Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023**

**Subject Code:3161912 Date:10-07-2023**

**Subject Name:Gas Dynamics**

**Time:10:30 AM TO 01:00 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 the following terms:<br>1. Mach number<br>2. Subsonic flow<br>3. Supersonic flow | **03** |
| | **(b)** | State few advantages of wind tunnel testing. | **04** |
| | **(c)** | Explain "Speed of Sound" using appropriate schematic diagram. Derive that speed of sound $a = \sqrt{\gamma RT}$. | **07** |
| **Q.2** | **(a)** | Sketch *T-S* and *h-S* diagrams for nozzles with adiabatic and isentropic flow processes and define nozzle efficiency. | **03** |
| | **(b)** | Determine the speed of sound in air at 30°C. Assume R = 287 J/kg K. | **04** |
| | **(c)** | Derive the following from one dimensional steady flow energy equation. $$\frac{a^2}{\gamma-1}+\frac{1}{2}C^2=\frac{1}{2}C_{\max}^2=h_0$$ | **07** |
| | | **OR** | |
| | **(c)** | Air flows through a duct. The pressure and temperature at station 1 are $p_1$=0.7 atmosphere and $T_1$ = 30°C, respectively. At the second station, the pressure is 0.5 atmosphere. Determine the temperature and density at the second station. Assume the flow to be isentropic. Assume R = 287 J/kg K. | **07** |
| **Q.3** | **(a)** | Which governing equations satisfy the state before and after a normal shock? Write a short note. | **03** |
| | **(b)** | Differentiate between a nozzle and diffuser. | **04** |
| | **(c)** | Prove that for a normal shock, $\frac{P_y}{P_x}=\frac{1+\gamma M_x^2}{1+\gamma M_y^2}$ | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Why expansion shock is impossible? | **03** |
| | **(b)** | State and explain applications of supersonic diffusers. | **04** |
| | **(c)** | Starting from the energy equation for flow through a normal shock, obtain the Prandtl Mayer relation, $M_x^* M_y^* = 1$. | **07** |
| **Q.4** | **(a)** | Define Fanning's coefficient of friction and hydraulic diameter. | **03** |
| | **(b)** | Write a note on Fanno curve with neat sketches. | **04** |
| | **(c)** | Explain the direction of isothermal flow process with friction with neat T-s diagram. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | What do you understand by chocking of flow in case of Fanno flow? | **03** |
| | **(b)** | Explain the difference between Fanno flow and isothermal flow. | **04** |

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|---|---|---|---|
| | **(c)** | Derive an equation describing a Fanno curve, show three Fanno curves on the temperature entropy co-ordinates at three mass flow densities. | **07** |
| **Q.5** | **(a)** | List out assumption in Rayleigh flow. | **03** |
| | **(b)** | What is Rayleigh flow? Give two practical examples. | **04** |
| | **(c)** | Write a note on classification of wind tunnels. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Sketch the line on the T-s diagram and explain the significant of it. | **03** |
| | **(b)** | Differentiate between open and closed-circuit wind tunnels. | **04** |
| | **(c)** | Discuss the practical applications of wind tunnels. | **07** |

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