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

III B.Tech II Semester Regular/Supplementary Examinations,May 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. With the help of neat sketches, discuss multi-staging of rockets by stacking 'one after the other' ('tandem staging') and 'parallel staging'. Bring out the major advantages and/or disadvantages of adopting tandem staging, parallel staging and a combination. [16]

2. A spacecraft is in a circular parking orbit at an altitude of 200 km from the earth. Calculate the velocity change required to perform a Hohmann transfer to a circular orbit at geosynchronous altitude, in the same plane. [16]

3. (a) How many sets of initial conditions can we make use of for solving the two - body equation of motion? Give an example of one set of these.
   (b) A remote sensing satellite is in a circular orbit of 7,500 km. What is its inclination? [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) What are the effects of charged particles on a satellite?
   (b) List out the precautions that the astronaut should follow to avoid or minimize the damage due to radiation. [6+10]

6. (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]

7. Explain briefly about the attitude control for Nonspining space craft. [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. 4**

III B.Tech II Semester Regular/Supplementary Examinations,May 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. Write a short note on the following:
   (a) Trajectory and deceleration of a re-entry vehicle
   (b) Trajectory and heating of a re-entry vehicle. [8+8]
2. Write a short note on:
   (a) Hohmann transfer
   (b) Bi - elliptical transfers
   (c) Combined maneuvers. [5+5+6]
3. (a) Differentiate between a 'spacecraft' and a 'launch vehicle'.
   (b) Write short notes on Trajectories and orbits. [8+8]
4. (a) Write the important features of a satellite in geostationary orbit.
   (b) The Virginia Tech earth station is located at 80.438^0 longitude and 37.229^0 N latitude. Calculate the look angles (azimuth and elevation angles) to a geosynchronous satellite whose sub-satellite point is located at 121^0 W longitude.
   (c) Why do signal losses occur in the earth's atmosphere for satellite communication? Write a note on ionospheric effects. [6+6+4]
5. Explain briefly about the attitude control for spining space craft. [16]
6. What do you understand by 'parking orbit' and 'impulsive shot' with reference to interplanetary missions? Explain, how Hohmann trajectory is useful for interplanetary missions with less propellant consumption. [16]
7. While piloting a spacecraft you received a report of your position and velocity in the geo - centric equatorial frame as
   $\overline{R}$ = 7000 i + 0 j + 0 k km
   $\overline{V}$ = 0 i - 0.763 j + 0 k km/s
   (a) Sketch the spacecraft position vector and velocity vector relative to the Earth.
   (b) What is the specific angular momentum? Draw this vector on the sketch.
   (c) What does this angular momentum vector tell you about the orientation of your orbit ?

(d) What is the specific mechanical energy of the satellite?

(e) What is the shape of the trajectory? How can you tell? [16]

8. Describe the rocket motion in a homogeneous gravitational field for two cases of pitch angles; (a) 90^0, and (b) less than 90^0. [16]

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Code No: 07A62106 **R07** **Set No. 1**

III B.Tech II Semester Regular/Supplementary Examinations,May 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) Explain the advantages and disadvantages of satellite communication systems.
   (b) Explain why orbits and frequencies are said to be limited resources. [8+8]

2. With the help of a neat sketch, explain the basic principle of operation of an aerospace plane. Illustrate the major challenges or difficulties associated with the design of such an aerospace plane. [16]

3. (a) Explain briefly the characteristics of an Elliptical orbit.
   (b) Determine the characteristics of an earth satellite with a perigee altitude of 5500 km and an apogee altitude of 20000 km. [6+10]

4. What are Galactic Cosmic rays? Describe the mechanism that protects the Earth from the effects of solar and cosmic charged particles. [16]

5. Write about the attitude control of a non-spinning spacecraft
   i) using thrust and
   ii) using momentum wheel. [8+8]

6. Mission planners for a manned spacecraft for Mars Mission have considered two different re-entry vehicles. Vehicle 'A' has a high Ballistic Coefficient while the other vehicle 'B' has a low Ballistic Coefficient. Assuming the re-entry velocity and flight path angle are the same for both the vehicles while entering the atmosphere of Mars, discuss the differences in the effects on the spacecraft, if any, in the light of the respective deceleration profiles. [16]

7. The position vector ($\overline{R}$) and velocity vector ($\overline{V}$) of a satellite are
   R = 8228 i + 389.0 j + 6888 k km
   V = -0.7000 i + 6.600 j - 0.6000 k km/s
   (a) Determine the size and shape (semi-major axis and semi- minor axis) for this satellite
   (b) Determine the inclination of the orbit. [16]

8. (a) How does a liquid propellant rocket differ from a solid propellant rocket? Explain which of the two will be useful for a sounding rocket of diameter 10 cm and length 1.5 m.
   (b) A missile, a single stage rocket, carries a war head of 50 kg. It has a structural mass of 250 kg, and propellant mass of 2,700 kg. If the specific impulse is 300 seconds, calculate the burnout velocity. [8+8]

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

III B.Tech II Semester Regular/Supplementary Examinations,May 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) What are the salient features of re-entry vehicles?
   (b) Write notes on the following:
      i. Space shuttle
      ii. Multi-staged rockets. [6+5+5]

2. What do you mean by attitude determination? What is the importance of attitude determination? [16]

3. Explain about the various communication satellite systems which are presently operational in space. [16]

4. (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]

5. The Hubble space telescope (HST) was placed in a circular orbit at an altitude of 600 km. Find the orbital characteristics to include the specific kinetic energy, the specific potential energy, the total specific energy, the period, the semilatus rectum p, the eccentricity, the orbital velocity, and the angular momentem H. [16]

6. (a) What are the forces that act on a re-entry vehicle? Among these which is the dominant force during re-entry? Elucidate.
   (b) A vehicle attempting to aero-brake into orbit around Mars needs to achieve an equivalent ΔV_{retro} of 2 km s^{-1}. If the entire aero-braking maneuver lasts for 10 minutes, estimate the drag force acting on the vehicle in the process, in terms of g's. [8+8]

7. (a) Write a note on Black body radiation curves. Explain how Stefan-Boltzman law can be useful in calculating the equilibrium temperature of a spacecraft without internal heat sources?
   (b) Write a short note about asteroids, comets and meteoroids. [10+6]

8. (a) A satellite is launched into Earth's orbit when its launch vehicle burns out at an altitude of 250 km. At this instant, the satellite's velocity is 7,900 m/s with ϕ (flight path angle, the angle between the local horizontal and the velocity vector) equal to two degrees. Calculate the satellite's altitude at perigee and at apogee.

(b) Calculate the eccentricity of the orbit for the satellite in the above problem. [10+6]

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