Seat No: ____

Enrollment No: __ PARUL UNIVERSITY FACULTY OF ENGINEERING & TECHNOLOGY B.Tech. Summer 2018 - 19 Examination

Semester: 4 Subject Code: 03101253 Subject Name: Aerodynamics-I

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Instructions:

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- 1. All questions are compulsory.
- 2. Figures to the right indicate full marks.
- 3. Make suitable assumptions wherever necessary.
- 4. Start new question on new page.

Q.1 Short Type Questions (All compulsory)

- 1) For $M_{\infty} < 0.3$, the flow is considered to be incompressible since the change in density is a) 0% b) 2% c) 5% d) 10%
 - The pitot static tube measures
 - a) Total pressure
 - b) Static pressure
 - c) Summation of total and static pressure
 - d) Difference between the total and static pressure
- 3) Which statement is true for the case of incompressible subsonic flow, As the cross-section area increases
 - a) velocity increases & pressure increases
 - b) velocity decreases & pressure increases
 - c) velocity increases & pressure decreases
 - d) velocity decreases & pressure decreases
- 4) The airspeed corrected for position and instrument error is called as ______.
 - a) True airspeed
 - b) Calibrated airspeed
 - c) Indicated airspeed
 - d) Equivalent airspeed
- 5) The planform good for high speeds is _____.
 - a. Elliptical b. Rectangular c. Taper d. Delta
- 6) Define rotational flow
- 7) Define lift and drag
- 8) Define stagnation point
- **9**) Consider an airplane flying at a velocity of 250 m/s. Calculate its Mach number if it is flying at a standard altitude of 5 km
- **10**) Draw the θ - β -M
- 11) The stagnation temperature of an aircraft flying at an altitude of 14km with Mach 0.8 is

12) For a velocity field given as
$$u = \frac{y}{x^2 + y^2}$$
 and $v = -\frac{x}{x^2 + y^2}$, the vorticity is _____

- 13) For a source flow of strength λ , the stream function is given as _____.
- 14) As an angle of attack increases, the aerodynamic center moves towards ______.
- **15**) The total pressure and entropy across the normal shock wave ______ and _____ respectively

Q.2 Answer the following questions. (Attempt any three)

- 1. Draw and explain the C_l vs. α (alpha) curve for symmetrical and unsymmetrical airfoil with their pressure distributions.
- 2. Define (1) angular rotation, (2) vorticity, (3) circulation, (4) stream function (5) velocity potential
- **3.** Write down the assumptions you considered for Bernoulli's theorem and also with a neat sketch derive the Bernoulli's equation for stream line and with Euler's equation.

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- **4.** A 2-D incompressible flow is given by velocity field 3yi+2xj. Does this flow satisfy continuity equation? If yes find the stream function and potential function for the same.
- Q.3A) What are the Aerodynamic forces and moments? Derive equations for Lift and drag with a (07) suitable diagram
- Q.3B) Define the term drag over a body and explain in detail the types of drag and the ways to reduce (08) them.

OR

- Q.3B) Define center of pressure and derive its position at quarter chord point. In low speed wind tunnel (08) at an angle of attack 4°, coefficient of lift and moment coefficient at quarter chord point are 0.85 and -0.09 respectively. Calculate the location of center of pressure w.r.t. chord.
- **Q.4A)** A supersonic flow with $M_1 = 1.5$, $P_1 = 1$ atm, and $T_1 = 288$ K is expanded around a sharp corner (07) through deflection angle of 15°. Calculate M_2 , P_2 , T_2 , P_{02} , T_{02} and the angle that the forward and rearward Mach lines make with respect to the upstream flow direction.

OR

- Q.4A) Consider a velocity field where the x and y components of velocity are given by $u = cx/(x^2 + (07)y^2)$ and $v = cy/(x^2 + y^2)$ where c is a constant.
 - (i) Whether the flow is compressible or incompressible?
 - (ii) Whether the flow is rotational or Irrotational?
 - (iii) Obtain the vorticity and strain..

What type of elementary flow the above velocity field represents?

Q.4B) State Kutta Joukowsky Theorem. Derive an equation for it with a suitable diagram (08)