

Seat No.: _____

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GUJARAT TECHNOLOGICAL UNIVERSITY**M.E –Ist SEMESTER–EXAMINATION – JULY- 2012****Subject code: 712103N****Date: 09/07/2012****Subject Name: Fluid Mechanics and Gas Dynamics****Time: 2:30 pm – 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.

- Q.1** (a) Derive the momentum equation for one dimensional steady flow. **07**
- (b) Explain the different types of hydraulic similarities that exist between a prototype and its model. **07**

- Q.2** (a) Explain the flow in a constant area duct with heat transfer. **07**
- (b) Show that for steady one dimensional isentropic compressible flow through a duct **07**
- $$\frac{dA}{A} = \frac{dp}{\rho C^2} (1-M^2)$$

OR

- (b) A nozzle in a wind tunnel gives a test-section Mach number of 2. Air enters the nozzle from a large reservoir at 0.69 bar and 310K. The cross-sectional area of the throat is 1000 cm². Determine the following quantities for the tunnel for one dimensional isentropic flow: **07**
- (i) Pressure, temperatures and velocities at the throat and test sections.
 - (ii) Area of cross-section of the test section.
 - (iii) Mass flow rate.

Use Gas table given below at M=1 & $\gamma=1.4$ (Throat section)

p^*/p_o	T^*/T_o	ρ^*/ρ_o
0.528	0.834	0.632

Use Gas table given below at M=2 & $\gamma=1.4$ (Test section)

p/p_o	T/T_o	A/A^*
0.128	0.555	1.687

- Q.3** (a) Derive Rankine-Hugoniot equation for a normal shock wave. **07**
- (b) Explain the performance of convergent divergent nozzle with variation of back pressure. Draw the graphs of effects of variation of back pressure ratio on throat pressure ratio, exit pressure ratio and mass flow parameter. **07**

OR

Q.3 (a) Derive the following from one dimensional steady flow energy equation **07**

$$\frac{a^2}{\gamma-1} + \frac{1}{2} C^2 = \frac{1}{2} (C_{\max}^2) = h_0$$

- (b)** A circular duct passes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 3.45 bar and 38°C respectively and the coefficient of friction 0.005. If the Mach number at entry is 0.15, determine **07**
- (i) The diameter at the duct,
 - (ii) Length of duct,
 - (iii) Pressure and temperature at the exit.

Use Gas table given below at $\gamma=1.4$

M	p/p^*	T/T^*	p_o/p_o^*	c/c^*	$4fL_{\max}/D$
$M_1=0.15$	7.319	1.1945	3.928	0.164	28.354
$M_2=0.50$	2.138	1.143	1.340	0.534	1.069

- Q.4 (a)** Explain the propagation of disturbances in compressible fluid with neat sketch. **07**
(b) Explain variation in area, pressure and velocity with variation in Mach number for nozzle and diffuser. **07**

OR

- Q.4 (a)** Starting from energy equation for flow through a normal shock obtain relations **07**

$$M_x^* M_y^* = 1$$

- (b)** Calculate the Mach number at a point on a jet propelled aircraft, which is flying at 1100 km/hr at sea level where air temperature is 20°C. Take $k=1.4$ and $R=J/Kg K$. **07**

- Q.5 (a)** What is an aerofoil? Define with a sketch the various terms used in aerofoil geometry. **07**
(b) What is lift and drag co-efficient for an aerofoil? Write an expression for lift and drag. Show by a graph how the lift and drag co-efficient vary with angle of attack. **07**

OR

- Q.5 (a)** Derive Euler's equation and Bernoulli's equation for one dimensional incompressible flow. **07**
(b) Define following dimensionless numbers and state their significance for fluid flow problems: Reynold's number, Froude number and Mach number **07**
