Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: GAS DYNAMICS [AAE 3102]

REVISED CREDIT SYSTEM
(23/12/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

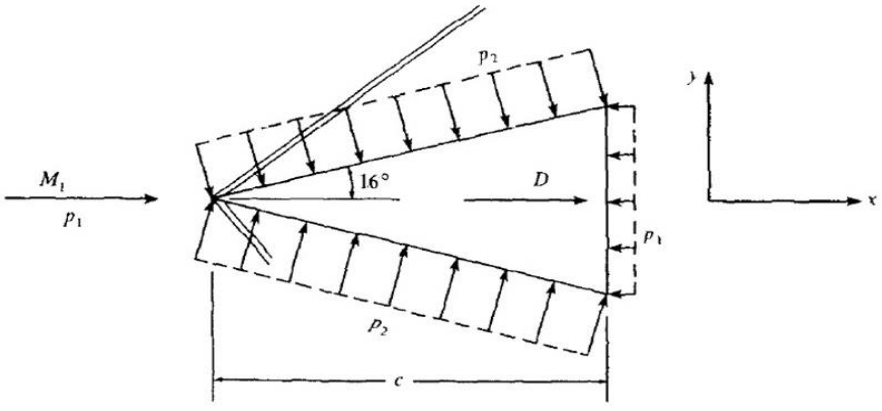
- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- Gas tables will be provided by the department

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

a) Supercritical airfoil
b) 3 dimensional relieving effect
c) Total parameters
d) Mach reflection
e) Hodograph

1B. Consider a 16^0 half angle wedge with unit span at zero angle of attack in a Mach number 2.8 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)



2A. Consider an airplane flying at standard sea level conditions and free stream velocity is 200km/hr. At some point on the wing the flow accelerates over the wing and reaching a maximum velocity of 300km/hr. Then calculate the following: **(05)**

a) What is the percentage pressure change between this maximum point and free stream? (assume for incompressible flow)

b) What is the percentage density change between this maximum point and free stream? (assume compressible flow, R=287J/kg.K)
c) What will be the critical Mach number of this same wing if it's travelling at sea level?

2B. Draw the schematic diagram of supersonic wind tunnel and explain their features. **(05)**

3A. Derive the equations of supersonic airfoils by considering linearized supersonic theory. Using the linearized theory calculate the drag coefficient for flat plate at 6^0 angle of attack in a Mach number 3 flow. **(05)**

3B. Differentiate the flow property variations in subsonic and supersonic flows in Fanno flow. Draw Fanno diagram as well. **(05)**

4A. Describe the followings: **(05)**
a) Compressibility effect
b) Shock ploar
c) Mach wave
d) Karman-Tsien rule
e) Area velocity relation

4B. Consider a flat plate with chord length of 2m. The free stream flow properties are M_1=3, P_1=1.1atm and T_1=275K. Using shock expansion theory, tabulate and plot following properties as functions of 'α' by considering angle of attack varying as 2, 5 and 8 deg. **(05)**
a) Pressure on top & bottom surfaces
b) Temperature on top & bottom surfaces
c) L/D

5A. Consider air enters a constant area duct at M_1=3.2, P_1=1.5atm, T_1=300K and ρ=1.225 kg/m^3. Inside the duct heat added per unit mass is q=4 x 10^5 J/Kg. Calculate the flow properties M_2, P_2, ρ_2, T_2, P_{02} and T_{02} at the exit of the duct. **(05)**

5B. Explain the application of diffuser. Draw the diagram of intersection of shocks or solid boundaries and free boundaries **(05)**