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

II B.Tech II Semester Regular Examinations, Apr/May 2006
AERODYNAMICS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Write a detailed note on NACA 4 digit numbering system. As this system produces open trailing edge, how do you get the tailing edge? [16]

2. Following data was obtained from wind tunnel test. The pitching moment coefficients were take about a spindle located 1/3 rd of chord behind the leading edge:

C_L	0.2	0.4	0.6	0.8
C_m	-0.02	0.00	0.02	0.04

   Find the value of aerodynamic center and C_{m0} . Develop the expression used. [16]

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. [16]

4. Sketch the stream line pattern of the flow given by the Complex Potential function w = A z^2 , where A is a constant and other symbols have usual meaning. Find the magnitude and direction of the stream at x = 1,y= 2 when A = 10. [16]

5. Prove that the thickness ratio of a symmetrical Zhukovsky airfoil is approximately 1.3 times (a/b − 1) , where b is a constant of transformation and a is the radius of the circle of transformation. [16]

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. [16]

7. A turbo-prop powered airplane if flying at 260 Knots at 6000 m altitude on a standard day. Each of the 4.26 m dia. ,4 bladed propeller at, 1050 rpm is driven by an engine delivering 1700 shp. The activity factor is 135.Make use of the supplied propeller performance chart. [16]

8. How does the generation of lift force on a helicopter differ from that in case of an airplane? What are the similarities and variations in the two types? Make use of sketches / plots to elaborate your answer. [16]

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Code No: RR222101 **Set No. 2**

II B.Tech II Semester Regular Examinations, Apr/May 2006
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. [16]

2. Compare pressure distribution over a symmetrical airfoil with that over an oval shaped cylinder in a viscous, incompressible fluid medium. Illustrate with sketches and plots. [16]

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? [16]

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. [16]

5. A small symmetrical Zhukovsky airfoil has t/c ratio of 10% and fitted with pressure hole on both surfaces at 12% of the chord behind the leading edge for use a yaw meter. Set this airfoil now at 1.5^0 and obtain the pressure difference. Express your answer in terms of pressure rise at the stagnation point. [16]

6. Develop an expression for the ideal thrust and efficiency developed by a propeller in terms of its 'inflow factor'. State and justify the assumptions. [16]

7. Define the term Thrust coefficient. Hence develop an expression for it from dimensional analysis. [16]

8. Sketch and explain flow patterns around a helicopter in vertical climb and descent mode. How are the aerodynamic forces balanced in each case? [16]

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

II B.Tech II Semester Regular Examinations, Apr/May 2006
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 geometry of a cambered airfoil. What is the role of leading edge radius? Can you separate out the effects of thickness and its effects on airfoil performance? Make use of sketches and c_1-c_d-α plots to illustrate your answer. [16]

2. Make use of dimensional analysis to work out formulas for aerodynamic forces and moments. [16]

3. An airplane weighing 4,50,000 N, with wing loading of 2750 N/ m^2 has its drag polar given by $C_D = 0.0216 + 0.04\ C_L^2$. Plot the thrust vs. velocity curve and obtain lift coefficient for minimum drag. What is the significance of this condition? [16]

4. Given Complex Potential function w = $U_z + \sqrt{z}$. Analyze the force field if the flow is irrotational. [16]

5. Consider the transformation given by $\zeta = 1$ / z. Show that the flow pattern due to uniform flow parallel to x axis gets transformed to circles of radii 1 / 2k at (0, -1 / 2k), where k depends upon U, the uniform stream velocity parallel to x axis. [16]

6. An airscrew is required to produce thrust of 5500 Newtons at a speed of 130 m/s at sea level. The diameter of the disc is 2.8 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. [16]

7. The thrust and torque grading at 1.22 m radius on each blade of a 2 bladed airscrew are 2120 N/m and 778 Nm/m respectively. Find the speed of rotation in radians / second of the airstreams immediately behind the disc at 1.22 m radius. [16]

8. How does a twin rotor helicopter differ from a conventional helicopter? Explain its design features and operational details. Make use of sketches / plots to elaborate your answer. [16]

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Code No: RR222101 **Set No. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2006
AERODYNAMICS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. 1.Elaborate with examples and theory, why should an airplane wing have an airfoil as its cross-section and not a flat plate or a circular cylinder. Make use of sketches and c_l-c_d-α plots to illustrate your answer. [16]

2. Develop expressions from pi theorem for C_l, C_d and C_m. An airfoil at $\alpha = 10^0$, develops C_l =1.26 and C_d =0.0115. Obtain C_n and C_a. [16]

3. Define the terms surface friction drag, Normal pressure drag, Trailing Vortex drag and wave drag of a flying object. How these components are combined together to express total drag. Suggest means to minimize each of these components with reference to how and when each one of these occurs. Make use of sketches /plots to illustrate your answer. [16]

4. Show that when the transformation $\zeta = z^2$ is applied to a field of uniform flow parallel to the OY axis the transformed stream lines are parabolas about the Oξ axis. Plot any streamline. [16]

5. Obtain lift coefficient on a 15% thick symmetrical Zhukovsky airfoil placed at an angle of attack of 5^0 to the free stream. Derive the expression used. Make use of sketches and plots to elaborate your answer. [16]

6. An airscrew is required to produce thrust of 6700 Newtons at a speed of 140 m/s at sea level. If the diameter of the disc is 3.1 m estimate the minimum power to be supplied on the basis of ideal actuator disc. [16]

7. An airplane is powered by a single engine, whose speed-power variation is given as

Speed(rpm)	1800	1900	2000	2100
Power(KW)	1072	1113	1156	1189

The fixed pitch airscrew of 3.05 m has the following characteristics:

J	0.40	0.42	0.44	0.46	0.48	0.50
K_T	0.118	0.115	0.112	0.109	0.106	0.103
K_Q	0.0157	0.0154	0.0150	0.0145	0.0139	0.0132

and is directly coupled to the engine crankshaft. What will be airscrew thrust and efficiency during the initial climb at 48 m/s. [16]

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. [16]

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