstream from the leading edge when the freestream velocity is 3402 m/s. ($c_f\sqrt{Re_x} = 0.43$). **(04)**

4C. How the Knudsen number (Kn) influence the hypersonic free molecular flow around simple bodies? **(02)**

5A. Derive an equations for hypersonic flight path and examine the paths of lifting and non-lifting hypersonic vehicles during atmospheric entry from space. **(04)**

5B. Consider the variation of lift with angle of attack for an infinitely thin flat plate. Using Newtonian theory, prove that the maximum lift occurs at α = 54.7 deg. **(04)**

5C. What are the real physical problems associated with transonoic and hypersonic flows w.r.t perturbed flows. **(02)**

6A. Calculate the lift and wave-drag coefficients using the linearized theory & exact shock-expansion theory for an infinitely thin flat plate in a Mach 2.6 freestream at an angle of attack α = 5^o. Conclude the accuracy of linearized theory in this case? **(04)**

6B. Write the Relations which are used to reduce the Conservation Equations to Differential Form. **(03)**

6C. Differentiate between the Newtonian Model and Buseman- Newtonian model. **(03)**