Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: AERODYNAMICS-II [AAE 305]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Aerodynamic flow property table is allowed
- Missing data may be suitable assumed.

1A. Describe the followings: **(05)**

a) Area Rule
b) Compressibility correction
c) Difference between total parameter and characteristic parameter
d) What is meant by flow get choked in Fanno flow diffuser
e) Hodograph

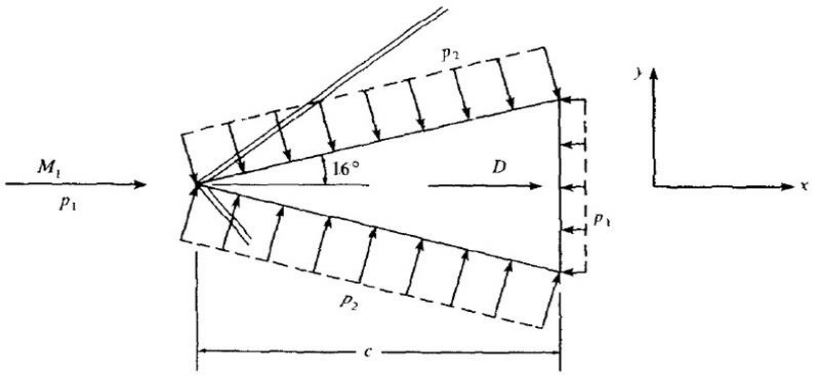
1B. What is the importance of various forms of energy equations? (Alternative forms of energy equations). Derive the equations for speed of sound which are interconnected between total and characteristic parameters of speed of sound. **(03)**

1C. What is Mach angle and why it is important in supersonic flights? **(02)**

2A. Derive the basic hypersonic relations and prove that in hypersonic speed the wave angle is 20% larger than the deflection angle **(03)**

2B. Consider a 16^0 half angle wedge with unit span at zero angle of attack in a Mach number 5 of air at standard conditions. Calculate: **(05)**

a) The pressure coefficient on the wedge
b) The drag coefficient (assume the pressure exerted over the base of the wedge, the base pressure is equal to the free stream pressure). (use $\theta - \beta - M$ relation to calculate β)



2C. Define three dimensional relieving effects and what is the application of this effect on aircrafts? **(02)**

3A. Draw the schematic diagram of supersonic wind tunnel and explain their features **(05)**

3B. What is shock polar? Write down their properties. Explain through a neat diagram how to determine wave angle, deflection angle and attached (detached) shock waves from a given shock polar for a particular value of Mach number **(05)**

4A. Draw the diagrams of intersection of same and opposite families of shocks and define the concept of slip line. **(05)**

4B. Derive and describe the basic hypersonic shock and expansion wave relations. **(05)**

5A. Derive and explain the one dimensional flow with friction (Fanno Flow) and explain their physical properties in subsonic and supersonic flows. **(05)**

5B. Consider a rocket engine burning hydrogen and oxygen in the combustion chamber and here the temperature and pressure are 3600K and 28atm respectively. The molecular weight of the chemically reacting gas in the combustion chamber 18 and γ = 1.22. The pressure at the exit of the convergent – divergent rocket nozzle is 1.31 x 10^2 atm. The area of the throat is 0.42 m^2. Assuming a calorically perfect gas. If like that, Calculate : **(05)**

a) The exit Mach number
b) Exit velocity
c) The mass flow through the nozzle
d) Area at the exit.

6A. Consider an infinitely thin flat plate at angle of attack of 10 deg in a Mach 10 inviscid flow. Calculate the pressure coefficients on the top and bottom of the plate, the lift and drag coefficients and the lift to drag ratio by using **(05)**

a) Exact shock – wave and Expansion wave theory
b) Newtonian theory and compare the results

6B. Describe the followings: **(05)**

a) Critical Mach number
b) Diffuser
c) Why at high subsonic speeds compressibility effects comes into calculations?
d) Normal and Oblique shocks
e) Left and Right running curves in supersonic flow