Seat No.: _____  Enrolment No. 

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018**

**Subject Code: 2171914** **Date: 15/11/2018**

**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. **Use of gas tables and steam tables is permitted.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Define the following terms: (a) Stagnation temperature (c) Stagnation velocity of sound (c) Mach number. | **03** |
| | **(b)** | Explain Mach number and its significance. | **04** |
| | **(c)** | Define Gas dynamics state various laws applied in the study of gas dynamics. | **07** |
| **Q.2** | **(a)** | State assumptions made in deriving equations for Fanno flow. State two engineering fluid flow conditions which can be analyzed as Fanno flow | **03** |
| | **(b)** | Show Rayleigh heating and Rayleigh cooling process on *h-s* diagram. | **04** |
| | **(c)** | Write a short on reference velocities. | **07** |
| | | **OR** | |
| | **(c)** | Air enters the combustion chamber at 60kPa, 350K and 75m/s. the gasses leave the combustion chamber at a mach number of 0.75. for a mass flow rate of air of 30kg/s. Find mach number and stagnation temperature at inlet, the exit stagnation temperature, the rate of heat transfer and rate of fuel burnet of C.V. of 44 MJ/kg. | **07** |
| **Q.3** | **(a)** | Discuss concept of formation of normal shock waves. | **03** |
| | **(b)** | State the assumptions in the analysis of Rayleigh flow and give applications of Rayleigh flow. | **04** |
| | **(c)** | Discuss the following terms with help of sketch (a) Mach angle (b) Zone of Silence (c) zone of action (d) Mach cone. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain (a) stagnation pressure (b) stagnation temperature | **03** |
| | **(b)** | Define fanno flow process and state its governing equations. | **04** |
| | **(c)** | Derive the expression for the pressure ratio across normal shock in terms of density ratio | **07** |
| **Q.4** | **(a)** | What is strength of shock wave? Explain. | **03** |
| | **(b)** | Derive following form of Prandtl-mayer equation $V_1V_2 = a^{*2}$ | **04** |
| | **(c)** | State and explain the practical application of wind tunnel | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Define critical state? Calculate the ratio of stagnation density to critical density for mono-atomic ideal gas | **03** |
| | **(b)** | What are various types of wind tunnels used for low and high speed testing of models? | **04** |
| | **(c)** | Draw the Fanno curve on h-s diagram and discuss the effect of friction in case of subsonic and supersonic flow. What is the limiting value of Mach number? | **07** |
| **Q.5** | **(a)** | Define coefficient of compressibility and bulk modulus. | **03** |

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| | **(b)** | How the enthalpy changes in the Rayleigh flow when heat addition continues beyond maximum enthalpy point? | **04** |
| | **(c)** | A circular duct passes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 3.5bar and 38˚C respectively and coefficient of friction is 0.005. if the Mach number at entry is 0.15, determine: (1) diameter of duct (2) length of duct (3) pressure and temperature at exit. | **07** |

**OR**

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|---|---|---|---|
| **Q.5** | **(a)** | Derive expression for pressure ratio, temperature ratio and velocity ratio for the Fanno flow of a perfect gas. | **03** |
| | **(b)** | Explain the phenomenon of choking in isentropic flow. | **04** |
| | **(c)** | A Mach -2 aircraft engine employs a subsonic inlet diffuser of area ratio 3. A normal shock is formed just upstream of the diffuser inlet. The free stream conditions upstream of the diffuser are: p= 0.10 bar, T= 300 K. Determine (a) Mach number, pressure and temperature at the diffuser exit. (b) Diffuser efficiency including the shock. Assume isentropic flow in the diffuser downstream of the shock. | **07** |

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