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10AE666

Sixth Semester B.E. Degree Examination, June/July 2016
Rockets and Missiles

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define rocket propulsion systems and classify them. **(04 Marks)**

b. The following measurements were made in a sea level test of a solid propellant rocket motors, Burn duration = 40 sec; Initial mass before test = 1210 kg; Mass of rocket motors after test = 215kg; Average thrust = 62250 N; Chamber pressure = 7 MPa; Nozzle exit pressure = 0.070 MPa; Nozzle throat diameter = 0.0855 M; Nozzle exit diameter = 0.2703m. Determine m, V_2, C^*, C and I_s at sea level and C and I_s at 1000 m and 25000 m in altitude. Assume an invariant thrust and mass flow rate and negligible short start. For altitudes of 1000 m and 25000 m the ambient pressure is 0.0898 and 0.00255 MPa. **(12 Marks)**

c. Define: i) Specific impulse; ii) Effective exhaust velocity. **(04 Marks)**

2 a. Define the terms: i) Thrust co-efficient; ii) Characteristics velocity. **(04 Marks)**

b. What are the principal losses in real nozzles? **(04 Marks)**

c. A satellite is launched from a circular equatorial parking orbit at an altitude of 160 km into a coplanar circular synchronous orbit by using a Herman transfer ellipse. Assume a homogeneous spherical earth with a radius of 6374 km. Determine the velocity increments for entering the transfer ellipse and for achieving the synchronous orbit at 42200 km altitude. Refer following figure for the terminology of the orbits. **(12 Marks)**

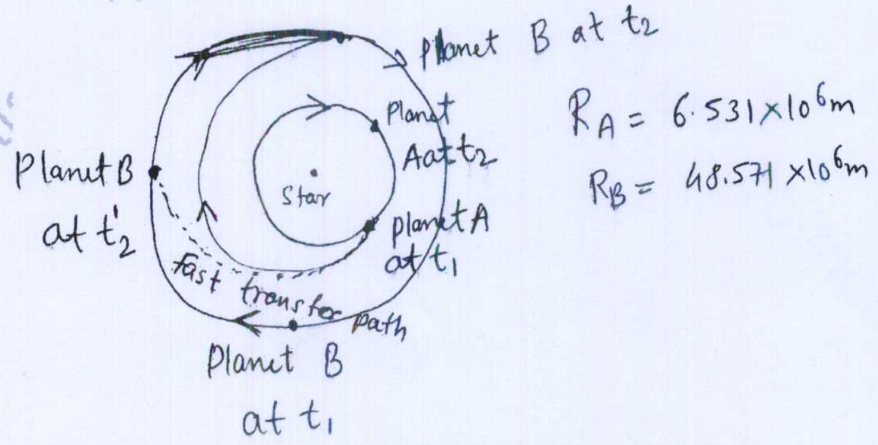

Fig.Q.2(c)

3 a. Explain with the help of a neat diagram solid propellant rocket motor. Explain progressive, regressive and burning with sketches. **(08 Marks)**

b. List out the liquid oxidizers and liquid monopropellants used in rocket engine. **(05 Marks)**

c. Explain briefly hybrid rocket propulsion with its applications and grain-configuration. **(07 Marks)**

4 a. Explain briefly the sequence in idealized process for selecting propulsion system. (10 Marks)
b. List out the typical criteria used in selection of particular rocket propulsion system. (06 Marks)
c. List out the two advantages and disadvantages of solid and liquid propellant. (04 Marks)

PART – B

5 a. Briefly describe the lift distribution for slender bodies of revolution. (10 Marks)
b. Describe the generalized nature of aerodynamic forces and stability derivatives. (10 Marks)

6 a. Discuss the pitching effectiveness of the cruciform configuration with all movable controls. (10 Marks)
b. Name the various types of missiles controls and also explain. (10 Marks)

7 a. Mention the merits and demerits of various Thrust Vector Control Mechanisms. (08 Marks)
b. Write a short note on:
i) TVC with multiple thrust chamber or nozzle.
ii) Testing of thrust vector control.
iii) Integration of thrust vector control with vehicle. (12 Marks)

8 a. Explain the different types of test performed before qualifying a rocket propulsion systems. (05 Marks)
b. Explain with the help of sketch, vertical static test stand for a large liquid propellant thruster. (09 Marks)
c. List important physical quantities measured in rocket testing. (06 Marks)

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