Reg. No.

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, February 2021

SUBJECT: UNSTEADY AERODYNAMICS [AAE4004]

REVISED CREDIT SYSTEM

(03/02/2021)

Duration: 3 Hours

Max. Marks: 50

(02)

Instructions to Candidates:

- Answer ALL the questions
- Missing data may be suitably assumed
- **1A)** How the unsteady aerodynamics play a significant role in the study of aeroelastic effects of **(02)** airfoil/or wing?
- **1B)** What is meant by quasi-steady aerodynamics? How it is different from steady and unsteady **(03)** aerodynamics?
- **1C)** List out five major factors that significantly affects the aerodynamic loads on a lifting surface. **(05)**
- **2A)** Derive the Laplace equation from the following potential flow equation.

$$\nabla^2 \Phi - \frac{1}{a^2} \left[\frac{\partial^2 \Phi}{\partial t^2} + \frac{\partial}{\partial t} (q^2) + q \cdot \nabla \left(\frac{q^2}{2} \right) \right] = 0$$

- **2B)** Explain the major cause for the failure of Helios, the solar- and fuel-cell system powered **(03)** unmanned aerial vehicle manufactured by AeroVironment?
- **2C)** In the linearization method, aerodynamic problem is divided into two distinct cases viz., thickness **(05)** case and lifting case. Which one of these has the major contribution in lift generation. Justify it.
- **3A)** How does the Bernoulli's equation help in solving an unsteady aerodynamic problem? (03)
- **3B)** Derive the potential flow equation with the help of seven primary equations that plays an **(07)** important role in fluid dynamics.
- **4A)** If the aerodynamic load value becomes a complex number for an unsteady flow problem, how **(02)** does it lead to flutter?
- **4B)** Show the two important relations of inversion formula namely Sohngen Inversion integral for the **(03)** finite interval integral problem.

4C)	Explain in detail the off-body boundary condition of an unsteady aerodynamic problem.	(05)
5A)	Specify a problem to which the Laplace equation can be used to solve for unsteady aerodynamics.	(02)
5B)	Write a short note on free wake and prescribed wake model.	(06)
5C)	Why do we need the Kutta condition in solving an aerodynamics of an airfoil and/ or wing?	(02)