Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (2012 Onwards) (Sem.–8)

SPACE MACHINES AND LAUNCH VEHICLES

Subject Code : ASPE-403

M.Code : 72566

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION–A

1. Write briefly :

a) What is a geocentric rotating reference frame? Can you use this frame when studying the motion of comets?

b) State Kepler's 1st law.

c) What is the shape of the least expensive escape trajectory?

d) Angular momentum of a space craft in orbit is conserved. State yes or no.

e) What is the necessity of multi-stage a rocket?

f) Define Total impulse.

g) Define Gravity turn.

h) What is the change in vertical velocity of an object in a circular orbit?

i) Define Burnout velocity.

j) What is a Hohmann trajectory?

SECTION-B

2. A space probe of mass 250 Kg is in a circular orbit around earth at an altitude of 5000 Km, find the additional kinetic energy required per unit mass (J/kg) to escape the earth's gravitational well from the orbit.

3. For two-impulse Hohmann orbital transfer maneuver between two circular orbits ($r_2 > r_1$), obtain an expression for specific thrust at each impulse as a function of r_2-r_1.

4. Obtain an expression for burnout velocity of a multi-stage rocket.

5. An observer is noticing two satellites orbiting earth; one in a circular orbit at an altitude of 2000 Km, the other is an elliptical orbit with apogee of 3000 Km and perigee of 1000 Km. Find the time period of rotation of these two satellites around earth.

6. Obtain the transfer matrix required to transform from one frame of reference to another through ZXZ transformation.

SECTION-C

7. There is a satellite of 34.5 Kg revolving earth in a circular orbit of altitude 500 Km. It contains 15 Kg of propellants. Its destination orbit is a circular orbit at an altitude of 5000 Km. Considering earth to be spherical with uniform gravitational field, what is the minimum mass of propellants required for orbit transfer. [G-gravitational constant = 6.67×10^{-11} m^3/ Kg s^2, M - mass of earth = 5.98×10^{24} Kg, V_e - exhaust velocity of gas = 3400 m/s, γ =1.4]

8. Obtain range equation for a vehicle moving vertically from earth's surface. Exclude aerodynamic effects.

9. For an object in circular orbit around earth, considering constant gravitational fields and exponential atmosphere, obtain a relation for rate of fall of the satellite.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.