U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

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

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

Course Code: 23AS5PCBPR / 22AS5PCBPR **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.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Explain the thrust generation mechanism for air breathing and non-air breathing engine. Write the thrust equation for both.	*CO1*	*PO1*	**10**
	b)	A turbo jet engine is propelling an aircraft at a speed of 239.6 m/s and has the following data. Mass flow rate of air = 45 kg/s, mass flow rate of fuel = 2.65 kg/s, thrust produced = 50 kN. Determine the specific thrust, thrust specific fuel consumption, exhaust jet velocity, heat supplied and propulsive efficiency. Take the calorific value of fuel as 42800 kJ/kg and assume the exit pressure is equal to ambient pressure.	*CO1*	*PO2*	**10**
		OR			
2	a)	Formulate the thrust equation for a jet engine with suitable figure.	*CO1*	*PO1*	**05**
	b)	A turbojet engine inducts 51 kg of air per second and propels an aircraft with a uniform flight speed of 912 km/h. The isentropic enthalpy change for the nozzle is 200 kJ/kg and its velocity coefficient is 0.96. The fuel-air ratio is 0.0119, the combustion efficiency is 0.96 and the lower heating value of the fuel is 42 MJ/kg. Calculate i) the thermal efficiency of the engine, ii) the fuel flow rate in kg/h and TSFC, iii) the propulsive power in kW iv) the thrust power, and v) the propulsive efficiency.	*CO1*	*PO2*	**10**
	c)	List out and explain the various aircraft performance parameters.	*CO1*	*PO2*	**05**
		UNIT - II			
3	a)	Illustrate the behavior of subsonic pitot inlets during high mass flow and low mass flow conditions with a T-S diagram.	*CO2*	*PO1*	**06**

		b)	Discuss about the critical, subcritical and supercritical modes of operation.	*CO2*	*PO2*	**06**
		c)	Examine about the starting problem in supersonic inlets.	*CO2*	*PO3*	**08**
			OR			
	4	a)	Draw the schematic diagram of can type and can-annular types of combustion chambers and interpret it.	*CO1*	*PO2*	**08**
		b)	Write a short note on the process of combustion in a gas turbine combustion chamber indicating the various zones.	*CO2*	*PO2*	**08**
		c)	What are the requirements of combustion chamber?	*CO2*	*PO3*	**04**
			UNIT - III			
	5	a)	Explain the working of axial flow compressor with a neat sketch.	*CO1*	*PO1*	**08**
		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)	Describe about the stage of an axial flow compressor and draw the stage velocity triangles.	*CO1*	*PO1*	**06**
		b)	Draw the variation of pressure and velocity of air flow flowing through the stages of an axial flow compressor	*CO1*	*PO1*	**04**
		c)	A 10-stage axial flow compressor provides and overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. The temperature of air at inlet is 15°C, the work is equally divided between the stages. A 50% reaction is used with a blade speed of 210 m/s and a constant axial velocity of 170 m/s. Determine the blade angles. Assume a work done factor of 1.	*CO4*	*PO2*	**10**
			UNIT - IV			
	7	a)	Identify the need for cooling of gas turbine blades and explain the cooling methods with a neat sketch.	*CO1*	*PO1*	**10**
		b)	Explain the detail about matching of turbine and compressor of engine.	*CO4*	*PO2*	**10**
			OR			

	8	a)	Differentiate between turbine and compressor.	*CO1*	*PO1*	**05**
		b)	A multi stage gas turbine is to be designed with impulse stages, and is to operate with an internal pressure and temperature of 6 bar and 900 K, and an outlet pressure of 1 bar. The isentropic efficiency of the turbine is likely to be 85%. All the stages are to have a nozzle outlet angle of 15°, equal inlet and outlet blade angles, a mean blade speed of 250 m/s, and equal inlet and outlet gas velocities. Determine the number of stages required. Take Cp=1.15 kJ/kg.K, γ=1.33.	*CO4*	*PO2*	**10**
		c)	Explain the T-S plot of single stage of axial turbine.			**05**
			UNIT - V			
	9	a)	Illustrate the working principle of centrifugal compressor with a neat sketch.	*CO1*	*PO1*	**08**
		b)	A centrifugal compressor under test gave the following data: Speed 11500 rev/sec; Inlet total head temperature 21°C; Outlet and inlet total head pressure 4 bar and 1 bar; impeller diameter 75 cm. If the slip factor is 0.92, find the compressor efficiency.	*CO4*	*PO2*	**06**
		c)	Analyze the effect of impeller shape (forward, radial and backward curved blades) on performance of a centrifugal compressor.	*CO1*	*PO2*	**06**
			OR			
	10	a)	A centrifugal compressor impeller admits 20 kg/s air at static state of 1 bar, 300K and runs at 15000 rpm. Isentropic efficiency is 90% for the compression up to 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)	Compare centrifugal and axial flow compressors.	*CO1*	*PO1*	**8**

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