Reg. No.



(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2024

AIRBREATHING PROPULSION [AAE 2222]

REVISED CREDIT SYSTEM

Time: 3 H	Iours Date: 11 th MAY 2024	Max. Marks: 50
Instructions to Candidates:		
*	Answer ALL the questions.	
*	Missing data may be suitably assumed.	
Q.NO	Questions	Marks
1 A .	Write any four technical differences between Turbofan engand Ramjet engine.	gine (02)
1 B .	With the help of neat diagram derive the thrust equation a propulsion efficiency of an aircraft engine.	and (03)
1C.	For an ideal cycle of a reciprocating IC engine, in which heat added to the working medium air at constant volume, following working conditions are given. $P_a = 1$ bar, $T_a = 320$ Compression ratio = 4, gas constant of air = 287 J/Kg. of Pressure ratio = 4, Adiabatic exponent=1.4. For 1 kg of work medium air determine a) Amount of heat added and amoun heat rejected b) Thermal efficiency of Carnot cycle for the give working conditions c) Thermal efficiency of the cycle d) indicated mean effective pressure (IMEP).	tt is the) K, leg, ting t of (05) The
2A.	Give any four reasons how turboprop engine is different from the traditional engines.	rom (02)
2B.	Write any six technical differences between centrifugal and a flow compressor.	xial (03)
2C.	A Brayton cycle operates with a regenerator of 75% effectivener. The air at the inlet to the compressor is at 0.1 MPa and 30% the pressure ratio is 6 and the maximum cycle temperature 900°C. If the compressor and turbine have efficiencies of 8 each, find the percentage increase in the cycle efficiency due regeneration.	ess. ⁰ C, e is (05) 80% e to
3A.	Define specific fuel consumption and Equivalent shorsepower.	haft (02)

- **3B.** Derive the thrust force equation for a single-spool turbojet engine (03) with an afterburner and bypass facility.
- 3C. For an ideal IC engine operating with combustion at constant pressure given that it is operating with P_a=1 bar, T_a=350 K, compression Ratio =20, Isobaric expansion ratio =2. The working medium is air (k=1.4 and R=287 kJ /kg.K), For 1 kg of air calculate a) Pressure and temperature at all cycle points b) Work done under various cycle legs c) Heat added and heat rejected during various cycle gas d) Carnot cycle efficiency and e) Indicate mean effective pressure.
- **4A.** Why the after-burner facility and duct facility required in **(02)** turbofan engine?
- 4B. Draw and explain the velocity triangle of an axial flow compressor (03) stage using the appropriate notations
- **4C.** (05) With the help of neat diagram derive the thermodynamic analysis of axial flow turbines
- **5A.** Describe the importance of turbine blade cooling in an aircraft engines. (02)
- **5B.** Define the term 'Degree of Reaction'. Also explain the when the degree of reaction at zero, 0.5 and 1 conditions.
- 5C. Air at 1.0 bar and 288 K enters an axial flow compressor with an axial velocity of 150 m/s. There are no inlet guide vanes. The rotor stage has tip diameter of 60 cm and a hub diameter of 50 cm and at rotates at 100 rps. The air enters the rotor and leaves the stator in the axial direction with no change in velocity or radius. The air is turned through 30.2 degrees as it passes through the rotor. Assume a stage pressure of 1.2 and overall pressure ratio 6. Find a) The mass flow rate of air, b) the power required to drive the compressor, c) The degree of reaction at the mean diameter, d) Number of compressor stages required if the isentropic efficiency is 0.85.

(03)