Reg. No. : | | | | | | | | | | | | |

Question Paper Code: 1104310

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV / DEC 2024
Fourth Semester
Aerospace Engineering
U20AE405 – AIR BREATHING PROPULSION
(Regulation 2020)

Time: Three Hours | Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Identify the GT engine performance parameter.
2. Define jet engine "Thermal efficiency".
3. List out the types of subsonic combustion chambers and its zones.
4. Write the significance of variable area nozzle and its methods.
5. Write the role of "Slip" in centrifugal flow compressor.
6. What are the requirements to obtain HP ratio per stage of the AFC?
7. What are the non-dimensional quantities of axial flow turbine?
8. What do you understand the centrifugal stress on turbine blade?
9. Write the principle of nuclear ramjet.
10. List out the variables influencing the performance of ramjet.

PART – B (5 x 16 = 80 Marks)

11. (a) (i) List out and explain the factors affecting the thrust. (12)

(ii) Derive the propeller efficiency of turboprop engine (4)

(OR)

(b) A single-spool turbojet engine is powering an aircraft flying at Mach number of 0.85 at an altitude where the ambient conditions are T_a=233K, P_a=26.4 kPa. The nozzle is choked and the gases are leaving the nozzle with velocity of 600 m/s; the nozzle area is 0.2 m^2. The maximum temperature is 1,200 K and the fuel-heating value is 43,000 kJ/kg. Calculate (16)

(i) Compressor pressure ratio (ii) The fuel-to-air ratio
(iii) Thrust force (iv) Overall efficiency

12. (a) (i) Describe the main requirements for complex design of a combustion chamber. (12)

(ii) What are the disadvantages of annular combustion chamber? (4)

(OR)

(b) (i) Classify and explain the thrust reverser systems. (10)

(ii) Write short note on variable geometry fixed ejector nozzle. (6)

13. (a) (i) List out the advantages of AFC over the CFC. (6)

(ii) Explain the free vortex method of axial flow compressor. (10)

(OR)

(b) Air at 1 bar and 15°C enters a three-stage axial compressor with a velocity of 120 m/s. There are no inlet guide vanes, and constant axial velocity is assumed throughout. In each stage the rotor turning angle is 25°. The annular flow passages are shaped so that the mean blade radius is everywhere 20 cm. The rotor speed is 9000 rpm. The polytropic efficiency is constant at 0.9. The blade height at the inlet is 5 cm. Draw the velocities diagram and calculate (16)

(i) Specific work for each stage
(ii) The mass flow rate
(iii) The power necessary to run the compressor
(iv) The stage temperature ratios
(v) The overall compressor pressure ratio
(vi) The blade height at the exit from the third stage
(vii) The degree of reaction of the first stage

14. (a) With neat sketch, explain the layout of an axial turbine and its related velocity triangles. (16)

(OR)

(b) Briefly describe about the various turbine blade cooling methods. (16)

15. (a) With neat sketch, describe about the ideal ramjet engine and its different states. (16)

(OR)

(b) (i) Explain about the scramjet engine. (10)

(ii) Write short note on Ramp injector in scramjet combustor. (6)

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