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UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program Name: B. Tech ASE+AVE **Semester – VII**
Course Name: Spacecraft Avionics **Max. Marks : 100**

Course Code : AVEG 432 **Duration : 3 Hrs**
No. of page/s: 03

Note: Internal choice is given for Question No 11 & 12.

Section – A (5x4=20)

1. Discuss about NASA's Goddard Space Flight Center use a common bus for several satellites Which is attained by 1553 and 1773 buses
2. If F1 ⟶ magnitude of force on Sun by Earth F_2 ⟶ Magnitude of force on Earth by Sun, them which of the following is correct? And Justify the Answer
   a) F1 < F2
   b) F1>F2
   c) F1=F2
   d) Can't say
3. The range between a ground station and a satellite is at 50,000 km of altitude. Calculate the free space loss at a frequency of 5 GHz
4. Calculate the semi major axis of the orbit for the satellite which is launched into Earth orbit where its vehicle burns out at an altitude of 250km.at burnout the satellite's velocity is 7950 m/s with the zenith angle equal to 89 degrees.
5. Explain the various Losses in the Satellite signal.

Section – B (4 x 10 = 40 Marks)

6. A spacecraft is in a circular parking orbit with an altitude of 200 km. Calculate the velocity change required to perform a Hohmann transfer to a circular orbit at geosynchronous altitude.

7. Answer the following questions (Each carries two marks)

i) A satellite is to be transferred from its geostationary orbit to a circular polar orbit of the same radius through a single impulse out of plane maneuver. The magnitude of change in the velocity required is_____ times the magnitude of escape velocity

ii) To transfer a satellite from an elliptical orbit to a circular orbit having radius equal to the apogee distance of the elliptical orbit, the speed of satellite should be

   a) Increased at the apogee
   b) Decreased at the apogee
   c) Increased at the perigee
   d) Decreased at the perigee

iii) For a satellite, a= 6700 km, e=0.01. What will be the satellite's altitude at perigee and apogee?

iv) At perigee , kinetic energy and potential energy can be written as $(K.E)_p$ and $(P.E)_p$ and $\lambda_1 = \frac{(K.E)p}{(P.E)p}$, where as at apogee: kinetic energy is $(K.E)_a$, potential energy is $(P.E)_a$ and $\lambda_2 = \frac{(K.E)a}{(P.E)a}$, which of the following relation between λ_1 and λ_2 is true?

   a) $\lambda_1 > \lambda_2$
   b) $\lambda_1 < \lambda_2$
   c) $\lambda_1 = \lambda_2$
   d) $none\ of\ the\ above$

v) The time period of satellite revolving around earth in circular orbit is:

   a) Independent on mass of satellite
   b) Independence on distance from the planet
   c) Independent from inclination angle
   d) Option (a) and (b) are true
   e) Option (a) and (c) are true

8. A satellite link operating at 14 GHz has receiver feeder losses of 1.5 dB and a freespace loss of 207 dB. The atmospheric absorption loss is 0.5 dB and the antenna pointing loss is 0.5 dB. EIRP = 60 dbW, Gain of the Antenna is 50dB. Depolarization losses may be neglected. Calculate the Received power and total loss for clear sky conditions.

9. a) Draw and explain the attitude control system for the spacecraft
   b) Explain various attitude sensor

Section – C (20 x 2 = 40 Marks)

10. a) Calculate the perturbations in longitude of the ascending node and argument of perigee caused by the Moon and Sun for the International Space Station orbiting at an altitude of 400 km, an inclination of 51.6 degrees, and with an orbital period of 92.6 minutes.

    b) Briefly explain the orbital perturbation in details **(12+08)**

11. A satellite is in a circular Earth orbit at an altitude of 400 km. The satellite has a cylindrical shape 2 m in diameter by 4 m long and has a mass of 1,000 kg. The satellite is traveling with its long axis perpendicular to the velocity vector and its drag coefficient is 2.67. Calculate the perturbations due to atmospheric drag and estimate the satellite's lifetime.

