CBCS SCHEME

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BAE403

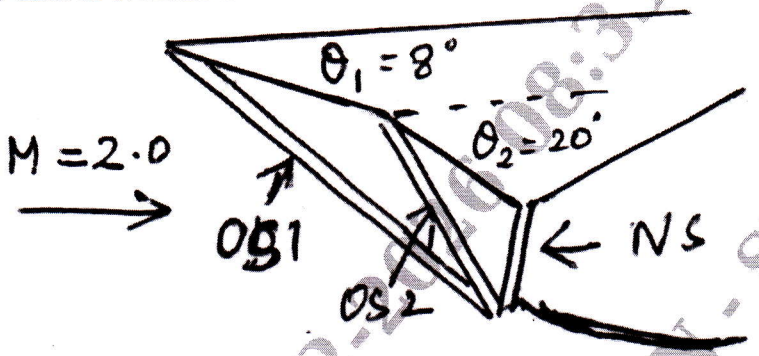
Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	With the help of PV and TS diagram, explain the cycle analysis of four stroke engine.	10	L3	CO1
	b.	What are the drawbacks of piston engine and requirement of gas turbine engines?	10	L2	CO1
		OR			
Q.2	a.	Differentiate two stroke and four stroke engines.	10	L2	CO1
	b.	Explain the working principle of Gas turbine engine. Also draw the T – S diagram and PV diagram.	10	L3	CO1
		Module – 2			
Q.3	a.	An advanced fighter aircraft with engine operating at Mach 0.8 and 10 km altitude where, T_a = 223.297 k and P_a = 0.2649 bar has the following uninstalled performance data and uses a fuel with C.V = 42,800 KJ /kg; Thrust = 50KN; Mass flow rate of air = 45 kg/s Mass flow rate of fuel = 2.65 kg/s. Determine the specific thrust, thrust specific fuel consumption; Exit velocity, thermal efficiency, propulsive efficiency and overall efficiency. (Assume Exit pressure equal to ambient pressure)	12	L4	CO2
	b.	Define Thrust of an engine and derive the thrust equation for a general.	08	L2	CO2
		OR			
Q.4	a.	Derive the momentum theory for propellers with suitable assumptions.	10	L3	CO2
	b.	Using suitable graphs explain the performance characteristics of turbojet engine.	10	L2	CO2

Module – 3

Q.5	a.	A two – ramp external compression inlet in a supersonic flow is shown in fig. Q. 5 (a). Calculate the total pressure recovery of this inlet assuming the best back pressure has placed the normal shock on the lip. Also compare this inlet to Normal-Shock-inlet at Mach 2.0.  Fig. Q.5 (a) OS1 – Oblique shock 1 OS2 – Oblique shock 2 NS – Normal shock	12	L4	CO3
	b.	Performance wise highlight the requirements of a good inlet. Draw the streamline pattern along with T – S diagram for a subsonic inlet under varying speed operations.	08	L3	CO3
		OR			
Q.6	a.	Plot Mach number, static pressure, static temperature and static density variations along the longitudinal axis of a convergent	10	L3	CO3
	b.	A De Laval Nozzle has to be designed for an Exit Mach number of 1.5 with Exit diameter of 200 mm. Find the ratio of throat area /Exit area necessary. The reservoir conditions are given as $P_o = 10^6$ Pa, $T_o = 20°C$. Find also the maximum mass flow rate through the nozzle. What will be the Exit pressure and temperature?	10	L4	CO3
		Module – 4			
Q.7	a.	Explain the working of a centrifugal compressor and draw the velocity triangles.	08	L3	CO4
	b.	A centrifugal compressor running at 9000 rpm. Delivers 6000 m^3 /min of free air. The air is compressed from 1 bar and 20°C to a pressure ratio of 4 with an isentropic efficiency of 82%. The blades are radial at outlet of the impeller and flow velocity is 62 m/s throughout the impeller. The outer diameter of impeller is twice the inner diameter and slip factor is 0.9 Find: i) Final temperature of air ii) Theoretical power iii) Impeller diameter at inlet and outlet iv) Breadth of impeller at inlet.	12	L4	CO4

		OR			
Q.8	**a.**	Explain the working of a axial compressor and draw the velocity triangles.	**08**	**L3**	**CO4**
	b.	The conditions of air at the entry of an axial compressor stage are $P_1 = 1.024$ bar and $T_1 = 314$ k. The air angles are $\beta_1 = 51°$, $\beta_2 = 90°$, $\alpha_1 = \alpha_2 = 7°$ respectively. The mean diameter and peripheral speed are 50cm and 100 m/s. respectively. Mass flow rate through stage is 25 kg/s. Work done factor is 0.95 and mechanical efficiency is 92%. Assume forced vortex flow. Determine: i) Rotor blade air angle ii) Specific work iii) Degree of Reaction iv) loading coefficient	**12**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Mention the classifications of gas turbine cooling methods. Explain any two of them with neat sketches.	**10**	**L3**	**CO5**
	b.	Discuss the following: i) Types of combustion chamber ii) Combustion process with neat sketch.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	With the help of a neat sketch, explain the working principle of a radial turbine. Also draw the velocity triangles.	**10**	**L3**	**CO5**
	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 temperature 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) The work done ii) The axial velocity which is constant throughout the stage.	**10**	**L4**	**CO5**

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