GATE Aerospace Engineering

Assignment Questions (Space Technology)

Question 1: In an inertial coordinate system, the position and velocity vectors of a satellite are , respectively, (4.1852 **I** + 6.2778 **J** + 10.463 **K**) 10^7 ft and (2.5936 **I** + 5.1 872 **J**) 10^4 ft/sec where I, J and K are unit vectors. Determine the specific mechanical energy, &, and the specific angular momentum, h. Also find the flight path angle, φ.

Ans: h = 6.0922 X 10^{12} ft^2/sec, specific angular momentum =1.573x 109 ft^2/sec^2, φ= 35.42^0

Question 2: For a given satellite, ε = - 2.0x10^8 ft^2/sec^2 and e = 0.2 Determine its specific angular momentum, semi-latus rectum, and semi-major axis.

Ans: a= 3.5 1 98 x 1 07 ft, p= 3.3790 x 107 ft, h= 6.897 x 10^{11} ft^2 /sec

Question 3: A radar tracking station tells us that a certain decaying weather satellite has e = 0.1 and perigee altitude = 200 n.mi. Determine its altitude at apogee, specific mechanical energy, and specific angular momentum.

Ans: Altitude at apogee= 6.1 35 x 10^6 ft, ε= -2.861 x 10^8 ft^2 /sec^2, h= 5.855 x 10^{11} ft^2 /sec

Question 4: A space probe is to be launched on an escape trajectory from a circular parking orbit which is at an altitude of 100 nmi above the earth. Calculate the minimum escape speed required to escape from the parking orbit altitude. (Ignore the gravitational forces of the sun and other planets.)

Ans: escape speed= 36,157.9 ft/sec

Question 5: A space object is sighted at an altitude of 1.046284 x 10^7 ft above the earth traveling at 2.593625x 10^4 ft/sec and a flight path angle of 0^0 at the time of sighting.
determine ε , h, p, e, r_a, $r_{p.}$

Ans: ε= - 1.12 339 x 10^8 ft^2/sec^2 , h= 8.141 x 10^{11} ft^2 /sec, p= 4.7082763 x 10^7 ft, e=0.5,
$r_{a\,=}$ 9.416553 x 107 ft, r_p= 3.138851 x 107 ft

Question 6: For a certain satellite the observed velocity and radius at ν = 90^0 is observed to be 45,000 ft/sec and 4,000 n mi, respectively. Find the eccentricity of the orbit.

Ans: e= 1.581