(Or)

12. a) There are planets A and B, from both the planets we throw the same object with same initial velocity ‘u’. If the gravity at planet A and planet B are g_1 and g_2.And if objects take time t_1 and t_2 to reach to ground respectively. Then find the relation between g_1,t_1,g_2 and t_2.

    b) Draw and explain the Highly Elliptical Orbit **(12+08)**

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Program/Course	**:**	**B. Tech ASE+AVE**					
Semester	**:**	**VII**					
Name of the Subject	**:**	**Spacecraft Avionics**					
Subject Code	**:**	**AVEG 432**					
Name of Question Paper Setter	**:**	**RAJA M**					
Employee Code	**:**	**40000908**					
Mobile & Extension	**:**	**8938817363**					
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Note: Internal choice is given for Question No 11 & 12.

Section – A (5x4=20)

1. A satellite in Earth orbit has a semi-major axis of 6,700 km and an eccentricity of 0.01. Calculate the satellite's altitude at both perigee and apogee.
2. Write about MIL-Std 1750A Technology for Autonomous Operational survivability (TAOS) for spacecraft control and payload operation
3. The range between a ground station and a satellite is at 50,000 km of altitude. Calculate the free space loss at a frequency of 5 GHz
4. Explain the aerodynamic drag in Low earth orbit satellite.
5. Write short notes about spacecraft attitude sensor.

Section – B (4 x 10 = 40 Marks)

6. A satellite is in a circular parking orbit with an altitude of 200 km. Using a one-tangent burn, it is to be transferred to geosynchronous altitude using a transfer ellipse with a semi-major axis of 30,000 km. Calculate the total required velocity change and the time required to complete the transfer.

7. Answer the following questions (Each carries two marks)

i) A satellite is to be transferred from its geostationary orbit to a circular polar orbit of the same radius through a single impulse out of plane maneuver. The magnitude of change in the velocity required is_____ times the magnitude of escape velocity

ii) To transfer a satellite from an elliptical orbit to a circular orbit having radius equal to the apogee distance of the elliptical orbit, the speed of satellite should be

   a) Increased at the apogee
   b) Decreased at the apogee
   c) Increased at the perigee
   d) Decreased at the perigee

iii) For a satellite, a= 6700 km, e=0.01. What will be the satellite's altitude at perigee and apogee?

iv) At perigee , kinetic energy and potential energy can be written as $(K.E)_p$ and $(P.E)_p$ and $\lambda_1 = \frac{(K.E)p}{(P.E)p}$, where as at apogee: kinetic energy is $(K.E)_a$, potential energy is $(P.E)_a$ and $\lambda_2 = \frac{(K.E)a}{(P.E)a}$, which of the following relation between λ_1 and λ_2 is true?

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v) The time period of satellite revolving around earth in circular orbit is:

   a) Independent on mass of satellite
   b) Independence on distance from the planet
   c) Independent from inclination angle
   d) Option (a) and (b) are true
   e) Option (a) and (c) are true

8. a) An artificial earth satellite is in an elliptic orbit which brings it to altitude of 200 km at perigee and out to an altitude of 600 km at apogee .calculate the velocity of the satellite at both perigee and apogee. **(06+04)**

   b) Draw and explain the Attitude control system for the spacecraft.

9. Explain the following system used in space shuttles
    a) Multiplex interface adapter(MIA)
    b) Multiplex/demultiplexer data bus (MDM)

Section – C (20 x 2 = 40 Marks)

10. a) A satellite is in an orbit with a semi-major axis of 7,500 km, an inclination of 28.5 degrees, and an eccentricity of 0.1. Calculate the J2 perturbations in longitude of the ascending node and argument of perigee. **(10+10)**

    b) Explain the following perturbation
        i) Solar radiation
        ii) Moon and sun perturbation
        iii) Aerodynamic drag
        iv) J2 Perturbation

11. Explain the following
    a) Free space Loss
    b) Equivalent Isotropic Radiated Power for Antenna
    c) White noise
    d) Control momentum gyroscope
    e) One tangent orbital transfer

(Or)

12. A satellite is in a circular Earth orbit at an altitude of 400 km. The satellite has a cylindrical shape 2 m in diameter by 4 m long and has a mass of 1,000 kg. The satellite is traveling with its long axis perpendicular to the velocity vector and its drag coefficient is 2.67. Calculate the perturbations due to atmospheric drag and estimate the satellite's lifetime.