Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2160102 **Date:09/05/2016**

Subject Name: Fundamentals of Jet Propulsion

Time: 10:30 AM to 01:00 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 table is permissible.**

Q.1	**(a)**	In a gas turbine engine the compressor is driven by high pressure stage of a two stage turbine and compresses 5 kg of air per second from 1 bar to 5 bar with an efficiency of 85%. High pressure turbine stage has an efficiency of 87% and its inlet temperature is 980K. the low pressure turbine stage is having efficiency of 82% and both the turbines has different pressure ratios. Exhaust from low pressure turbine is preheated in heat exchanger having an effectiveness of 70%. Neglect the mass of fuel and pressure losses. Estimate the intermediate pressures and temperatures for the cycle. Also calculate the power output of the cycle and overall efficiency. Ambient temperature and pressure 288K and 1 bar..	**10**
	(b)	Write a short note on pulsejet engine.	**04**
Q.2	**(a)**	Derive Mach area relation for the variable area ducts and explain the importance of that relation.	**07**
	(b)	In a turbojet engine with forward facing ram intake, the jet velocity relative to the propelling nozzle at exit is twice the flight velocity. Determine the rate of fuel consumption in kg/s, when developing a thrust of 25000N under the following conditions. Ambient pressure and temperature 0.7 bar and 274K, compression pressure ratio 4:1, flight 810Km/h, turbine pressure ratio 2.23, efficiency of compressor, turbine and nozzle are 85%, 90% and 95%,	**07**
		OR	
	(b)	With a neat sketch explain the zones of combustion chamber.	**07**
Q.3	**(a)**	Explain the Brayton cycle with reheating, intercooling and regenerator. Make the comparison of all the possible modifications compared to simple Brayton cycle.	**07**
	(b)	Write a short note on liquid propellant rocket engines.	**07**
		OR	
Q.3	**(a)**	A normal shock wave occurs at the entry of ram jet diffuser. Engine speed is 2.5 Mach at an altitude of 20000 ft. the area of the entrance section is 3 sq ft. the Mach number entering the combustion chamber is 0.4 and the total temperature of gases entering nozzle is 1900K. Fuel air ratio is 0.016. T_1=248K, P_1=0.465bar, sound speed is 317m/s calculate, c/s area of diffuser, area ratio of nozzle, diffuser pressure ratio and stagnation pressure at the entry to nozzle.	**07**
	(b)	Write a short note on flame tube cooling and fuel injection.	**07**
Q.4	**(a)**	Write a short note on over-expanded nozzles	**07**
	(b)	A supersonic diffuser has the following data for air flow. Inlet Mach number 2.5, exit Mach number 0.3, area ratio of diffuser 2.52. a normal shock occurs within the diffuser. Find the area ratio at which shock occurs, pressure ratio of the diffuser and Mach number upstream and downstream the shock.	**07**

OR

Q.4	**(a)**	Derive the expression for jet thrust and propeller thrust for jet engines.	**07**
	(b)	The pressure ratio of the nozzle is 3, the static conditions at the entry to the nozzle are 750K and 6 bar, the velocity of gases at the entry to the nozzle is 20m/s, calculate: the Mach numbers at nozzle entry and exit, static and stagnation properties at the exit to the nozzle and area ratio of the nozzle.	**07**
Q.5	**(a)**	With neat sketches explain the effect of compressor pressure ratio and temperature ratio on the performance of turbojet engine.	**07**
	(b)	Write a short note on turboprop engine with relative advantages and disadvantages.	**07**

OR

Q.5	**(a)**	What are the factors affecting the net thrust development in ramjet engine	**07**
	(b)	Define the performance parameters of the turbojet engine.	**07**

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