Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024**

**Subject Code: 3150107 Date: 21-05-2024**

**Subject Name: Aerodynamics**

**Time: 02:30 PM TO 05:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1*** | **(a)** | Define Kutta Condition. | **03** |
| | **(b)** | Explain how Bernoulli's principle contributes to lift in an airplane wing. | **04** |
| | **(c)** | Describe the effect of wing shape on air pressure and lift. | **07** |
| **Q.2** | **(a)** | What are the main differences between normal and oblique shock waves? | **03** |
| | **(b)** | Interpret the significance of the angle of attack in relation to an aircraft's lift. | **04** |
| | **(c)** | Analyze the factors that lead to stall and describe how it can be prevented. | **07** |
| | | **OR** | |
| | **(c)** | Explain 5 digit of NACA family with appropriate example. | **07** |
| **Q.3** | **(a)** | What is the Biot-Savart law? | **03** |
| | **(b)** | State the conservation equations that apply to shock waves. | **04** |
| | **(c)** | Critique the use of vortex generators in improving aerodynamic performance. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Summarize the factors that influence the strength of the magnetic field produced by a current-carrying conductor according to the Biot-Savart law. | **03** |
| | **(b)** | Summarize why oblique shock waves are preferable in certain aerodynamic designs, like supersonic inlets. | **04** |
| | **(c)** | Develop a concept for a new type of airfoil that could enhance lift or reduce drag, supported by theoretical principles. | **07** |
| **Q.4** | **(a)** | What is a shock polar diagram? | **03** |
| | **(b)** | Summarize how shock polar diagrams can be used to analyze the effect of oblique shocks on supersonic flow. | **04** |
| | **(c)** | Calculate the pressure, temperature, and density changes across a normal shock given the upstream conditions and Mach number. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | List the conditions under which Helmholtz's theorem holds true. | **03** |
| | **(b)** | Utilize Helmholtz's theorem to solve boundary value problems in fluid dynamics or electromagnetic. | **04** |
| | **(c)** | Analyze the effect of Mach number on the strength of a shock wave. | **07** |
| **Q.5** | **(a)** | Define and explain Turbulent flow. | **03** |

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|---|---|---|---|
| | **(b)** | Develop a practical application or engineering design that leverages Helmholtz's theorem to optimize a system's performance. | **04** |
| | **(c)** | Apply the Biot-Savart law to determine the magnetic field produced by a circular current loop at various points along its axis. | **07** |

**OR**

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|---|---|---|---|
| **Q.5** | **(a)** | Define and explain laminar flow. | **03** |
| | **(b)** | Discuss effect of aspect ratio on finite wing. | **04** |
| | **(c)** | Derive speed of sound equation. | **07** |

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