USN 10AE763

## Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018 Space Mechanics and Launch Vehicle

Time: 3 hrs. Max. Marks: 100

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

## PART - A

1 a. Derive an expression for transformation of displacement.

(10 Marks)

b. Briefly explain Euler transformation.

(10 Marks)

- 2 a. Briefly explain the procedure of converting Two body problem to single body problem.

  (10 Marks)
  - b. Assume that the ratio of the mass of the moon to that of the moon plus earth is known as  $\mu = \frac{m_2}{m_1 + m_2}$ . By observation relative to the fixed stars, the angular velocity 'w' of the line

joining the centers of the earth and moon can be measured as  $w = 2.66 \times 10^{-6}$  rad/sec. Show that the distance between the two bodies is

$$D^{3} = \frac{gR^{2}}{w^{2}(1-\mu)}.$$
 (10 Marks)

3 a. Briefly explain Orbit Establishment from initial conditions.

(10 Marks)

b. A satellite is launched with the following initial conditions:

$$\frac{r_0 v_0^2}{K} = 1.4 \ ; \ \beta_0 = 20^0 \ ; \ \frac{r_0}{R} = 2.0 \; . \label{eq:beta_0}$$

Determine the orbit parameters e and a/R and establish the initial position with respect to perigee. (Assume elliptical orbit). (10 Marks)

4 a. Briefly explain the perturbation of Orbital Parameters.

(10 Marks)

b. Briefly explain Long - Range Ballistic trajectories.

(10 Marks)

## PART - B

- 5 a. Compare Liquid propellant, Solid propellant and Hybrid rockets.
- (10 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. A Arrange of the sec (2.250 N)

Mass of rocket motor after test = 215 kg; Average thrust = 62,250 N;

Chamber pressure = 7.00 MPa; Nozzle exit pressure = 0.070 MPa;

Nozzle throat diameter = 0.0855m; Nozzle exit diameter = 0.2703m.

Determine m,  $v_2$ ,  $c^*$ , c and  $I_s$  at sea level and c and  $I_s$  at 1000 and 25,000 m attitude. Assume an invariant thrust and mass flow rate and negligible short start and stop transients. [For altitudes of 1000 & 25,000 m the ambient pressure is 0.0898 and 0.00255 MPa]. (10 Marks)

6 a. Briefly explain about Launch Vehicle Trajectories.

(10 Marks)

b. Write short notes on Orbital Elements.

(10 Marks)

a. 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. Discuss the performance of a single – stage rocket engine, by deriving some expression.

b. Determine the burnout speed of a rocket launched vertically, using a fuel of specific impulse 250 sec and a mass fraction of 0.22 with R = 3. (08 Marks)

8 a. Briefly explain Life support system for manned mission.
b. What are the generalized requirements of materials for spacecraft?
c. How materials for space craft can be selected?
(05 Marks)

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