KUMARAGURU
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Register Number: …….

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Fourth Semester

AERONAUTICAL ENGINEERING

U13AET401: Aerodynamics - I

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Bernoulli's equation is applicable to any ideal fluid flow of perfect gas provided
   a) there is no change of temperature b) there is change of temperature
   c) there is no transfer of energy of fluid d) there is transfer of energy of fluid
2. Navier Stokes equation is momentum equation for ……..fluid
3. The stream function for uniform flow parallel to x- axis
   a) *Ux* b) *Uy*
   c) *Ux* + *Uy* d) *Ux* - *Uy*
4. For a combination of doublet with uniform flow the dividing streamline is ……
5. Theoretical maximum slope of lift curve of flat plate aerofoil is
   a) zero b) one
   c) 2π d) π
6. When transformation is applied to fluid motion, the distance between streamlines ……..
7. Induced drag for an aerofoil is minimum for
   a) maximum aspect ratio b) minimum aspect ratio
   c) unit aspect ratio d) infinite aspect ratio
8. For elliptical distribution of lift along span, the downwash is ……. along span.
9. Effective pitch of a propeller is
   a) Advance per revolution b) Geometrical pitch of propeller
   c) Forward speed of aircraft d) Advance ratio
10. Propeller blade is twisted for……..from root to tip.

PART B (10 x 2 = 20 Marks)

(Not more than 40 words)

11. Express equation of continuity in terms of potential function for ideal fluid.
12. What are rotational and irrotational vortices?
13. What are circulation and vorticity of a fluid flow?
14. Sketch stream line and potential line of doublet at origin.
15. State theorem of Blasius.
16. How magnification ratio of Joukowski transformation can be determined?
17. Why induced drag is considered lift dependent drag.
18. State Biot- Savart law and its applications.
19. What do you mean by propeller efficiency?
20. Draw propeller chart.

PART C (5 x 14 = 70 Marks)

(Not more than 400 words)

Q.No. 21 is Compulsory

21. State and prove Kutta – Joukowski theorem.

22. a) Derive continuity equation in polar coordinates.

(OR)

b) (i) Simplify Bernoulli's equation and express in terms of pressure. (7)

(ii) How this can be modified for compressible flow? (7)

23. a) (i) Sketch and explain finite angle trailing edge and cusped trailing edge of an aerofoil. (7)

(ii) How Karman – Treftz modified Joukowski profile. (7)

(OR)

b) A circular cylinder 2 m diameter 12 m long is rotated at 300 rpm about its axis, when it is kept perpendicular to an airstream 40 m/s and density 1.208kg/m^3. Determine theoretical lift, position of stagnation point or points.

24. a) For a thin aerofoil has circular arc camber with maximum camber 2.5% of the chord. Determine the moment coefficient about aerodynamic center. The camber line is $z = k\left[\frac{1}{4} - \left(\frac{x}{c}\right)^2\right]$ where origin is taken at mid-chord point.

(OR)

b) (i) Write short notes on assumptions of thin aerofoil theory. (7)

(ii) Write short notes on concept of horse shoe vortex system on airplane. (7)

25. a) (i) State the assumptions of simple blade element theory of propellers. (4)

(ii) Derive ideal efficiency of propeller using above theory. (10)

(OR)

b) A 3m diameter propeller is coupled to an engine of speed 3000 rpm. Tip speed of the propeller is limited to 90% of the sonic speed for compressibility effects. What is the gear reduction ratio to be provided if the aircraft is flying at 5km altitude?

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