Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (OLD course)• EXAMINATION – SUMMER 2015

Subject Code: 711103 **Date: 13/05/2015**

Subject Name: Fluid Mechanics and Gas Dynamics

Time: 10:30 am to 1:00 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 are permitted.**

Q.1	**(a)**	Explain the difference between sink flow and source flow with figures	**07**
	(b)	What is shock wave and derive the Rankineï Hugoniot equation for normal shock waves.	**07**
Q.2	**(a)**	Define the following terms: (i) Stream function (ii) Velocity potential (iii) Geometric similarity (iv) Dynamics similarity.	**07**
	(b)	The resistance force F of a supersonic plane during flight can be considered as depended upon the length of aircraft L, the velocity V, air viscosity μ and air density ɟ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force.	**07**
		OR	
	(b)	The component in a fluid flow are given by u = $2xy$, v= $a^2 + x^2 - y^2$ (i) show that the flow is possible (ii) Derive the relative stream function	**07**
Q.3	**(a)**	What do you mean by continuity equation? derive continuity equation for three dimensional incompressible flow	**07**
	(b)	What do you mean by lift and drag in aerofoil. Explain the flow past an incline Joukowski aerofoil.	**07**
		OR	
Q.3	**(a)**	Explain the Doublet	**07**
	(b)	The velocity potential function for a two dimensional flow is $\phi = x(2y-1)$, at a point P(4,5), determine (i) The velocity and (ii) The value of stream function	**07**
Q.4	**(a)**	Define fanno flow. Show that the upper and lower branches of a Fanno curve represent subsonic and supersonic flows.	**07**
	(b)	Air at a P_0=10 bar and T_0=400 K is supplied to a 50 mm diameter pipe. The friction factor for the pipe surface is 0.002 if mach number changes from 3.0 at entry to 1.0 at the exit determine (a) the length of the pipe (b) the mass flow rate	**07**
		OR	
Q.4	**(a)**	What do you mean by critical pressure ratio. Derive critical pressure ratio for a compressible flow through a nozzle and also write factors depends on it.	**07**
	(b)	Define the stagnation temperature and critical temperature of a gas. Also derive the equation $\frac{T^*}{T} = \left(\frac{2}{\gamma+1}\right)$ with usual notations.	**07**

Q.5	**(a)**	For a Rayleigh flow obtain flow an expression for the value of maximum possible heat transfer in terms of mach number	**07**
	(b)	Find the velocity and acceleration at a point (1,2,3) after 1 second for three dimensional flow given by $u = yz + t,\ v = xz - t,\ w = xy, m/s$	**07**

OR

Q.5	**(a)**	What do you understand by Mach number? Explain the concept of zone of silence and zone of action.	**07**
	(b)	Air has a velocity of 1000 km/hr at a pressure of 9.81 kN/ m^2 vacuum and a temperature of 47°C. Compute its stagnation property and local mach number. Take atmospheric pressure 98.1 kN/ m^2, R = 287 J/Kg. K and γ =1.4. What would be the compressibility correction factor for a pitot static tube to measure the velocity at a Mach number of 0.8.	**07**

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