U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Aerospace Engineering **Duration: 3 hrs.**

Course Code: 23AS5PCBPR **Max Marks: 100**

Course: Basic Propulsion

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

				CO	PO	Marks
			UNIT - I			
1	a)	For available engine data, show that the sum of the thrust force for each component of the gas turbine engine is equal to the thrust force developed by the engine using usual thrust force equation.		CO3	PO2	**10**
	b)	Explain the working of a turbofan engine. Use necessary sketches.		CO1	PO1	**10**
		OR				
2	a)	Derive an expression for thrust & specific fuel consumption using cycle analysis for an Ideal Ramjet engine, Highlight the ideal cycle assumptions.		CO2	PO2	**14**
	b)	Compare Jet propulsion and Propeller propulsion		CO1	PO1	**06**
		UNIT - II				
3	a)	With the help of sketches explain the starting of an Intake.		CO1	PO1	**10**
	b)	What are the requirements of a combustor? Explain the sequence of events occurring in the combustion chamber.		CO1	PO1	**10**

	Compressor	Diffuser	Combustion chamber	Turbine	Jet pipe	Nozzle
Outlet area, m^2	0.117	0.132	0.374	0.310	0.420	0.214
Outlet velocity, m/s	124	112	94	271	196	584
Outlet gauge pressure, kPa	648	655	641	145	145	41
Mass flow rate, kg/s	69.4	69.4	69.4	69.4	69.4	69.4

			OR			
	4	a)	What are the different types of combustors? Explain them with necessary sketches.	*CO1*	*PO1*	**10**
		b)	With the help of T-S diagram explain the intake operation for take-off and cruise level condition.	*CO1*	*PO1*	**10**
			UNIT - III			
	5	a)	What are the various pressure influencing factors in an axial flow compressor? Explain them.	*CO2*	*PO2*	**8**
		b)	An axial flow compressor has the following design data: Inlet stagnation temperature = 290 K Inlet stagnation pressure = 1 bar Stage Stagnation temperature rise = 24 K Mass flow of air = 22 kg/s Axial velocity through the stage = 155.5 m/s Rotational speed = 152 rev/s Work done factor = 0.93 Mean blade speed = 205 m/s Reaction at the mean radius = 50 % Determine i) blade and air angles at the mean radius ii) the mean radius iii) the blade height	*CO4*	*PO2*	**12**
			OR			
	6	a)	Explain the working of an axial flow compressor, use necessary sketches. Draw the inlet and outlet velocity triangles.	*CO1*	*PO1*	**10**
		b)	Derive an expression for radial equilibrium in axial flow compressor.	*CO4*	*PO2*	**10**
			UNIT - IV			
	7	a)	What are the various blade cooling methods? Explain with sketches.	*CO1*	*PO1*	**10**
		b)	In a single stage gas turbine, gas enters and leaves in axial direction. The nozzle efflux angle is 68° the stagnation temperature and stagnation pressure at stage inlet are 800°C and 4 bar respectively. The exhaust static pressure is 1 bar, total – to static efficiency is 0.85 and mean blade speed is 480 m/s Determine i) work done ii) the axial velocity which is constant through the stage iii) the total-to-total efficiency and iv) the degree of reaction assume $\gamma = 1.33$ and $C_{pg} = 1.147$ kJ/kg K	*CO4*	*PO2*	**10**

			OR			
	8	a)	With the help of T-S plot explain the working principle of an axial turbine.	*CO1*	*PO1*	**7**
		b)	What are the various losses in axial turbine?	*CO1*	*PO1*	**3**
		c)	In a single-stage axial flow gas turbine, gas enters the turbine at a stagnation temperature and pressure of 1150 K and 8 bar respectively. Isentropic efficiency of stage is equal to 0.88, mean blade speed is 300 m/s and rotational speed is 240 rps. The gas leaves the stage with velocity 390 m/s. Assuming inlet and outlet velocities are same and axial, find the blade height at the outlet conditions when the mass flow of gas is 34 kg/s and temperature drop in the stage is 145 K.	*CO4*	*PO2*	**10**
			UNIT - V			
	9	a)	Explain the working principle of a centrifugal compressor. Highlight the role played by each component.	*CO1*	*PO1*	**10**
		b)	A centrifugal compressor runs at 15000 rpm and produces a stagnation pressure ratio of 4 between the impeller inlet and outlet. Stagnation conditions of air at the intake are 100 kPa and 300 K. The absolute velocity at the compressor intake is without any whirl component. At the exit of the impeller, the flow component of the velocity is 135 m/s and the blades are radial. The total-to-total efficiency of the compressor is 0.78. Draw the velocity triangles and find the blade angle at the inlet. Also compute the slip and slip coefficient. The rotor diameter at the exit is 0.58 m and that at the inlet is 0.25 m.	*CO4*	*PO2*	**10**
			OR			
	10	a)	A centrifugal compressor impeller admits 20 kg/s air at static state of 1 bar, 300 K and runs at 15000 rpm. Isentropic efficiency is 90% for the compression upto 5 bar total pressure. The air enters the impeller eye without prewhirl with the velocity of 120 m/s. Considering the ratio of whirl velocity to tip speed as 0.9 and the internal diameter of the impeller eye as 20 cm. Determine i) rise in the total temperature in the compressor ii) impeller tip speed iii) impeller tip diameter iv) power required to drive the compressor v) outer diameter of the impeller eye	*CO4*	*PO2*	**12**
		b)	Explain the performance characteristics of a centrifugal compressors. Use the necessary sketches.	*CO1*	*PO1*	**8**

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