Code No: RR222101 **Set No.1**

II B.Tech. II Semester Regular Examinations, April/May -2005
AERODYNAMICS-I
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe the effect of camber and thickness distribution and leading edge circle of airfoil on aerodynamic characteristics. Make use of sketches and c_1-c_d-α plots to illustrate your answer.

2. Consider Pressure distribution over a cambered section in a viscous, incompressible medium. Explain the phenomenon of separation and stalling with C_p plots and sketches of resulting flow patterns.

3. An airplane weighing 250,000 N, S = 100 m^2 has its drag polar given as $C_D = 0.024 + 0.04\, {C_L}^2$. Plot the thrust vs. velocity curve and obtain lift coefficient for minimum drag. What is the significance of this condition?

4. Show that the Complex Potential function w = U_z + (q/2π) L_n [(z+a) / (z-a)] represents flow about a Rankine oval. Sketch the streamlines and equipotential lines.

5. What are the basic principles of conformal transformation? Show that for a transformation of the type ζ = z + b^2/z , (b is a constant), the velocity ratio between corresponding points is the inverse of the length ratios.

6. An airplane powered by a single propeller is flying in straight and level condition at an altitude. Develop an expression for the slipstream velocity of the propeller in terms of flight speed, drag coefficient, wing plan form area and the propeller diameter.

7. What makes the blade element theory of propellers superior to the Froude Momentum theory? Hence describe the Blade element Theory in details. Hence define various useful parameters involved. Make use of sketches and plots to explain your answer.

8. How does a Gyroplane differ from a conventional helicopter? Explain its design features and operational details. Make use of sketches / plots to elaborate your answer.

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Code No: RR222101

Set No.2

II B.Tech. II Semester Regular Examinations, April/May -2005
AERODYNAMICS-I
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the importance of leading edge circle on the performance of an airfoil at angle of attack. Make use of sketches and c_l-c_d-α plots to illustrate your answer.

2. Obtain a relationship between forces on an airfoil based upon wind axis and body axis. How can you make use of dimensional analysis to obtain these forces in terms of physical parameters available to you.

3. An airplane with wing loading of 2400 N/ m2 has its drag polar given by $C_D = 0.016 + 0.055\, C_L^2$. Plot the thrust vs. velocity curve and obtain lift coefficient for minimum drag. What is the significance of this condition?

4. Define a complex potential function from the first principle. What is represented by a Complex potential function? Consider a point source placed in a uniform stream. Plot the streamlines and equipotential lines. Make use of sketches and plots to explain your answers.

5. Apply the Kutta-Zhukovsky transformation to obtain a cambered airfoil of thickness ratio 15% and camber of 10%. Make use of sketches and plots to elaborate your answer.

6. Two propellers are required to be used in tandem for producing maximum efficiency. Making use of Froude Momentum theory work out the size and location of the rear airscrew.

7. A 4- bladed airscrew is required to propel an aircraft at 125 m/s at sea level, the rotational speed being 1200 rpm. The blade element at 1.25 m radius has an absolute incidence of 6^0 and the thrust grading is 2800 N/m per blade. Assuming a reasonable value for the section lift curve slope, calculate the blade chord at 1.25 m radius. Neglect rotational interference, sectional drag and compressibility.

8. Describe with neat sketches / plots a fully articulated rotor system of a helicopter. Explain its action in effecting collective and cyclic pitch as desired by the pilot.

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Code No: RR222101 **Set No.3**

II B.Tech. II Semester Regular Examinations, April/May -2005
AERODYNAMICS-I
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the requirements of airfoil section for low speed applications in airplanes? Suggest one section .How far the requirements are satisfied in an airplane. Make use of sketches and c_1-c_d-α plots to illustrate your answer.

2. Compare pressure distribution over a symmetrical airfoil with that over a circular cylinder in a viscous, incompressible fluid medium. Illustrate with sketches and plots.

3. Define total drag acting on an airplane and its components. What are the causes of each of these components? Compare the total drag acting on a Jumbo jet and that on a supersonic fighter plane. Make use of sketches /plots to illustrate your answer.

4. Show that part of the flow given by Complex Potential function w =(Cosh z/c) represents irrotational flow in a convergent-divergent channel of constant depth.

5. Obtain lift coefficient on a 2% thick, Zhukovsky airfoil having 2% camber, placed at an angle of attack of 4^0 to a 2D free stream of irrotational flow. Derive the expression used. Make use of sketches and plots to elaborate your answer.

6. An airscrew is required to pruce thrust of 5000 Newtons at a speed of 130 m/s at sea level. The diameter of the disc is 2.5 m. Estimate the minimum power to be supplied on the basis of ideal actuator disc. Another propeller is placed in its slipstream such that its disc area is just equal to that of the slipstream. Work out the size ant input power to the second propeller on the basis of Froude momentum theory.

7. A 3-bladed airscrew is driven at 1560 rpm at a flight speed of 110 m / s at sea level. At 1.25 m radius, the local efficiency is estimated to be 87%, while the L/D ratio of the blade section is 57.3. Calculate the local thrust grading, ignoring rotational interference.

8. What are the bases of assessment of power requirements in case of a helicopter in flight? Hence describe induced power, profile power and parasite power requirements. Make use of sketches / plots to elaborate your answer.

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II B.Tech. II Semester Regular Examinations, April/May -2005
AERODYNAMICS-I
(Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Explain mean line and thickness distribution in case of NACA 5 digit series of airfoil sections. How are the different from Juokowaski airfoils?

2. Determine the aerodynamic center of an airfoil that exhibited following characteristics: at zero lift, $C_{mc/4}$ = -0.04: at $\alpha = 8^0$, $C_{mc/4}$ = -0.10, C_L =1.0 and C_D =0.06.

3. An airplane weighing 160,000 N, S = 42 m^2 has its drag polar given as $C_D = 0.014 + 0.05\ C_L^2$. Plot the thrust vs. velocity curve and obtain lift coefficient for minimum drag. What is the significance of this condition?

4. Define a complex potential function from the first principle. What is represented by a Complex potential function? Consider a point source placed in a uniform stream. Plot the streamlines and equipotential lines. Make use of sketches and plots to explain your answers.

5. Calculate the velocity just outside the boundary layer at the 0.50 x/c location of a symmetrical Zhukovsky airfoil of t/c ratio of 40 % set at zero incidence in a stream of undisturbed velocity 50 m/s.

6. Show from ideal actuator disc theory that the 'inflow' factor of a single propeller driving the airplane in st. and level flight depends upon its flight speed, drag coefficient, wing plan form area and propeller diameter.

7. At 1.25 m radius on a 3 bladed airscrew, the airfoil section has the following characteristics; solidity = 0.1 ,$\theta = 29^0$ 7' ,$\alpha = 4^0$ 7', C_L = 0.49 L / D = 50 Allowing for both axial and rotational interference, find the local efficiency of the element.

8. What is the use and necessity of a vertical tail rotor in case of a conventional helicopter? Compare the means of generation of lift on a helicopter with that on a fixed wing aircraft. What is the equivalent of tail rotor in an airplane?

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