Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE004

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Regular) - May, 2018

Regulation: IARE – R16

LOW SPEED AERODYNAMICS

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Define stream function and velocity potential and obtain the relation between them. **[7M]**
   (b) Two components of velocity and incompressible flow is given by $u = x^3 - -y^3$ and $v = z^3 - y^3$. Determine the third component, assuming that the origin a stagnation point. **[7M]**

2. (a) Obtain an expression for stream function and velocity potential for a source in uniform horizontal stream. **[7M]**
   (b) Consider a velocity field where the x and y components of velocity are given $u = y/\left(x^2 + y^2\right)$ and $v = -x/\left(x^2 + y^2\right)$, where 'c' is a constant. Show that it is a possible case of flow fieldand determine the equation of the stream line. **[7M]**

UNIT – II

3. (a) Draw a schematic diagram of an airfoil and explain the salient geometric parameters. **[7M]**
   (b) Define the center of pressure and aerodynamic center and derive the relation to calculate the aerodynamic center. **[7M]**

4. (a) Explain the basic concept of classical thin airfoil theory. **[7M]**
   (b) Prove that using thin airfoil theory, the quarter chord point is the center of pressure and also the aerodynamic centre of an airfoil. **[7M]**

UNIT – III

5. (a) Briefly explain the following with relevant sketches:
      i) Downwash
      ii) Horse shoe vortex
      iii) Induced drag coefficient **[7M]**
   (b) Assuming elliptic circulation distribution given, obtain the closed form expression for the Induced angle of attack and Induced drag coefficient. **[7M]**

6. (a) Explain the following
      i) Biot-Savart Law.
      ii) Helmholtz vortex theorems **[7M]**
   (b) Explain the source panel and vortex panel methods and write the governing equations. **[7M]**

UNIT – IV

7. (a) Define D-Alembert Paradox. **[7M]**
   (b) Explain with relevant sketches subsonic and supersonic leading edges. **[7M]**
8. (a) Discuss the effects of propeller on the aircraft wing and airplane dynamics. **[7M]**
   (b) Explain the method of singularities (Prandtl-Glauret singularity) **[7M]**

UNIT – V

9. (a) What do you understand by the boundary layer theory, explain laminar, turbulent and transition over a flat plate at low Reynold's number **[7M]**
   (b) Derive the expressions for displacement thickness. **[7M]**
10. (a) Derive the Navier-Stokes equation for 2D flows in partial differential non-conservation form. **[7M]**
   (b) Derive the expressions for Momentum thickness **[7M]**

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