Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER VI – • EXAMINATION – SUMMER 2015

Subject Code: 160102 **Date:04/05/2015**

Subject Name: Fundamentals of Jet Propulsion

Time:10.30AM-01.00PM **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)** Explain the methods of thrust reversing in jet engines. **07**

(b) List the factors affecting the performance of the turbojet engine. Explain the effect of turbine inlet temperature and the compressor pressure ratio on the performance of the turbojet engine. **07**

Q.2 **(a)** A jet propelled plane consuming air at the rate of 1.2 Kg/s is to fly at Mach no 0.6. The diffuser has a pressure coefficient of 0.9, decreases the flow to a negligible velocity. The compressor pressure ratio is 5 and the maximum cycle temperature is 1273K. After expanding in the turbine the gases are expanded in nozzle to a pressure of 0.69bar. The isentropic efficiencies of compressor, turbine and the nozzle are 0.81, 0.85 and 0.91. Calculate the fuel air ratio and the thrust developed by the engine. The static atmospheric conditions are 0.55bar and the 255K. **07**

(b) The ratio of exit to entry area in a subsonic diffuser is 4. The Mach no. of a jet of air approaching the diffuser at stagnation pressure of 1.013 bar and static temperature 290K is 2.5. There is a normal shock at outside the diffuser entry. Flow in the diffuser is isentropic determine Mach no, static pressure, static temperature at exit to the diffuser and the stagnation pressure loss in the diffuser **07**

NORMAL SHOCK PROPERTIES				
M_X	M_Y	P_{OY}/P_{OX}	P_{OY}/P_X	P_Y/P_X
2	0.577	0.729	5.641	4.5
2.5	0.513	0.499	8.526	7.125
3	0.475	0.328	12.061	10.33
3.5	0.451	0.213	16.242	14.125
ISENTROPIC FLOW PROPERTIES				
M	P/P_O	T/T_O	A/A*	M*
0.1	0.99	0.998	5.35	0.134
0.3	0.939	0.682	2.035	0.326
0.5	0.843	0.954	1.339	0.534
0.55	0.814	0.943	1.225	0.585
2.5	0.0585	0.444	2.637	1.826
3	0.027	0.357	4.234	1.964
3.5	0.013	0.289	6.789	2.064

OR

(b) What is the purpose of diffuser in jet engines? With a neat sketch explain the supersonic inlets. **07**

Q.3 **(a)** With the aid of schematic diagram explain the working, advantages, disadvantages and the applications of the solid propellant rockets. **07**

(b) Draw and explain the liquid propellant feed systems for the rocket engines. **07**

OR

Q.3 **(a)** Explain the process of combustion in a gas turbine engine. **07**

(b) Classify the jet engines and with a neat sketch explain the working, advantages and the disadvantages of pulse jet engine. **07**

Q.4 **(a)** Briefly explain the factors affecting the design and performance of the gas turbine engine combustion chamber. **07**

(b) With the aid of schematic diagram, P-V diagram and the T-S diagram explain the Reheat cycle with intercooling and heat exchangers. **07**

OR

Q.4 **(a)** A Brayton cycle works between 1 bar 300K and 5 bar 1250K. There are two stages of compression with perfect intercooling and two stages of expansion. The work out of first expansion stage being used to drive the two compressors. The air from the first stage turbine is again heated to 1250K and expanded through second stage turbine. Calculate the power output of power turbine and cycle efficiency without and with a perfect heat exchanger and compare the results. The rotating components, efficiencies are hundred percent. **07**

(b) Derive the expression for the maximum mass flow rate through the convergent nozzle and explain the choking of nozzle. **07**

Q.5 **(a)** A turbojet engine has the fuel air ratio of 0.015. The flight speed is 0.7 Mach. The air intake by capacity of the engine is 20 Kg/s. For the maximum thrust power condition, calculate thrust, thrust power, thermal efficiency, propulsive efficiency, overall efficiency, TSFC and specific impulse for the turbojet engine. The flight speed is 200m/s and the flight to jet speed ratio is 0.5. **07**

(b) Write a short on rocket thrust chamber cooling. **07**

OR

Q.5 **(a)** A supersonic diffuser has the area ratio of 3.5. The flow through diffuser is isentropic. The stagnation pressure and the Mach number at the entry to the diffuser is 2 bar and 2 respectively. Calculate the static and stagnation conditions (pressure and temperature and the Mach no.) at the exit to the diffuser. The static temperature at the entry to the diffuser is 500K. **07**

$$A/A^* = 1/M\ [2/(\gamma + 1)\ (1 + ((\gamma - 1)/2)\ M^2)]\ (\gamma + 1)/2(\gamma - 1)$$

(b) Write a short note on effect of back pressure in convergent duct and the C-D nozzle. **07**

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