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Question Paper Code : 40054

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2021.

Fourth Semester

Aeronautical Engineering

AE 8404 – PROPULSION - I

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate between the operation of aircraft piston engines and jet engines.

2. What are the advantages of closed gas turbine cycle?

3. Why over expansion is not possible in subsonic flows?

4. Draw T-S diagram of turbo jet engine.

5. Define solidity and state its importance.

6. Name the factors influencing the design of a turbine?

7. What is the function of a swirler in a can type gas turbine combustion chamber?

8. Mention the functions of impeller in a centrifugal air compressor.

9. Differentiate between the axial flow compressor over the centrifugal flow compressor.

10. Define degree of reaction of an axial flow compressor.

PART B — (5 × 13 = 65 marks)

11. (a) With neat sketches explain the effect of compressor pressure ratio and turbine inlet temperature on performance of turbojet engine. (13)

Or

(b) Derive the thrust equation and also explain the working principle of a typical twin spool turbofan engine with neat sketches. (13)

12. (a) Classify gas turbine combustion chambers. List the advantages and disadvantages of any three types of combustion chambers from structural design and combustion performance point of view? (13)

Or

(b) Sketch the typical flow pattern in the flame tube of a typical gas turbine combustion chamber and mark all the regions in the flow pattern. Explain the salient features of these regions. (13)

13. (a) Explain with a neat sketch of 50% degree of reaction velocity diagram.(13)

Or

(b) Explain various methods of turbine blade cooling. (13)

14. (a) Derive Euler's turbo machinery equation for compressors and explain on the working principle of centrifugal compressor. (13)

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 stage 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 40kg/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. (13)

15. (a) Explain the starting problem associated with supersonic inlets. What is the remedy for this problem? (13)

Or

(b) Derive an expression for minimum frontal area ratio as a function of deceleration ratio and maximum allowable velocity ratio for a subsonic inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Explain blade profile design consideration with a neat sketch. (15)

Or

(b) A single sided centrifugal compressor is fitted to an aircraft which is flying at a certain altitude. The impeller eye reached air at a velocity of 230 m/s. The free stream pressure and temperature of the air are 0.23×10^5 Pa and 217 K respectively. The impeller eye has a provision of air pre whirl of 25° at all radii. The inner and outer diameters of the eye are 0.18 m and 0.33 m respectively. The diameter of the impeller periphery is 0.54 m and the impeller rotates at a speed of 16,200 rpm. The air mass flow rate is 3.6 kg/s. Estimate the stagnation pressure at the compressor outlet. (15)

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