Question Paper

Exam Date & Time: 22-Jul-2022 (02:00 PM - 05:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

IV Semester Make-up Examination Aircraft Propulsion (AAE 2255)

AIRCRAFT PROPULSION [AAE 2255]

Ма	rks: 50	Duration:	180 mins.
Descriptive Questions			
Answer all the questions. Section Duration: 18			n: 180 mins
1)		Write a note on scramjet engine	(2)
	A)		
	В)	With a neat sketch, explain the pressure variation through a convergent-divergent nozzle with reduction in back pressure.	(4)
	C)	Draw a real Brayton cycle for turbofan engine and explain different processes along with the equations.	(4)
2)		Explain how an afterburner is incorporated in an aircraft engine and what is it's necessity.	(2)
	A)		
	B)	Explain different parameters that affects the aircraft thrust.	(3)
	C)	An aircraft flies with 280 m/s at an altitude of 20 km, where the ambient pressure and temperature are 26.5 kPa and 223.16 K, respectively. The jet speed, pressure, and temperature are 600 m/s, 750 K, and 30 kPa, respectively. The propulsion system of the aircraft consumes 200 kg/s of air and burns 6 kg/s of fuel having a heating value of 42,600 kJ/kg. Calculate the (i) specific thrust (ii) propulsive efficiency using first expression (iii) thermal efficiency (iv) overall efficiency and (v) TSFC.	(5)
3)		Explain why subsonic flow accelerates through a convergent section.	(2)
	A)		
	B)	Draw a neat sketch of ideal Brayton cycle with intercooling and explain why intercooling is important in improving the thermal efficiency of the cycle.	(3)
	C)	In an ideal Brayton cycle, the ratio of the highest to the lowest pressure is 10. The gas enters the compressor at 310 K and leaves the combustion chamber at 1400 K. Determine the (i) gas temperature at exit of compressor (ii) gas temperature at exit of turbine (iii) back work ratio and (iv) thermal efficiency. Take specific heat for air as 1.005 kJ/kg-K and gas as 1.148 kJ/kg-K.	(5)
4)		Explain why turbofan engines are preferred in civil aircrafts.	(2)
	A)		
	B)	With a neat sketch explain the working principle of turboprop engine and write it's advantages and disadvantages.	(3)

- C) A ramjet flies at Mach 3.5 at an altitude where the ambient pressure and temperature are 48 kPa (5) and 240 K, respectively. The mass flow rate of air is 38 kg/s. The gas leaves the combustion chamber at 2000 K. The heating value of the fuel is 45 MJ/kg. Assuming the constant specific heat, determine the (i) thrust (ii) fuel-air ratio and (iii) TSFC.
- 5) Draw a neat sketch of a ramjet engine, it's ideal enthalpy-entropy plot and explain different (3) processes along with the equations.
 - A)
 - B) Explain different design parameters of axial flow compressor.

- (3)
- C) The speed of an axial compressor is 15000 rpm. The mean diameter is 0.6 m. The axial velocity is (4) constant and is 225 m/s. The velocity of whirl at inlet is 85 m/s. The work done is 45 kJ/kg of air. The inlet conditions are 1 bar and 300 K and stage efficiency is 0.89. Determine the fluid deflection angle and the pressure ratio.

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