UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December, 2017

Program/course:M.Tech/ASE+UAV	**Semester – I**
Subject: Introduction to Flight	**Max. Marks : 100**
Code :ASEG 7008	**Duration : 3 Hrs**
No. of page/s: 03	

INSTRUCTIONS:

1. No students will be allowed to leave the examination hall before 1hr.
2. Assume any missing data with suitable explanation.

SECTION-A [05x04=20]

1. How the material strength is significant in aerospace industry? What kind of materials is used for manufacturing of an a/c? **04**
2. Sketch the conventional aircraft along with its control surfaces. Brief out the major components of it. **04**
3. A jet transport is flying at a standard altitude of 9144*m* with a velocity of 804km/*hr*. what is its Mach number? **04**
4. The flight test data for a given airplane refer to a level-flight maximum velocity run made at an altitude which simultaneously corresponds to a pressure altitude of 9144*m*. and a density altitude of 8686*m*. Calculate the temperature of the air at the altitude at which the airplane was flying for the test. **04**
5. Write down the difference between piston-prop and turbo-fan engines. **04**

SECTION-B [10x4=40]

6. Describe the fundamental significance of Avionics in Aerospace defence technology. How the databases are useful to exchange the information. List out the various Integrated Avionics weapon systems. What kind of the information can be exchange through the various protocols for the data transmission? **10**

7. Derive the Euler's equation using the mass and energy conservation rules. Furthermore, deduce the algorithm to the Bernoulli's equation and state the assumption. Also classify the equation for compressible and incompressible fluid flow cases. **10**

8. Describe the difference between aerodynamic center and center of pressure. Draw both the points over an airfoil. How the lift variation proportional to the effect of camber. Describe by means of the suitable neat sketch. Also, write down the formulation for center of pressure calculation over the typical airfoil. **10**

9. Consider an airfoil in a flow of air, where fad ahead (upstream) of the airfoil, the pressure, velocity and density are 101314*pa*, 160*km/hr*, and 1.225kg/m^3, respectively. At a given point A on the airfoil, the pressure is 99111*pa*. What is the velocity at the point A.? **10**

SECTION-C [20X2=40]

10. In a supersonic wind tunnel, the air temperature and pressure in the reservoir of the wind tunnel are T_0 = 1000K and P_0= 10Atm respectively. The static temperatures at the throat and exit are T* = 833K and *Te* = 300K respectively. The mass flow rate through the nozzles 0.5kg/s. For air, c_p = 1008J/kg K. Calculate: **20**

(a) Velocity at the throat, *V**

(b) Velocity at the exit, *Ve*

(c) Area of the throat, *A**

(d) Area of the exit, *Ae*

11. Consider a flying wing (such as Northrop YB-49 of the early 1950s) with a wing area of 206m^2, an aspect ratio of 10, a span effectiveness factor of 0.95, and a NACA 4412 airfoil. The weight of the airplane is 7.5x10^5N. If the density altitude is 3km and the flight velocity is 100m/s, calculate the total drag on the aircraft**. [Refer appendix-A and Figure 1].** **20**

