Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITYS

M.E Sem-I Regular Examination January / February 2011

Subject code: 711103 N

Subject Name: Fluid Mechanics & Gas Dynamics

Date: 02 /02 /2011 **Time: 02.30 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)** The resistance R to the motion of a completely submerged body depends upon the length of body L, velocity of flow V, mass density of fluid ρ and the kinematic viscosity of fluid υ. Determine expression for R by Π- theorem. **07**

(b) Starting from the energy Equation for flow through a normal shock obtain the following relation: **07**

$M_x * M_y = 1$

Q.2 **(a)** Prove that: **07**

$T_o/T = 1 + (\Upsilon-1)/2 * M^2$ and

$P_0 / P = [1 + (\Upsilon-1)/2 * M^2]^{\Upsilon/(\Upsilon-1)}$

(b) Air is accelerated isentropically from 100 m/s to 400 m/s in a nozzle. If the temperature at the initial state is 400 K and Mach number at the final state is 1.5 , determine (i) the initial mach number (ii) the final temperature. **07**

OR

(b) Describe the behaviour of flow in convergent-divergent nozzle when it is operated at (i) the design pressure ratio (ii) Pressure ratio higher than the design value. (iii) Pressure ratio lower then design value. **07**

Q.3 **(a)** Air is discharge from reservoir at $P_0 = 6.91$ bar and $t_0=325°$ C through a nozzle to an exit pressure of 0.98 bar. If the flow rate is 3600 kg/hr determine for isentropic flow: **07**

(i) Throat area, pressure and velocity,
(ii) Exit area, Mach number, and
(iii)Maximum velocity.

(b) Derive relationship between ϕ and ψ in polar coordinates. **07**

OR

Q.3 **(a)** Show upper and lower branch of Fanno curve represent subsonic and supersonic flows respectivetly. Prove that at the maximum entropy point Mach number is unity. **07**

(b) Friction factor for a 25mm diameter 11.5 meter long pipe is 0.004. The coordinates of air at entry are $p_1= 2$ bar, $T_1=301$ K, $M_1= 0.25$ determine mass flow rate, pressure, temperature and mach number at exit. **07**

Q.4 **(a)** Draw Rayleigh line and show constant entropy line on p- v diagram. **07**

(b) A combustion chamber in a gas turbine plant receives air at 350 K, 0.55 bar and 75 m/s. The air-fuel ratio is 29 and the calorific value of the fuel is 41.87 MJ/ kg. Taking $\Upsilon= 1.4$ and R= 0.287 KJ/kg K for gas determine : (i) the initial and final mach numbers (ii) final pressure, temperature and velocity of gas. **07**

OR

Q.4	**(a)**	What are the different laws on which models are designed for dynamic similarity? Where they are used?	**07**
	(b)	A pipe of diameter 1.5 m is required to transport an oil of sp. Gr. 0.90 and viscosity 0.03 poise at rate of 3000 litter/s. Tests were conducted on a 15 cm diameter pipe using water at 20^0 C. Find the velocity and rate of flow in model. . Viscosity of water at 20^0 C= 0.01poise.	**07**
Q.5	**(a)**	Explain flow past an incline Joukowski aerofoil.	**07**
	(b)	What do you understand by Mach number ? Explain the concept of zone of silence and zone of action.	**07**

OR

Q.5	**(a)**	Derive continuity equation for three dimensional incompressible flow.	**07**
	(b)	Explain the development of shock wave. What is rarefaction wave?	**07**

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