B.TECH.DEGREE EXAMINATION

Eighth Semester

Branch: Aeronautical Engineering

ROCKETS AND MISSILES (AN 010 801)

Time: 3 hours maximum: 100 marks

Part A

Answer all questions

1. Explain MHD?
2. What is aerodynamic centre. Distinguish it from centre of pressure?
3. What is the maximum altitude attained in a rocket? How can this altitude increase?
4. Write a short note on different types of chemical rockets.
5. What are the different materials used in rockets? What are its special requirements?

(3x5 = 15 Marks)

Part B

Answer all questions

Each question carries five marks

6. Draw a neat sketch of electric rocket and explain briefly?
7. Mention airframe components of rockets and missiles.
8. Explain gravity turn trajectory of a rocket.
9. Explain physical or chemical reasons for maximum value of specific impulse at a particular mixture ratio of oxidizer to fuel?
10. How do you provide separation velocity needed for the upper stage of a space vehicle during stage separation.

(5x5= 25 Marks)

Part C

Answer all questions

Each question carries twelve marks

11. Name and Explain different types of propellant used in solid rocket vechicles.

OR

12. Explain the following terms,
    (i) Combustion pressure(Pc)
    (ii) Propellant Area Ratio
    (iii) Linear burning rat
13. What are the factors considered for the selection of airfoil shapes preferred for a supersonic missile. Explain its advantages and disadvantages. Differentiate ballistic missile from cruise missile. Give examples.

OR

14. (i)Derive an expression for ideal velocity of a rocket in terms of payload ratio, structural efficiency and specific impulse.
    (ii) A rocket has $1/5^{th}$ of its original take off mass at the time of burn out. If the burning time and specific impulse of the propellant are respectively 10 sec and 240 sec,determine burn out velocity.
15. Write down the equations of a two dimensional rocket motion at constant pitch angle in an inclined trajectory with homogeneous gravitational field.Derive expressions for burn out and culmination range.

OR

16. (i) Write down the equations of a two dimensional rocket motion in gravity turn trajectory neglecting the aerodynamic forces.
    (ii) The total increase in velocity required for transfer from low earth orbit at 28˚ inclination to a geosynchronary equatorial orbit is 4.29km/sec. A space tug with a restartable hydrogen oxygen engine has I_{sp}=453s,m_p=16000kg,m_s=1300kg. How much payload can the tug deliver to geosynchronous orbit? Can the tug make a round trip without payload?
17. Describe the salient features of a chemical rocket. Obtain the expression for its heat of reaction. Define combustion efficiency. How can it be increased?

OR

18. Hydrogen peroxide is used both as a mono propellant and an oxidizer in bi propellant systems. It is stored in liquid form and available in various degrees of dilution with liquid water. For rocket application concentrations (70-98%) known as high test peroxide (HTP) are used. For a monopropellant application, calculate the adiabatic flame temperature as a function of water control based on an initial mixture temperature of 298.15K.

19. What is the need for thrust vector control for rockets? List down the thrust vector control methods commonly employed in rocketry and explain any one of them. What are the important features of aerodynamic controls? Compare the wing and tail configurations.

OR

20. (i) Why is multistaging necessary in rocket propulsion? Explain optimal rockets. What are the two stage and three stage optimal rockets?

(ii) A two stage launch vehicle has a first stage specific impulse of 250 sec and a second stage impulse of 350 sec. Both stages have the same structural ratio of 0.05. Determine the minimum propellant mass required to place a 1000kg payload into a 200Km high circular earth orbit. (Assume an additional 1.5Km/sec velocity impulse required to overcome drag gravity losses).

(12x5=60Marks)