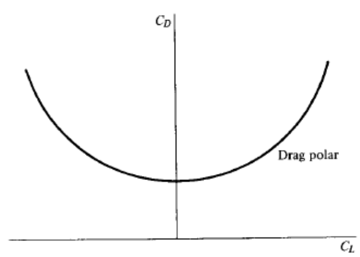
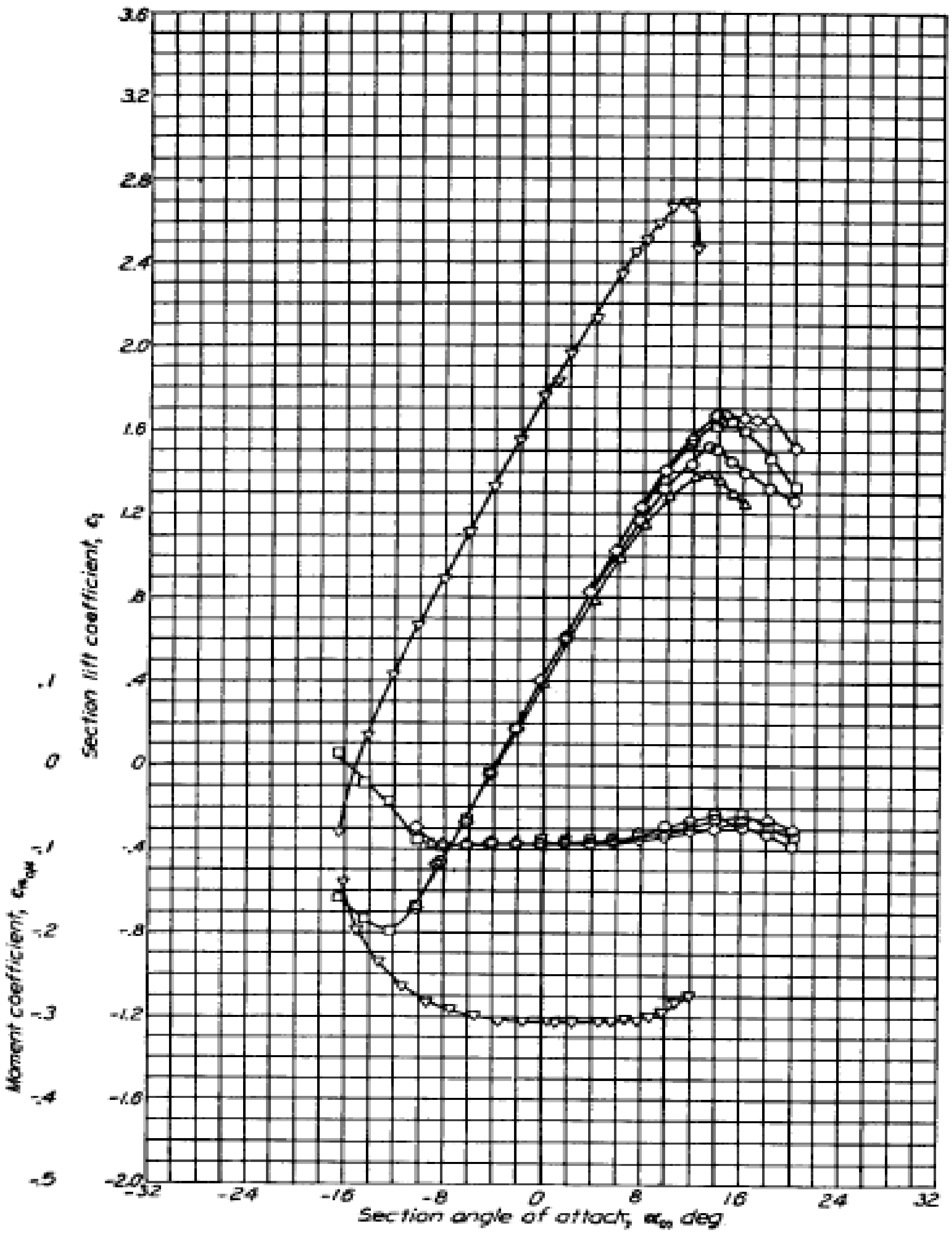


Fig 1. Drag-polar for the YB-49 a/c

OR

11. Define the various altitudes used in the Aeronautics to perform the suitable operation of an aircraft. Estimate the atmospheric values at the geopotential altitudes of 5Km, 9Km, 14Km and 20Km. **20**

Appendix-A: Airfoil Data set-NACA4412



NACA 4412 Wing Section

Roll No: -------------------------

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SECTION-A [05X04=20]

1. Describe the different wing configurations. Sketch each of them **04**

2. Sketch schematic diagram of Helicopter. Name each of the components. **04**

3. What is fail-safe and safe-fail structures in Aeronautical technologies for the aircraft body simulations? **04**

4. The flight test data for a given airplane refer to a level-flight maximum velocity run made at an altitude which simultaneously corresponds to a pressure altitude of 9144m. and a density altitude of 8686m. Calculate the temperature of the air at the altitude at which the airplane was flying for the test. **04**

5. Sketch the conventional aircraft along with its control surfaces. Brief out the major components of it. **04**

SECTION-B [10X04=40]

6. Draw and explain the pressure variation over the symmetrical airfoil with the various AoA. Define how the stalling occurs over and airfoil. Draw coefficient of pressure vs distance to chord ratio variation in each case. **10**

7. Explain the basic theory of Aerospace propulsion. Sketch the neat diagram of Gas turbine engine. Describe the function of each subsystems corresponds to it. Explain it with the help of T-S diagram with reference to the application from engineering thermodynamics. **10**

8. Consider the flow of air over a small flat plate which is 5cm long in the flow direction and 1m wide. The freestream condition corresponds to the standard sea level, and the flow velocity is 120m/s. Calculate the value of Re. Note down the various Re boundary conditions for the incompressible and compressible fluid flow regime. **10**

9. An airplane is flying at standard sea-level conditions. The temperatures at the point over wing are 250K. What is the pressure at this point? Derive the respective algorithms used in the calculation of atmospheric properties. **10**

SECTION-C [20X2=40]

10. In a supersonic wind tunnel, the air temperature and pressure in the reservoir of the wind tunnel are T_0 = 1000K and P_0= 10Atm respectively. The static temperatures at the throat and exit are T* = 833K and Te = 300K respectively. The mass flow rate through the nozzles 0.5kg/s. For air, c_p = 1008J/kg K. Calculate:

