



**B.E DEGREE EXAMINATIONS: NOV/DEC 2022**

(Regulation 2018)

Fifth Semester

**AERONAUTICAL ENGINEERING**

U18AEI5205: Aircraft Propulsion

**COURSE OUTCOMES**

<b>CO1:</b>	Analyze overall performance of an aircraft engines.
<b>CO2:</b>	Explain the relation between area ratio and external deceleration ratio for diffuser.
<b>CO3:</b>	Describe the combustion mechanisms of gas turbine engine.
<b>CO4:</b>	Calculate the operating characteristics of compressors, turbines, and nozzles.
<b>Time: Three Hours</b>	<b>Maximum Marks: 100</b>

**Answer all the Questions:-**

**PART A (10 x 2 = 20 Marks)**  
**(Answer not more than 40 words)**

1.	In a gas turbine power plant, the compressor work is 400 kJ/kg, the heat supplied is 1 MJ/kg and the turbine work is 600 kJ/kg. Calculate the thermal efficiency of plant.	CO1	[K <sub>3</sub> ]
2.	A turbo fan engine has a bypass ratio of 5 and a total mass flow rate is 120kg/s. Calculate the mass flow rate through bypass duct.	CO1	[K <sub>3</sub> ]
3.	List any two requirements of an aircraft intake.	CO2	[K <sub>1</sub> ]
4.	Define “buzz” in supersonic inlets	CO2	[K <sub>1</sub> ]
5.	Compare lean and rich mixture	CO3	[K <sub>2</sub> ]
6.	What is the purpose of swirl vanes in combustion chamber?	CO3	[K <sub>2</sub> ]
7.	An axial flow compressor that generates a stagnation pressure ratio of 4, operating with inlet and exit stagnation temperatures of 300K and 400K respectively .If the ratio of specific heats is 1.4, Determine the isentropic efficiency of compressor .	CO4	[K <sub>3</sub> ]
8.	An aircraft with a turbojet engine flies at a velocity of 100 m/s. If the jet exhaust velocity is 300 m/s, the propulsive efficiency of the engine, assuming a negligible fuel-air ratio	CO1	[K <sub>3</sub> ]
9.	In after-burner engine, variable area nozzle is required? Why	CO4	[K <sub>2</sub> ]
10.	List the various losses in a nozzle	CO4	[K <sub>1</sub> ]

**Answer any FIVE Questions:-**  
**PART B (5 x 16 = 80 Marks)**  
**(Answer not more than 400 words)**

11.		<p>The airplane Fiat G91Y is a single-seat Strike and Reconnaissance fighter powered by two General Electric J85-GT-13A turbojets each rated at 12.12 kN at an altitude of 9150 m where the ambient conditions are 32 kPa and 240 K. The pressure ratio across the compressor is 12 and temperature at the turbine inlet is 1400 K. The aircraft speed is 310 m/s. Assume ideal operation for all components, assume nozzle is fully expanded and constant specific heat in all processes, <math>C_p = 1.005 \text{ kJ/kg} \cdot \text{K}</math>. The heating value of the fuel is 42,700 kJ/kg.</p> <p>Determine</p> <ol style="list-style-type: none"> <li>1. Fuel-to-air ratio</li> <li>2. The velocity of the exhaust gases</li> <li>3. The air mass flow rate</li> <li>4. The propulsive efficiency</li> <li>5. The thermal efficiency</li> <li>6. The overall efficiency</li> </ol>	16	CO1	[K <sub>4</sub> ]
12.		Compare external deceleration and internal deceleration and hence derive an expression showing the relation between minimum area ratio and deceleration ratio.	16	CO2	[K <sub>3</sub> ]
13.	a)	Briefly discuss about various factors affecting combustion chamber design.	08	CO3	[K <sub>2</sub> ]
	b)	With neat sketch, explain the working principle of combustion chamber.	08	CO3	[K <sub>2</sub> ]
14.	a)	Draw the velocity diagram and derive the work done equation for single axial flow compressor.	08	CO2	[K <sub>3</sub> ]
	b)	A 10-stage axial flow compressor provides an overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. When the temperature of air at inlet is 15°C. The work is equally divided between stages. 50% reaction is used with blade speed of 210 m/s and constant axial velocity of 170 m/s. Estimate the blade angles. Assume a work done factor of 1.	08	CO4	[K <sub>4</sub> ]

15.	a)	With neat sketch briefly, discuss about the various methods of turbine blade cooling.	08	CO4	[K <sub>3</sub> ]
	b)	With neat sketch, explain the working principle of afterburner technique and also mention its advantages and disadvantages.	08	CO3	[K <sub>2</sub> ]
16.	a)	Define thrust and derive the thrust equation for turbojet engine operating with optimum expansion condition.	08	CO1	[K <sub>3</sub> ]
	b)	Discuss the various thrust reversal mechanisms used in jet engines.	08	CO4	[K <sub>2</sub> ]

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