Reg. No. : E N G G T R E E . C O M

Question Paper Code : 30017

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fourth Semester

Aeronautical Engineering

AE 3402 – AIR BREATHING PROPULSION

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the advantages of open cycle gas turbine cycle?
2. What is thrust Augmentation?
3. How supersonic inlets are different from sub sonic inlets?
4. Why thrust reversal is primary importance in aircraft landing?
5. How is flame stabilization done in jet engine combustor?
6. Name fuels used in aircraft and state its important characteristics.
7. List various types of compressor designs.
8. Define degree of reaction of an axial flow compressor.
9. Why is 50% degree of reaction design prefened in gas turbines?
10. Why turbine blade cooling is to be done?

PART B — (5 × 13 = 65 marks)

11. (a) Explain principle of operation of piston engine for aircraft application and its advantages and disadvantages.

Or

(b) What are the different thrust augmentation methods? Explain them in detail with suitable sketches.

12. (a) Explain stall in subsonic inlets and operational modes of subsonic inlets.

Or

(b) Explain in detail about different operational modes of supersonic inlet with neat sketch.

13. (a) Explain different operating variables on gas turbine engine combustion chamber performance.

Or

(b) Explain different types of combustion chamber with neat sketch and their advantages and disadvantages.

14. (a) Write brief note on nozzle choking and minimum condition to be satisfied for it with appropriate plots.

Or

(b) Draw with a neat diagram and explain the operating conditions of the convergent divergent nozzle.

15. (a) What is the need for matching of compressor and turbine? Write down the matching procedure with suitable sketches. Also briefly discuss the methods of turbine blade cooling and mention its advantages and disadvantages.

Or

(b) A sixteen-stage axial flow compressor is to have a pressure ratio of 6.3. Tests have shown that a stage total-to-total efficiency of 0.9 can be obtained for each of the first six stages and 0.89 for each of the remaining ton stages. Assuming constant work done in each stage and similar stages find the compressor overall total-to-total efficiency. For: a mass flow, rate of 40 kg/s determine the power required by the compressor. Assume an inlet total temperature of 288 K.

Also discuss the factors affecting stage pressure rise of an axial flow compressor with suitable sketches.

PART C — (1 × 15 = 15 marks)

16. (a) A single stage axial flow turbine operates with an inlet temperature of 1100 K and total pressure of 3.4 bar. The total temperature drop across the stage is 144 K and the isentropic efficiency of the turbine is 0.9. The mean blade speed is 298 m/s and the mass flow rate is 18.75 kg/s. The turbine operates with a rotational speed of 12000 rpm. If the convergent nozzle is operating under choked condition determine (i) blade-loading coefficient (ii) pressure ratio of the stage and (iii) flow angles.

Or

(b) A single stage gas turbine operates at its design condition with an axial absolute flow at entry and exit from the stage. The absolute flow angle at the nozzle exit is 70 deg. At stage entry, the total pressure and temperature are 311 kPa and 850 °C respectively. The exhaust static pressure is 100 kPa, the total to static efficiency is 0.87 and mean blade speed is 500 m/s. Assuming constant axial velocity through the stage, determine (i) the specific work done (ii) the Mach number leaving the nozzle (iii) the axial velocity (iv) total to total efficiency (v) stage reaction.

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