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: 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)		Compare the working principles of a turbofan engine and a turboprop engine in the context of air-breathing propulsion. Use necessary sketches.	*CO 1*	*PO 1* *PO 2*	**10**
	b)		Derive an expression for range of an aircraft by considering a steady level flight, relating lift, drag, specific impulse and mass of the aircraft. Highlight the significance for different applications like fighter aircraft, passenger aircraft etc.	*CO 1*	*PO 1* *PO 2*	**10**
			OR			
2	a)		Derive an expression for Thrust & SFC using cycle analysis for an Ideal Ramjet engine. Highlight the ideal cycle assumptions.	*CO1* *CO2*	*PO 2* *PO 3*	**10**
	b)		Explain the thrust generation mechanism for air-breathing and non-air-breathing engine. Use necessary sketches. Write the thrust equation for both.	*CO1* *CO 2*	*PO 1* *PO 2*	**10**
			UNIT – II			
3	a)		Apply the principles of subsonic and supersonic inlets in the context of air-breathing propulsion systems.	*CO 2*	*PO 2* *PO 3*	**10**
	b)		Explain the different types of combustors. Use necessary sketches.	*CO 2*	*PO 2*	**10**
			OR			
4	a)		What are the requirements of a combustor?	*CO2*	*PO2*	**07**
	b)		Explain critical, sub-critical and super-critical mode of operation in a supersonic intake.	*CO2*	*PO2*	**08**
	c)		Derive an expression for isentropic efficiency of a diffuser.	*CO2*	*PO2*	**05**
			UNIT - III			
5	a)		Explain the working of an axial flow compressor. Write the inlet and outlet velocity triangles.	*CO 3* *CO 4*	*PO 2*	**10**

		b)	Derive an expression for stage pressure ratio for an axial flow compressor. Highlight, what are the various stage pressure ratio influencing factors?	*CO 3* *CO 4*	*PO 2*	**10**
			OR			
	6	a)	Analyze the aerodynamic and mechanical considerations in achieving radial equilibrium and discuss how these factors contribute to the overall stability and performance of the compressor.	*CO 3* *CO 4*	*PO 2*	**10**
		b)	Discuss the aerodynamic challenges and benefits associated with transonic flow in compressor blades.	*CO 3* *CO 4*	*PO 2*	**10**
			UNIT - IV			
	7	a)	What are the various blade cooling techniques? Explain them with suitable sketches.	*CO 3* *CO 4*	*PO 2*	**10**
		b)	Given the specifications of a gas turbine engine, analyze how the design of the axial turbine stage should be matched to the preceding compressor stage.	*CO 3* *CO 4*	*PO 3*	**10**
			OR			
	8	a)	Explain the working of a single stage axial flow turbine.	*CO3*	*PO2*	**10**
		b)	A multistage gas turbine is to be designed with impulse stages and is to operate with an inlet pressure and temperature of 6 bar and 900K and an outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 750 and equal outlet and inlet blade angles. Mean blade speed of 250 m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages required.	*CO3*	*PO2*	**10**
			UNIT - V			
	9	a)	Explain the working of a centrifugal compressor. Highlight, the different parts of the centrifugal compressor.	*CO 3* *CO 4*	*PO 1*	**08**
		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 0.25m.	*CO 3* *CO 4*	*PO 2*	**08**
		c)	Compare centrifugal and axial compressors.	*CO1*	*PO1*	**04**
			OR			
	10	a)	Explain the performance characteristics of a centrifugal compressors.	*CO1*	*PO1*	**08**
		b)	What is vane type and vaneless diffusion?			**04**
		c)	Derive an expression for work done per unit mass, in terms of pressure ratio.	*CO3*	*PO1*	**08**

****