CBCS SCHEME

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18AS53

Fifth Semester B.E. Degree Examination, July/August 2021
Aerospace Propulsion

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Explain the following performance parameter of Aircraft propulsion with definition:
i) Thrust
ii) Specific fuel consumption
iii) Propulsive efficiency
iv) Specific Impulse
v) Thermal efficiency. **(10 Marks)**

b. An aircraft propeller flies at a speed of 450kmph. The diameter of the propeller is 4.1m and the speed ratio is 0.79. The ambient conditions of air the flight altitude are T = 255K and P = 0.55 bar. Find the following: i) Thrust ii) Thrust power iii) Propulsion efficiency. **(10 Marks)**

2 a. Explain about the turbofan engine with clear diagram and its advantages and disadvantages. **(10 Marks)**

b. With a neat sketch, explain the construction and working principle of Ramjet Engine and its advantages and disadvantages. **(10 Marks)**

3 a. Explain with neat sketch working principle of liquid propellant rocket engine with pump feed system. **(10 Marks)**

b. Explain working principle of Hybrid rocket engine with neat sketch and its advantages and disadvantages. **(10 Marks)**

4 a. Explain working principle of geometries of Ion thrusters with neat sketch and its advantages and disadvantages. **(10 Marks)**

b. A Rocket flies at a speed of 20,000kmph with an effective exhaust jet velocity of 1400m/s and the heat produced by the propellant is 7000kJ/kg. If the propellant flow rate is 5.4kg/s. Determine: i) Propulsion power ii) Propulsive efficiency iii) Engine output iv) Overall efficiency. **(10 Marks)**

5 a. Explain about types of propellants and propellant tanks. **(10 Marks)**

b. Compare helium to nitrogen gas when used for pressurizing a propellant tank with 250kg of 90% hydrogen peroxide by estimating their required mass and volume. The pressurizing tank is initially at a gas pressure P_o of 14MPa and the required propellant final tank pressure P_p is 3.40MPa. The density of this liquid propellant is 1388kg/m^3 and the ambient temperature is 298K. Assume $P_g \simeq P_p$ together with ideal flow conditions so that we may use well-known expressions for isentropic and isothermal expansions. **(10 Marks)**

6 a. Explain about the propellant properties and liquid oxidizers. **(07 Marks)**

b. Explain about liquid monopropellants and gaseous propellants. **(07 Marks)**

c. Explain about combustion process. **(06 Marks)**

7 a. Explain about propellant grain and grain configuration. **(10 Marks)**
b. Explain about attitude control and side maneuvers with solid propellant rocker motors. **(10 Marks)**

8 a. Explain with neat sketch propellant manufacturing process flow for a rocket motor. **(10 Marks)**
b. Explain about vortex-shedding instability. **(04 Marks)**
c. During testing of a new propellant in a strand burner, the regression rate at a chamber pressure of 7 and 17MPa are found to be 25 and 45mm/s, respectively. If the regression rate happens to follow Saint-Rober't law. Determine the chamber pressure when it regresses at 35mm/s. **(06 Marks)**

9 a. In a liquid-propellant rocket engine, propellant is injected into its combustion chamber at pressure of 6MPa and temperature of 3800K. If the residence time happens to be 0.7ms. Determine the length of cylindrical combustion chamber. Assume that instantaneous combustion occurs, which produces flow with Mach number of 0.3. Take $\gamma = 1.2$ and MW of product gas = 25. **(10 Marks)**
b. Explain about losses in Real nozzle and compare to an ideal nozzle. **(05 Marks)**
c. Write short note on nozzle alignment. **(05 Marks)**

10 a. Explain about factors influencing Injector Behavior. **(07 Marks)**
b. Explain about loads and stresses in thrust chamber wall. **(07 Marks)**
c. Explain with neat sketch of any five thrust vector control mechanisms. **(06 Marks)**

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