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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160102 **Date: 01/05/2017**

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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	Explain the working principles of an aircraft engine.	
	2	Define air breathing and non air breathing engines.	
	3	What is the primary function of the inlet of an aircraft engine?	
	4	How is forward motion of an aircraft achieved by propeller action?	
	5	How does the aircraft lift off the ground?	
	6	What is a bypass engine?	
	7	What should be the range of fuel air ratio for perfect combustion?	
	8	What is the difference between ramjet engine and scram jet engine?	
	9	How are efficiencies of the inlet diffuser and the propelling nozzle of a turbojet engine defined?	
	10	Why are expansion shocks impossible?	
	11	What is choking of nozzle?	
	12	Define specific impulse.	
	13	Why rocket nozzles are having a diverging shape?	
	14	Name the various possible combustion chamber arrangements.	
Q.2	**(a)**	Write a short note on turbofan engine.	**03**
	(b)	The exit velocity from a jet unit is 650 m/s for an air flow of 40 kg/s through the unit. The aircraft is flying at 250 km/h. calculate the thrust developed, the thrust power and the propulsion efficiency. Neglect mass of fuel.	**04**
	(c)	A turbojet engine inducts 51 kg of air per second and propels an aircraft with an uniform flight speed of 912 km/h. the enthalpy change for the nozzle is 200 kJ/kg. The fuel air ratio is 0.0119 and the combustion efficiency is 0.96. Calculate thermal efficiency of the engine, fuel flow rate, propulsive efficiency and propulsive power, thrust power, propulsive efficiency and TSFC.	**07**
		OR	
	(c)	With a neat sketch explain the different zones of combustion chambers.	**07**
Q.3	**(a)**	Draw h-s diagram representing nozzle operation and diffuser operation separately.	**03**

	(b)	Derive the maximum mass flow condition for variable area ducts.	**04**
	(c)	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 at entry to the diffuser. Find the total loss in stagnation pressure from entry to exit to the diffuser and diffuser exit properties. Conditions at entry to diffuser are 0.5 bar, 300K.	**07**

OR

Q.3	**(a)**	Classify jet engines.	**03**
	(b)	Write a short note on needs of combustion chamber.	**04**
	(c)	Explain the methods of thrust augmentation in detail.	**07**
Q.4	**(a)**	Write in brief about rocket engines.	**03**
	(b)	Define: thrust, propulsive efficiency, thermal efficiency, and overall efficiency in terms of jet engine.	**04**
	(c)	An open cycle plant is to have an intercooler. Intercooling is to an ambient pressure and temperature. Pressure ratio in each stage of compression is 2.5, pressure drop in combustion chamber is 3%, maximum cycle temperature is 1000°C, ambient conditions are 1 bar and 27°C. Find the net power output and efficiency of the cycle.	**07**

OR

Q.4	**(a)**	Differentiate between critical, subcritical and supercritical operations of ramjet diffuser.	**03**
	(b)	Draw Brayton cycle with Reheating and intercooling and enlist the processes.	**04**
	(c)	A nozzle in a wind tunnel gives a test section Mach number 2. Air enters the nozzle from a large reservoir at 0.8 bar and 310 K. the c/s area of the throat is 1020 cm^2. Determine pressure, temperature and velocities at the throat and test section, mass flow rate and c/s area of the test section.	**07**
Q.5	**(a)**	How F/A_f and TSFC affect the performance of an aircraft?	**03**
	(b)	Write a short note on performance of turbojet engine with the change in compressor pressure ratio.	**04**
	(c)	A ramjet engine operates at M 1.5 having the diameter of the inlet diffuser at entry is 50 cm and the temperature at nozzle entry is 1600 K. the velocity of air the exit to diffuser is negligible. Calculate efficiency of the ideal cycle, flight speed, air flow rate, diffuser pressure ratio and air fuel ratio. Pressure loss in combustion chamber is 2% of diffuser delivery pressure. Atmospheric conditions are 245 K and 0.44 bar.	**07**

OR

Q.5	**(a)**	Give a comparison of jet engines and reciprocating engines.	**03**
	(b)	Derive the expressions for jet thrust and pressure thrust for turbojet engine.	**04**
	(c)	With neat sketches explain effect of back pressure in convergent and divergent duct.	**07**

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