Sixth Semester B. Tech Degree Examination

Branch: Aeronautical Engineering

(Model Question Paper)

(2013 Scheme)

13.603: PROPULSION-I

Time: 3 hours Max. Marks:100

PART- A

Answer all questions. Each question carries 2 marks

1. Show the ideal Brayton cycle on P-V and T-S diagrams labelling the compressor work and turbine work.
2. Write the thrust equation. What are the different factors affecting thrust?
3. What is the use of flame holders during the process of combustion?
4. Briefly explain subsonic inlets.
5. Write short note on supersonic inlets.
6. Explain the process of choking in isentropic nozzles.
7. Briefly explain under-expanded and over-expanded nozzles.
8. What are the types of thrust reversers used in aircrafts?
9. What are the different types of propellers used in aircrafts?
10. What are the selection criteria for an aircraft propeller?

(10x2=20 Marks)

PART – B

Answer any one question from each module. Each question carries 20 marks

MODULE-1

11. a) What is trust augmentation? What are the different methods of thrust augmentation employed in gas turbine engines?

    b) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 20^0C. The pressure of the air after compression is 4 bar. The isentropic efficiencies of the compressor and turbine are 80% and 85% respectively. the air-fuel ratio used is 90:1. If the flow rate of air is 3 kg/s, find:
    (i) Power developed.
    (ii) Thermal efficiency of the cycle.
    Assume Cp= 1.0 kJ/kg K and γ= 1.4 for air and gases. Calorific value of fuel= 41800kJ/kg.

OR

12. a) What are the different types of combustion chambers used in gas turbine engines? Explain each one of them.

b) What are the line design important factors affecting combustion chamber design?

(10*2= 20 marks)

MODULE-2

13. a) Explain the boundary layer development under pressure gradient in subsonic diffusers.

    b) What are the different factors to be considered while designing a subsonic inlet?

OR

14. a) What are the different modes of inlet operation in a supersonic inlet?

    b) Explain the starting problem in supersonic inlets.

(10*2= 20 marks)

MODULE- 3

15. a) What are the different possible flow conditions in a supersonic nozzle? Explain with the help of a graph.

    b) What is the percentage variation in thrust between sea level and 25 km for a rocket having a chamber pressure of 20 atm and an expansion area ratio of 6? Use k= 1.30.

(10*2= 20 marks)

OR

16. Design a nozzle for an ideal rocket engine that has to operate at 25km altitude and give 5000N thrust at a chamber pressure of 2.068 MPa and a chamber temperature of 2800K. Assuming k= 1.30 and R= 355.4 J/kg K, determine throat area, exit area, throat velocity and exit temperature.

(20*1=20 marks)

MODULE-4

17. a) Explain the phenomenon of hovering in helicopters.

    b) Explain briefly the blade element theory and momentum theory. Also state the assumptions used for these theories.

(10*2= 20 marks)

OR

18. An aircraft cruises at 644 km/hr speed at seal level, is powered by a 3-bladed propeller (connected to the engine, which rotates at 2600 rpm, through a 1:2 gear box) and is supplied 1491.5 kW of power. The propeller is designed with blades of NACA blade sections. Compute the propeller diameter and the efficiency of the propeller at this operating condition. If the propeller is a variable pitch propeller what would be its efficiency at 161 km/hr.

(20*1=20 marks)