Code No: 07A62106 **R07** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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1. How Telecommunications are used to help in the satellite vechile. [16]

2. List out the possible sources of error in injection that lead to orbit deviations. Discuss in detail. [16]

3. Write about dual spin spacecraft. [16]

4. (a) A satellite is in an orbit with a semi-major axis of 7,500 km and an eccentricity of 0.1. Calculate the time it takes to move from a position 30 degrees past perigee to 90 degrees past perigee.
   (b) The satellite in the above problem has a true anomaly of 90 degrees at one instant. What will be the satellite's position, i.e. it's true anomaly, 20 minutes later? [8+8]

5. (a) Explain how the thrust of a rocket develops. Derive the equation for the thrust. Differentiate between under-expanded and over-expanded nozzle performance.
   (b) Compare the various type of supersonic nozzles. [10+6]

6. Write short notes on the following:
   (a) Radiation effects to an astronaut in a space vehicle traveling below Van Allen belt
   (b) Two possible methods to protect a space vehicle against the damage to it due to the radiation in space [8+8]

7. 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 24,380 km. Calculate the total velocity change required and the time required to complete the transfer. [16]

8. What do you understand by Hohmann braking ellipses in the case of reentry? Obtain equations of motion for the down range trajectory as well as the altitude in terms of the flight path angle as an independent variable. [16]

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Code No: 07A62106 **R07** **Set No. 4**

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INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write short notes on the following:
   (a) Hohmann braking ellipses
   (b) Lifting body re-entry. [8+8]
2. (a) Write a brief note on Noise in satellite communication link.
   (b) Explain the procedure used to achieve desired performance in a satellite on-board transponder. [8+8]
3. (a) What do you understand by 'Pitch over' phase of a launch vehicle. Why is it required? How is it achieved?
   (b) Write a short note on 'Gravity Loss' pertaining to a launch vehicle. [8+8]
4. You are the engineer in charge of launching a satellite of 11,500 kg mass. The satellite will be placed in a circular sun - synchronous orbit, at an altitude of 800 km. What is the kinetic energy of the satellite? Compare this to the kinetic energy of a 400 kg lorry traveling on a straight road at 100 km/hour. Explain clearly whether the comparison is realistic. [16]
5. Write a detailed note on various aspects of satellite injection bringing out the effects of orbit inclination, injection direction, etc. on the performance of satellite launch vehicles launched from selected sites. [16]
6. (a) Describe the basic operating principles of a solid rocket motor. Give examples for their applications.
   (b) Explain how the shape of the propellant grain can affect the thrust profile of a solid rocket motor. [8+8]
7. Write briefly about Scientific challenges of CHANDRAYAAN-1 (The Indian lunar orbiter mission) [16]
8. Write about the attitude control of a non-spinning spacecraft
   (i) using momentum wheel and
   (ii) using control moment gyros. [16]

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III B.Tech II Semester Examinations,December 2010
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Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define 'Thrust' of a rocket and obtain the equation for the thrust in terms of rate of consumption of propellant and other parameters. Explain all the parematers in detail.
   (b) A small experimental rocket engine delivers an effective exhaust velocity of 1,800 m/s with a mass flow rate of 800 grams/second. What is the thrust developed by the rocket? [8+8]

2. A satellite is launched into Earth orbit where its launch vehicle burns out at an altitude of 250 km. At burnout the satellite's velocity is 7,900 m/s with a flight path angle of one degree. Calculate the satellite's altitude at perigee and apogee and the eccentricity of the satellite.
   (Note: flight path angle is the angle between the local horizontal and the velocity vector)
   [16]

3. (a) How many sets of initial conditions can we use for solving the two body equation of motion? Give an example of one set of these.
   (b) Calculate the altitude needed for a circular geosynchronous orbit. [8+8]

4. Is power generation possible continuously in a satellite? Consider
   (i) a polar sun-synchronous satellite and
   (ii) geostationary satellite

   and discuss. [16]

5. (a) Discuss the necessity of developing a Single Stage To Orbit (SSTO) vehicle for low Earth orbit missions. Explain the SSTO design constraints in detail.
   (b) Describe the methodology of optimizing multi-staging of a rocket assembly. [4+4+8]

6. (a) Where does the Space begin? Which is the object strongly affecting the space environment and how does it affect?
   (b) i) List out and describe the two forms of Sun's energy output.
   ii)Differentiate between 'Solar Flares' and 'Solar Winds'. [8+8]

7. Starting from satellite attitude dynamics principles, explain briefly about yo-yo Mechanisms. [16]

8. Describe the two requirements (a high value and a low value) for the hypersonic drag coefficient of a re-entry space vehicle. [16]

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Code No: 07A62106 **R07** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Elaborate on the forces that act on a space vehicle re-entering Earth's atmosphere.
   (b) Define 'Ballistic Coefficient' of a space vehicle. How is it useful in describing the motion of an object through the atmosphere, in terms of the acceleration or deceleration of the object? [8+8]

2. (a) A satellite is launched into a low Earth orbit an altitude of 400 km, velocity of 8,000 m/s with Φ equal to 12^0. Calculate the satellite's altitudes at perigee and apogee.(Φ is the flight path angle, the angle between the local horizontal and the velocity vector)
   (b) Calculate the eccentricity of the orbit of the satellite in the above problem. [10+6]

3. Write short notes on
   (a) Orbit Perturbations due to atmospheric Drag
   (b) Orbit perturbations from solar Radiation
   (c) Orbit perturbation due non-spherical Earth.
   (d) Third body perturbation. [4+4+4+4]

4. Consider the motion of a rocket in free space and obtain Tsiolkovsky's equation to predict the velocity increment in the vehicle. Further, obtain expression for the velocity increment at its burnout condition. Discuss the ideal velocity variation for different mass ratios. [16]

5. What is space craft power? Explain briefly about power generation and power storage in a satilite? [16]

6. Exposure to charged particle radiation in space is known to influence the performance of a spacecraft. Explain in detail the primary sources for these particles and the damage caused to the space vehicle due to its exposure to such particles. [16]

7. (a) Define the following quantities in rocket propulsion:
      i. Mass Ratio,
      ii. Propellant Mass Fraction,
      iii. Velocity Loss due to gravity, and
      iv. Altitude loss due to gravity.

(b) A rocket has the following data:
Propellant flow rate = 5 kg/s
Nozzle exit diameter = 11 cm
Nozzle exit pressure = 1.02 bar
Ambient pressure = 1.013 bar
Thrust = 7 kN
Determine the effective exhaust jet velocity, actual exhaust jet velocity and specific impulse. [8+8]

8. (a) Assume that the Earth station near the equator and the Earth station at a high latitude region are both observing distance variation of the same geo stationary satellite. How would these variations differ between these two Earth stations.

(b) When walking on a circus tight rope, balance is achieved by stretching both the arms all way out by holding a long bar. Show that the stretched out arms or the bar correspond to a reaction wheel used in a zero momentum three axis stabilized satellite. [8+8]

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