Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Space Mechanics and Launch Vehicles

Time: 3 hrs.   Max. Marks:100

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

PART – A

1 a. Show that the transformation of fixed co-ordinate system to moving co-ordinate system is the inverse of transformation.   (15 Marks)
   b. Discuss about inertial and earth fixed coordinate reference frames.   (05 Marks)

2 a. Obtain a general equation of motion for two body problem.   (12 Marks)
   b. Assume that the ratio of the mass of the moon so that of the moon plus earth is known as $\mu = \dfrac{m_2}{m_1 + m_2}$. The angular velocity of the line joining the centers of the earth the moon is w.

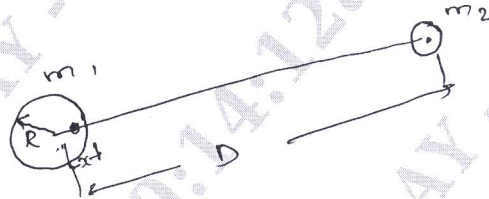   show that the distance between the two bodies is $D^3 = \dfrac{9R^2}{w^2(1-\mu)}$

Fig Q1(b)   (08 Marks)

3 a. Describe the orbital perturbation with suitable relations.   (10 Marks)
   b. Derive an expression for establishment of the orbit for any initial conditions. (10 Marks)

4 a. Determine the incremental velocity required to escape from an earth orbit with an altitude of 200km to a synchronous orbit with that required to inject into an ellipse which will just reach the moon's orbit. Take time period for synchronous orbit 23h 56min4s.   (12 Marks)
   b. Short notes on satellite perturbation due to
       i)   Earth oblateness effect
       ii) Solar lunar attraction.   (08 Marks)

PART – B

5 a. Elucidate the liquid rocket engine with neat sketch.   (12 Marks)
   b. For an ideal rocket with a characteristic velocity $C^* = 1500$m/s, a nozzle throat diameter of 18cm, a thrust coefficient of 1.38 and a mass flow rate of 40kg/s, compute the chamber pressure, the thrust and the specific impulse.   (08 Marks)
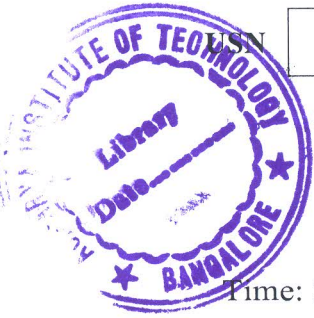
6 a. Derive an expression for one dimensional rocket equation in free space. **(12 Marks)**

b. Determine the burnout velocity and burnout altitude for a drugless projectile with the following parameters for a simplified vertical trajectory :
$\overline{C} = 2209 \text{m/s}$, $m_p / m_o = 0.57$, $t_p = 5.0 \text{sec}$ and $u_0 = h_o = 0$. **(08 Marks)**

7 a. Explicate in detail about Launch vehicle trajactories with suitable sketch. **(12 Marks)**

b. A two stage rocket is to attain a maximum speed of 26000 ft/sec with $I_1 = I_2 = 300 \text{sec}$ and $\beta_1 = \beta_2$. Determine the mass ratio of each stage. **(08 Marks)**

8 Explain the following :
  a. Space craft **(05 Marks)**
  b. Manned space mission **(05 Marks)**
  c. Unmanned space mission **(05 Marks)**
  d. Selection of materials for space craft. **(05 Marks)**

* * * * *