B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014

Fifth Semester

Aeronautical Engineering

AE 2304/AE 1351/AE 71/080180029/10122 AE 504 –PROPULSION – II

(Regulation 2008/2010)

Time : Three hours   Maximum : 100 marks

(Gas tables may be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by vortex blading?

2. Why is turbine blade to be cooled?

3. State the operating principle of ramjet.

4. How does ramjet differ from scramjet?

5. State the internal ballistics characteristics of rocket.

6. Define specific impulse of rocket.

7. Name the hardware components of rocket.

8. What are the fuel-oxidizer combinations for hybrid rocket?

9. What is the principle of ion propulsion rocket?

10. Define solar sail.

PART B — (5 × 16 = 80 marks)

11. (a) Write a short note on the following:

    (i) Difference between impulse and reaction turbines   (8)

    (ii) Turbine Blade cooling methods.   (8)

Or

(b) In a single-stage impulse turbine the nozzle discharges the fluid on to the blades at an angle of 25° to the plane of rotation and the fluid leaves the blades with an absolute velocity of 300m/s at an angle of 120° to the direction of motion of the blades. If the blades have an equal inlet and outlet angles and there is no axial thrust, estimate the blade angle, power produced per kg/s of the fluid. (16)

12. (a) (i) Explain critical, subcritical and supercritical operation of ramjet engine with neat sketch. (10)

(ii) Explain the combustion process in ramjet engine. (6)

Or

(b) (i) A ramjet engine operates at M = 1.5 at an altitude of 6.5 km. The diameter of the inlet diffuser at entry is 0.5 m and the stagnation temperature at the nozzle entry is 1600 K. The calorific c value of the fuel used is 40 MJ/kg. The properties of the combustion gases are same as those of air, i.e. = 1.4, R = 287 J kg 1 K. The velocity of air at the diffuser exit is negligible,

Assuming the efficiency of diffuser combustion chamber and nozzle as 0.9, 0.98 and 0.96 respectively. Determine the following

(1) Efficiency of the ideal cycle, (3)

(2) Fuel-air ratio and (3)

(3) Diffuser pressure ratio (2)

(ii) Explain about scramjet engine with neat sketch. (8)

13. (a) (i) A rocket has a propellant flow rate of 5 kg/s, nozzle exit diameter of 10 cm, nozzle exit pressure of 1.02 bar, ambient pressure of 1.013 bar, thrust chamber pressure of 20 bar and thrust of 71 kN. Calculate the specific impulse, specific propellant consumption and effective jet velocity. (6)

(ii) Explain about the rocket nozzle classification with neat sketch. (10)

Or

(b) (i) A rocket is to be designed to produce 5 MN of thrust at sea level. The pressure in the combustion chamber is 7 MPa and the temperature is 2800 K. If the working fluid is assumed to be a perfect gas with the properties of air at room temperature, determine the following:

(1) Specific impulse, (2)

(2) Mass flow rate, (2)

(3) Throat diameter, (2)

(4) Exit diameter (2)

(ii) Explain the performance of drag free, gravity free rocket. (8)

14. (a) (i) Explain about the selection criteria for solid propellant rockets. (8)

       (ii) Explain about cooling in liquid propellant rockets. (8)

Or

(b) (i) A chemical rocket is used for launch into earth orbit. At the end of the combustion chamber the stagnation temperature is 3000 K and the stagnation pressure is 2 MPa. The molecular weight of the combustion products is 26. The gases expand isentropically as an ideal gas mixture with specific heat ratio 1.2. The area ratio A_e / A_* of the nozzle is 20, and the throat diameter is 0.1 m. At sea level, determine the rocket thrust. (8)

       (ii) What is the difference between liquid propellant rocket and solid propellant rockets? (8)

15. (a) (i) Explain the electric rocket propulsion with neat sketch. (8)

       (ii) Explain the hybrid rocket with neat sketch. State its advantages and disadvantages. (8)

Or

(b) Write short note on the following.

       (i) Nuclear rocket propulsion (8)

       (ii) Nozzle less propulsion (8)

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