Register Number: ……..

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010.

Sixth Semester

AERONAUTICAL ENGINEERING

U07AR602: Propulsion II

Time: Three Hours **Maximum Marks: 100**

Answer all Questions:-

PART A (10 x 1 = 10 Marks)

1. The stage is consist of _____

   A) A Stator and a rotor B) A stator C) A rotor D) 2 stator

2. The ratio of static enthalpy drop in rotor to the static enthalpy drop in stage is_____

   A) Degree of reaction B) Blade coefficient C) Degree of action D) Constant

3. Rotating parts of Ramjet engine is _____

   A) Compressor B) Turbine C) Compressor and Turbine D) No rotating parts

4. In Scramjet, the combustion takes place at _____

   A) Subsonic speed B) Supersonic speed C) Hypersonic speed D) Low subsonic speed

5. The specific impulse of rocket is _____

   A) $\frac{F}{\dot{W}_f}$ B) $\frac{\dot{W}_f}{F}$ C) $\frac{\dot{m}_a}{F}$ D) $\frac{F}{\dot{m}_a}$

6. The condition for optimum expansion is _____

   A) $P_a = P_e$ B) $P_a > P_e$ C) $P_a < P_e$ D) $P_a = 0$

7. Compared to solid propellant rocket, the specific impulse of the liquid propellant rocket is _____

   A) High B) Low C) Equal D) Zero

8. During which burning the thrust, pressure and burning surface area increases ____

   A) Progressive Burning B) Regressive Burning C) Neutral Burning D) Reverse Burning

9. The propellant is accelerated by an electric field then it is_____

   A) Hall effect thruster B) Electron bombarding thruster

   C) Ion contact thruster D) Collide thruster

10. The electron ion thruster produces thrust by accelerating positively charged ions in _____

    A) Electric field B) Magnetic field C) Electrostatic field D) Electromagnetic field

PART B (10 x 2 = 20 Marks)

11. When does a stage is said to be vortex stage?
12. Define blade loading co-efficient.
13. Mention the advantages and disadvantages of Ramjet engine.
14. For a Ramjet engine $\gamma = 1.4$, what is the Mach number for which the minimum value of TSFC occurs.
15. Define characteristics exhaust velocity.
16. What are real nozzle correction factor.
17. What is temperature sensitivity of solid propellants?
18. List any two fuel- oxidizer combinations for hybrid propellant rockets.
19. Mention the advantages of using advanced propulsion technique.
20. What do you mean by resisto jet?

PART C (5 x 14 = 70 Marks)

21. (a) (i) What is the need for matching of compressor and turbine. Write down the matching procedure with suitable sketches. (7)

(ii) Briefly discuss the methods of turbine blade cooling and Mention its advantages and disadvantages. (7)

(OR)

(b) A gas turbine stage develops 3.36 MW for a mass flow rate of 27.2 kg/s. The stagnation pressure and stagnation temperature at stage entry are 772 kPa and 1000 K. The axial velocity is constant throughout the stage, the gases entering and leaving the stage without any absolute swirl. At nozzle exit the static pressure is 482 kPa and the flow direction is at 18° to the plane of wheel. Determine the axial velocity and degree of reaction for the stage given that the entropy increase in the nozzles is 12.9 J/kg °K. Assume that the specific heat at constant pressure of the gas is 1.148 kJ/kg °K and the gas constant is 0.287 J/kg °K. Determine also the total - to-total efficiency of the stage given that the increase in entropy of the gas across the rotor is 2.7 J/kg °K.

22. (a) Describe the working of a Ramjet engine. Depict the various thermodynamic processes occurring in it on h-s diagram. What is the effect of flight Mach number on its efficiency?

(OR)

(b) An ideal Ramjet is to fly at 20,000 ft at a yet-to-be determined Mach number. The burner exit total temperature is to be 1777 K and the engine will use 65.77 kg/s of air. The heating value of the fuel is 43031 kJ/kg. At what Mach number will the TSFC be optimized? What is the optimum TSFC? What is the thrust and dimensionless thrust at this condition?

23. (a) (i) Define and derive an expression for thrust coefficient. (7)

(ii) Determine the values of thrust coefficient for a gas with $\gamma = 1.2$ at pressure ratio 2.0 and 5.0. (7)

(OR)

(b) (i) With the help of a schematic, explain the effect of varying ambient pressure on the flow condition in a rocket nozzle, clearly bringing out the effects in various degrees of underexpansion and overexpansion. (7)

(ii) A rocket operates at sea level (P = 0.1013 MPa) with a chamber pressure of $P_1 = 2.068$ MPa, a chamber temperature of $T_1 = 2222$ K and a propellant consumption rate of $\dot{m} = 1$ kg/s. If $\gamma = 1.3$ and R = 345.7 J/kg K, calculate the ideal thrust and ideal specific impulse. (7)

24. (a) (i) Explain the working of a liquid propellant rocket engine employing gas pressure feed system. (7)

(ii) How do you classify solid propellant rockets? Write down the desired properties of a solid propellant rocket. (7)

(OR)

(b) (i) Explain various methods of thrust vector control with sketches. (7)

(ii) With suitable sketches discuss the need and methods for cooling of rocket engine thrust chamber. (7)

25. (a) Discuss the following advanced propulsion techniques with suitable sketches.

(i) Ion propulsion technique. (7)

(ii) Electric propulsion technique. (7)

(OR)

(b) (i) Draw neat sketch and explain the general working of Nuclear rocket. (7)

(ii) With suitable sketches discuss the general working of solar sail. (7)

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