Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:160102 **Date:17/12/ 2015**

Subject Name: FUNDAMENTALS OF JET PROPULSION

Time:2:30pm to 5:00pm **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)**	Compare and explain performance parameters of turbojet, turbofan and turboprop engine based on Mach number, Altitude	**07**
	(b)	Explain working of gas feed and pump feed system liquid rocket engine with the help of schematic diagram.	**07**
Q.2	**(a)**	List advantages and disadvantages of turbojet and turbofan engine. Also explain variation of pressure, temperature and exhaust velocity in turbojet and turbofan engine	**07**
	(b)	Derive Area – Mach relationship for De Laval nozzle.	**07**
		OR	
	(b)	Explain effect of shock wave boundary layer interaction for supersonic inlets	**07**
Q.3	**(a)**	What are the required characteristics and design criteria of gas turbine combustion chamber?	**07**
	(b)	A gas turbine used to propel an aircraft at a Mach number of 0.6. Stagnation temperature at turbine entry is 1027 ˚C, stagnation temperature rise through the compressor is 180 ˚C, calorific value of the fuel is 43000 kJ/kg, mechanical efficiency of power transmission is 98%, specific impulse 30 seconds and free stream conditions at entry are static temperature – 49 ˚C and sound speed 300 m/s. Calculate fuel air ratio, compressor pressure ratio turbine pressure ratio, exhaust nozzle pressure ratio and the Mach number of exhaust jet.	**07**
		OR	
Q.3	**(a)**	With the help of schematic diagram explain the various components of gas turbine combustion chamber	**07**
	(b)	A ramjet engine operates at Mach 2. The diameter of the inlet diffuser at entry is 30 x 10^{-4} m^2 and the stagnation temperature at nozzle entry is 1427 ˚C. The calorific value of fuel is 43MJ/Kg. Efficiency of diffuser, burner and nozzle are 95%, 96% and 94% respectively. The stagnation pressure loss in the combustion chamber is 2% of P_{02}. The free stream conditions are 245K, 44000 N/m^2 and sound speed of 315 m/s. Calculate efficiency of the ideal cycle, flight speed, mass flow rate of air, diffuser pressure ratio, fuel to air ratio and nozzle pressure ratio. Neglect diffuser exit velocity of the air.	**07**
Q.4	**(a)**	Explain optimum expansion, under expansion and over expansion condition of nozzle with the help of diagram.	**07**
	(b)	Determine the exit velocity and mass flow rate for isentropic flow of the air through a nozzle from inlet stagnation condition of 7 x 10^5 N/m^2 and 600 K to an exit pressure of 101325 N/m^2 if the exit area is 6.26 x 10-^{4} m^2. Assume standard values of air for γ, C_p and C_v.	**07**

OR

Q.4	**(a)**	With the help of schematic diagram explain ramjet engine and its working using T-S diagram. What is ram effect in ramjet engine?	**07**
	(b)	Air is discharged form a reservoir at 6.91 atm and 600K through a nozzle to an exit pressure of 0.98 atm. If the flow rate is 3600 Kg/hr. Determine for isentropic flow: throat area, pressure and velocity at throat, exit area and Mach number and maximum velocity.	**07**
Q.5	**(a)**	Explain thrust vectoring techniques used in rocket engines	**07**
	(b)	A rocket nozzle has a throat area of 20 x 10^{-4} m^2 and combustion chamber pressure of 25, bar. If the specific impulse is 150 seconds, speed ratio 2.1, heat release rate is 10,300 KJ/kg and mass flow rate 4.587 kg/s. determine: thrust coefficient, propellant, weight flow coefficient, specific propellant consumption, characteristic velocity, propulsive efficiency, thermal efficiency and overall efficiency.	**07**

OR

Q.5	**(a)**	Explain advantages and disadvantages of solid rocket motor and liquid rocket engine.	**07**
	(b)	An air diffuser expands from 200 cm^2 to 800 cm^2. The approach velocity is 400 cm/s and the discharge velocity is 100 cm/s. The inlet pressure and the ambient pressure are 1 atm and there is a static pressure rise in the diffuser of 0.076 m of water. If the air temperature is 294 K, find the net reaction on the diffuser?	**07**

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