BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTECH **SEMESTER : I**
BRANCH: SE&R **SESSION : MO/2024**

SUBJECT: SR502 ELEMENTS OF AERODYNAMICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Briefly explain the concept of flow similarity.	[5]	1	2
Q.1(b)	Consider two different flows over geometrically similar airfoil shapes, one airfoil being twice the size of the other. The flow over the smaller airfoil has freestream properties given by T_∞ = 200 K, ρ_∞ = 1.23 kg/m3, and V_∞ = 100 m/s. The flow over the larger airfoil is described by T_∞ = 800 K, ρ_∞ = 1.739 kg/m3, and V_∞ = 200 m/s. Assume that both μ and a are proportional to T 1/2. Are the two flows dynamically similar?	[5]	1	4
Q.2(a)	Discuss and write the conservative and non-conservative form of momentum equations.	[5]	2	2
Q.2(b)	Using the concept of elementary Flows, show that the coefficient of pressure around a circular cylinder is given by $Cp = 1\text{-}4\sin^2\theta$.	[5]	2	5
Q.3(a)	Describe the nomenclature of a six digit laminar flow aerofoil. How are the design lift coefficient and the drag bucket features are considered in such aerofoils.	[5]	3	3
Q.3(b)	Describe the concept of vortex sheet replacement with an aerofoil. What is its significance? Also describe the Kutta's condition which parallelly assists in such a consideration.	[5]	3	3
Q.4(a)	Describe the influence of downwash on an extracted aerofoil of a wing structure. Mention the additional features which do evolve due to the downwash factor.	[5]	4	3
Q.4(b)	Illustrate the concept of Prandtl's classical lifting line theory. What are the drawbacks and how those are allayed.	[5]	4	3
Q.5(a)	Obtain an expression of displacement thickness for the case of a compressible flow.	[5]	5	4
Q.5(b)	Using order analysis, derive the Prandtl's boundary layer equation.	[5]	5	5

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