GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3160102   **Date:20-11-2024**
Subject Name:Fundamentals of Jet Propulsion
Time:02:30 PM TO 05:00 PM   **Total Marks:70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	What is the Brayton cycle, and how is it related to the operation of a turbojet engine?	**03**
	(b)	1. What is the function of the compressor in a turbojet engine? 2. How does the combustion chamber in a turbojet engine work?	**04**
	(c)	How does the shape of a convergent-divergent nozzle (De Laval nozzle) affect the flow regime, and why is it crucial for achieving supersonic velocities?	**07**
Q.2	**(a)**	What is the role of the turbine in the turbojet engine cycle?	**03**
	(b)	1. What factors affect the efficiency of a turbojet engine? 2. What are the differences between a turbojet engine and a turbofan engine?	**04**
	(c)	Discuss the impact of varying back pressure on the flow characteristics in a nozzle, and explain the conditions under which a nozzle is choked.	**07**
		OR	
	(c)	How does the nozzle exit Mach number relate to the thrust produced by a turbojet engine, and what is the role of nozzle efficiency in optimizing engine performance?	**07**
Q.3	**(a)**	Define Can type combustion chamber.	**03**
	(b)	A turbofan engine has a fuel flow rate of 0.8 kg/s and produces a thrust of 100 kN. Calculate the specific fuel consumption (SFC) in terms of kg/N·s.	**04**
	(c)	A turbofan engine operates at sea level where the air density is 1.225 kg/m³. The engine has a fan diameter of 2 meters, and the air is accelerated through the fan to a velocity of 350 m/s from an inlet velocity of 0 m/s (static condition). Calculate the thrust produced by the turbofan engine assuming all the air passing through the fan is used for propulsion.	**07**
		OR	
Q.3	**(a)**	Define Annular type combustion chamber.	**03**
	(b)	List out design criteria of combustion chamber.	**04**
	(c)	A turbofan engine operates at a cruising speed of 250 m/s. The engine produces a thrust of 120 kN and the fuel energy input rate is 200 MW. Calculate the propulsive efficiency of the engine.	**07**
Q.4	**(a)**	Classify the Rocket.	**03**

(b)	What is meant by "propellant mass fraction" in a rocket?		**04**
(c)	Write an advantage and disadvantage of Ram ject Engine.		**07**

OR

Q.4	**(a)**	What are hybrid rocket engines?	**03**
	(b)	Shortly explain Battery systems and Fuel cell.	**04**
	(c)	Explain chemical and electric powered rockets.	**07**

Q.5	**(a)**	What is the primary challenge of rocket propulsion in space?	**03**
	(b)	A solid rocket motor has an exhaust velocity of 2,800 m/s and uses 1,000 kg of propellant. Calculate the specific impulse I_{sp} of the rocket motor in seconds.	**04**
	(c)	Explain ion and nuclear powered rockets.	**07**

OR

Q.5	**(a)**	What is meant by "exhaust velocity" in the context of rocket engines?	**03**
	(b)	What is Hybrid Propulsion Concept ?	**04**
	(c)	A rocket engine consumes 300 kg of propellant per second. The exhaust velocity of the propellant is 2,500 m/s. What is the thrust produced by the engine?	**07**

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