USN | | | | | | | | | | 10AE763

Seventh Semester B.E. Degree Examination, April 2018
Space Mechanics and Launch Vehicles

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1   a. Write a short note on Space vehicles.   (06 Marks)
    b. Describe the transformation of Angular velocities using Euler angles.   (08 Marks)
    c. Derive an expression for Absolute velocity and Acceleration referred to inertial frame.
                                                                                           (06 Marks)

2   a. Explain the two – body problem in terms of resultant force.   (10 Marks)
    b. Briefly explain Kepler's laws with necessary expression.   (10 Marks)

3   a. Determine the Eccentricity and True Anomaly for orbit establishment.   (10 Marks)
    b. Briefly describe orbital perturbations.   (10 Marks)

4   a. Derive the total energy requirement for the Hohmann transfer.   (12 Marks)
    b. Briefly explain Single Impulse Adjustments.   (08 Marks)

PART – B

5   a. How Rockets can be classified?   (08 Marks)
    b. The following measurements were made in a sea level test of a solid propellant rocket motor
        Burn duration = 40 sec   ;   Initial mass before test = 1210 kg   ;   Mass of rocket motor
        after test = 215 kg   ;   Average thrust = 62,250N   ;   Chamber pressure = 7 MPa ;
        Nozzle exit pressure = 0.070MPa   ;   Nozzle throat diameter = 0.0855M   ;   Nozzle exit
        diameter = 0.2703m. Determine $\dot{m}$, v_2 , c^* , c and I_s at sea level and c and I_s at 1000 and
        25,000m altitude. Assume an invariant thrust and mass flow rate and negligible short start
        and stop transients. For altitudes of 1000 and 25,000m the ambient pressure is 0.0898 and
        0.00255MPa.   (12 Marks)

6   a. Obtain the basic relations of motion for two – dimensional rocket motions in free space.
                                                                                           (10 Marks)
    b. List the advantages and disadvantages of solid and liquid propellant rocket.   (10 Marks)

7   a. Briefly explain Orbital elements.   (08 Marks)
    b. For a given mass ratio 'µ' and specific Impulse 'I' , how does the burnout velocity of a
        single – stage rocket vary with the Thrust ratio 'R'. Assume vertical flight.   (12 Marks)

8   a. What are the general requirements while selecting the materials for space craft?   (10 Marks)
    b. Write short notes on :
        i) Space craft   ii) Manned and unmanned space missions.   (10 Marks)

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