Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 712103N **Date: 10/12/2015**

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. **Data book of gas table allowed to use.**

Q.1	**(a)**	Derive Eulerôs equation of motion along a stream line for an ideal fluid stating clearly the assumptions.	**07**
	(b)	Derive an expression for velocity of sound wave for compressible fluid when the process assumed as (I) Isothermal and (II) Adiabatic	**07**
Q.2	**(a)**	Write physical difference between incompressible, subsonic and supersonic flows.	**07**
	(b)	The water is flowing through a pipe having diameter 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe is 35 lit/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.	**07**
		OR	
	(b)	Examine whether the following velocity components represent a physically possible flow? $u_r = r \sin d$, $u_d = 2 r \cos d$	**07**
Q.3	**(a)**	Explain uniform flow with source and sink. Obtain expression for stream and velocity potential function.	**07**
	(b)	A sonic velocity air jet has a temperature of 280 k. Determine (I) Velocity of sound in the jet (II) stagnation temperature and stagnation enthalpy of the jet (III) Stagnation velocity of sound (IV) critical speed of sound (V)crocco number	**07**
		OR	
Q.3	**(a)**	What is an airfoil? Define a neat sketch the various terms used in aero foil geometry.	**07**
	(b)	For air at a stagnation temperature of 1000K , find (I) Vmax (II) The static temperature and velocity for a Mach number of 0.8 (III) The Mach number and velocity for a static temperature of 800k (IV) The Mach number and static temperature for a velocity of 1000 m/s	**07**
Q.4	**(a)**	Derive the Rankine-Hugoniot equations for normal shock waves.	**07**
	(b)	Sketch and describe the flow pattern of an ideal fluid flow past a cylinder with circulation.	**07**
		OR	
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 enters a converging ï diverging nozzle of throat area 10 cm^2 with a pressure of 2.9 MPa and a temperature of 50^0 C. A normal shock occurs in the downstream section where the pressure is 0.5 MPa. Find out the Mach number and pressure just behind the shock wave. Also find the airflow rate through the nozzle.	**07**
Q.5	**(a)**	State Buckinghamôs ´ theorem. Why this theorem is considered superior over the Rayleighôs method for dimensional analysis?	**07**

(b) The air having a velocity of 40 m/s is flowing over a cylinder of diameter 1.5 m and length 10 m, when the axis of the cylinder is perpendicular to the air stream. The cylinder is rotated about its axis and a lift of 6867 N per meter length of the cylinder is developed. Find the speed of rotation and location of the stagnation points. The density of air is given as 1.25 kg/m^3. **07**

OR

Q.5 **(a)** Explain the different types of hydraulic similarities that must exists between a prototype and its model. **07**

(b) A 1:15 model of a flying boat is towed through water. The prototype is moving in sea-water of density 1024 kg/m^3 at a velocity of 20 m/s. Find the corresponding speed of the model. Also determine the resistance due to waves on model if the resistance due to waves of prototype is 600 N. **07**

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