20

(e) Velocity at the throat, V^*
(f) Velocity at the exit, Ve
(g) Area of the throat, A^*
(h) Area of the exit, Ae

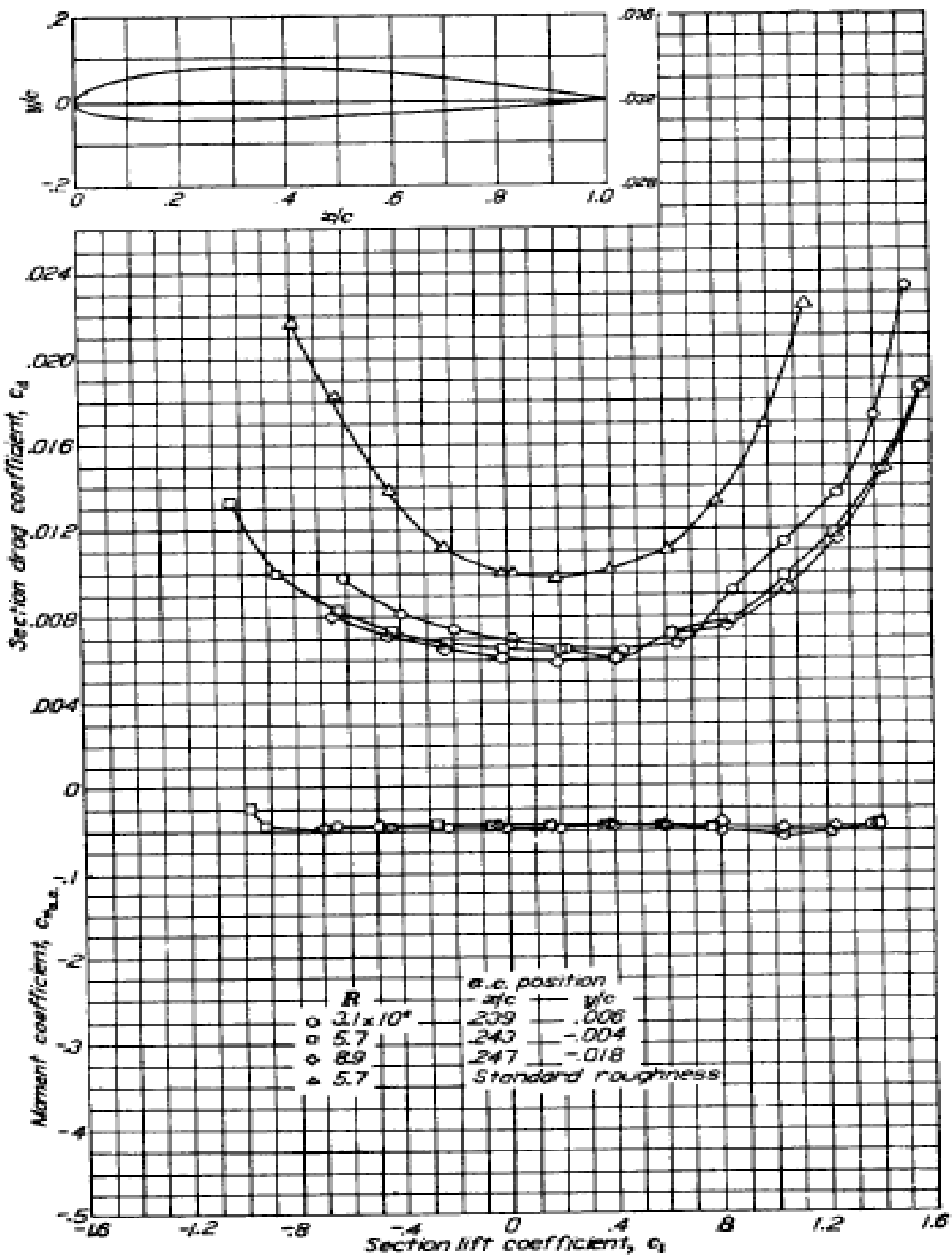
11. A model wing of constant chord length is placed in a low-speed subsonic wind tunnel, spanning the test section. The wing has a NACA 2412 airfoil and a chord length of 1.3m. The flow in the test section is at a velocity of 50m/s at the standered sea-level conditions, if the wing is at 4° AoA, calculate (a) $C_L, C_D, C_{m,m/4}$, (b) $L, D, M_{c/4}$ per unit span. **[Ref: Appendix-A]** **20**

OR

11. Write short notes on **20**

i) Avionics Databuses
ii) Low and High Speed wind tunnel
iii) Combustion Chamber
iv) Fail-safe Structures
v) Aerodynamic Centre

Appendix-A: NACA2412 Airfoil data



NACA 2412 Wing Section (*Continued*)