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10AE763

Seventh Semester B.E. Degree Examination, June/July 2017
Space Mechanics and Launch Vehicles

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain Inertial and earth fixed co-ordinate reference frames? **(04 Marks)**

b. Show that the transformation of fixed co-ordinate system to moving co-ordinate system is the inverse of transformation. **(06 Marks)**

c. Describe construction of Euler's angles and derive expression for Euler rates? **(10 Marks)**

2 a. Assume that 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 $D^3 = \frac{9R^2}{W^2(1-\mu)}$ by referring Fig Q2(a). **(10 Marks)**

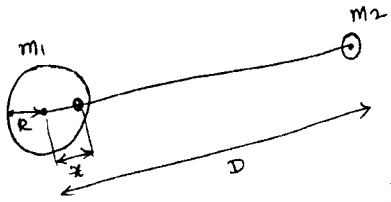

Fig Q2(a)

b. Derive well known Kepler's all three equation for planetary motion. **(10 Marks)**

3 a. Develop the general perturbation equations using Cowell's method. **(12 Marks)**

b. What are sun synchronous and geosynchronous orbits? **(08 Marks)**

4 a. Explain Hohmann orbits? **(05 Marks)**

b. A spacecraft is in a 480km by 800km earth orbit (orbit 1 shown in Fig Q4). Find
The ΔV required at perigee A to place the spacecraft in a 480km by 16000km transfer orbit (orbit 2)
The ΔV (aspogee kinck) required at B of the transfer orbit to establish a circular orbit of 16000km altitude (orbit 3). **(15 Marks)**

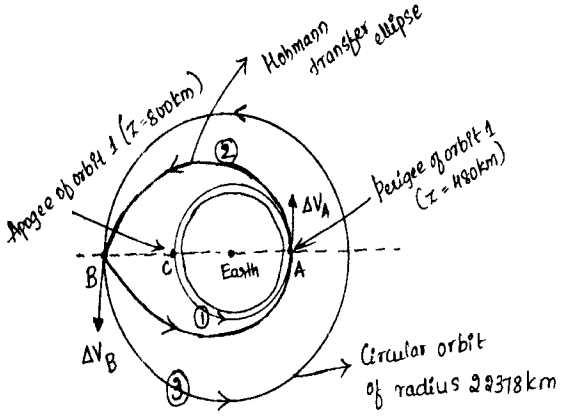

Fig Q4(b)

PART – B

5 a. Write a short note on
   i) Solid rocket engine
   ii) Liquid rocket engine
   iii) Hybrid rocket engine **(12 Marks)**

b. The following measurements were made in a standard sea level test of solid propellant rocket motor

Burning duration	=	40 Sec
Intial mass before test	=	1210 kg
Mass of rocket after test	=	215 kg
Thrust force	=	62250N
Camber pressure	=	7MPa
Nozzle exit pressure	=	0.07MPa
Nozzle throat diameter	=	0.0855 m
Nozzle exit diameter	=	0.2703 m

Determine, mass flow rate, exhaust velocity exit velocity, characteristic velocity specific impulse at standard sea level. Also find characteristic velocity, impulse at 1000m and 2500m having ambient pressure 0.0898MPa and 0.0025MPa. **(08 Marks)**

6 a. Derive the equations of gravity free drag free space flight. **(10 Marks)**

b. A 500Kg rocket is in a earth's orbit travelling at a velocity of 7790m/s. Its engine burnt to accelerate to a velocity of 12000m/s planning it on a escape trajectory engine expels at a rate of 10kg/se. the effective exhaust velocity is 3000m/s. Calculate duration of burn. **(10 Marks)**

7 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? **(10 Marks)**

b. Derive an expression for maximum velocity available for multistage rocket. **(10 Marks)**

8 a. How to make life support system for manned missions? **(10 Marks)**

b. Explain spacecraft power generation system? **(10 Marks)**

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