Code No: R09222105 **R09** **Set No. 2**

II B.Tech II Semester Examinations,April/May 2012
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write short notes on the following:
   (a) Effect of Earth's rotation on an orbit's ground track obtained on the assumption that the Earth is not rotating.
   (b) Estimation of the period and semi-major axis of an orbit for a known node displacement (ΔN). [7+8]
2. Based on fundamentals, obtain the thrust equation for a single stage rocket. Further, explaining the importance of various parameters employed in analyzing the performance of a rocket, express the rocket equation in terms of payload ratio and structural ratio. [15]
3. Consider the motion of a space vehicle of mass 'm' moving past a large body of mass 'M', separated by a distance of 'r_{min}'. Develop a relation between the two masses and explain when the trajectory is:
   (a) Elliptic.
   (b) Parabolic.
   (c) Hyperbolic. [5+5+5]
4. What are 'Galactic Cosmic rays'? Describe the mechanism that protects the Earth from the effects of solar and cosmic charged particles. [15]
5. Write detailed notes on propulsion for maneuvers. [15]
6. Distinguish between spin-stabilization and dual-spin stabilization attitude control mechanisms for spacecrafts. [15]
7. Describe the different types of re-entry of space vehicles. [15]
8. Explain in detail satellite control networks and their working procedure. [15]

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Code No: R09222105 **R09** **Set No. 4**

II B.Tech II Semester Examinations,April/May 2012
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Describe space environment.
   (b) Explain bielliptic orbit transfer. [8+7]

2. (a) What do you understand by 'Pitch over' phase of a launch vehicle. Why is it required?
   (b) Write a short note on 'Gravity Loss' pertaining to a launched vehicle. [8+7]

3. (a) Describe the re-entry co-ordinate system.
   (b) What are the potential forces that act on a re-entry vehicle? Among these which is the dominant force during re-entry. Explain. [7+8]

4. Discuss the possibilities of obtaining relations between orbital elements and position and velocity of a body in its motion about another body. [15]

5. Explain how the performance of a real rocket is different from that of an ideal rocket. Differentiate between under-expanded and over-expanded nozzle performance. [15]

6. Obtain expressions for:
   (a) Maximum ideal velocity for a given payload and
   (b) Maximum payload for a given ideal velocity, in case of a multi-stage (N) rocket traveling in a homogeneous gravitational field and in vacuum. Thus, deduce an expression for the minimum number of stages required in a multi-stage rocket assembly so that maximum payload can be placed in the specified orbit. [10+5]

7. A spacecraft is in a 8000 km radius circular orbit about Mars. A short-duration, impulsive thrust in the direction of motion is applied to increase the spacecraft velocity further. Find the minimum velocity increment that is required to let the spacecraft escape from the planet's gravitational field. Given, μ, the gravitational parameter of Mars = $42.81 \text{x} 10^3$ km^3/s^2. [15]

8. Establish the requirement of communication in a space mission? Describe the space communication architecture in detail. [15]

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Code No: R09222105 **R09** **Set No. 1**

II B.Tech II Semester Examinations,April/May 2012
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write short notes on the following with regard orbital elements:
   (a) Right ascension of the ascending node.
   (b) Longitude.
   (c) Altitude. [5 + 5 + 5]

2. Write a detailed note on the responsibilities and tasks related to operations teams of a space mission. [15]

3. In a combined plane change maneuver, both the size and orientation of the orbit are required to be changed. Discuss the possible ways to achieve this orbit transfer and suggest the advantageous method. [15]

4. If the re-entry velocity of a spacecraft is 7.4 kms^{-1} and the re-entry flight path angle is 10^0, find out the maximum deceleration experienced by the vehicle and the altitude at which it occurs? Given the Ballistic Coefficient of the vehicle is 1000 kgm^{-2}. [15]

5. (a) Define specific impulse of a rocket motor. Describe a solid rocket motor, its propellant and the casing along with its nozzle.
   (b) Develop the thrust equation for a solid rocket motor for the following conditions:
      i. When it is powering an aerospace vehicle in air medium, and
      ii. When ground tested on a static test bench. [8+7]

6. Write short notes on: a) Attitude control of spinning spacecraft. b) Yo-Yo mechanism c) Dual spin spacecraft. [5+5+5]

7. (a) What are the advantages and disadvantages of staging the rockets.
   (b) A three stage rocket has been designed with the following characteristics, to deliver small pay loads to low Earth orbit.

Specific Impulse of 1^{st} stage, $(I_{sp})1$	= 300 s
Specific Impulse of 2^{nd} stage, $(I_{sp})2$	= 350 s
Specific Impulse of 3^{rd} stage, $(I_{sp})3$	= 400 s
Mass of the pay load	= 1,500 kg
Structural mass of the 1^{st} stage	= 10,000 kg
Structural mass of the 2^{nd} and 3^{rd} stages	= 7,500 kg each
Mass of the propellant for 1st stage	= 50,000 kg

Mass of the propellant for 2^{nd} stage = 40,000 kg
Mass of the propellant for 3^{rd} stage = 35,000 kg
Estimate:

i. Initial mass of the entire vehicle.
ii. Final mass of the 1^{st} stage.
iii. Final mass of the 2^{nd} stage.
iv. Final mass of the 3^{rd} stage.
v. Velocity change (ΔV) for the 1st stage.
vi. Velocity change (ΔV) for the 2nd stage
vii. Velocity change (ΔV) for the 3rd stage.
viii. Initial mass of the 2^{nd} stage.
ix. Initial mass of the 3^{rd} stage.
x. Total velocity change (ΔV) of the booster. [5+10]

8. Write a detailed note on radiation effects to both manned and unmanned space-crafts. [15]

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Code No: R09222105 **R09** **Set No. 3**

II B.Tech II Semester Examinations,April/May 2012
INTRODUCTION TO SPACE TECHNOLOGY
Aeronautical Engineering

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write a short notes on the following:
   (a) Launch vehicles.
   (b) Satellites and Interplanetary probes. [7+8]

2. Illustrate various stages involved in spacecraft mission and operating systems. [15]

3. (a) Explain why a single stage to orbit launch vehicle has not been feasible.
   (b) Derive the expressions for the trajectory parameters for a rocket under gravity turn. [7+8]

4. (a) What are the advantages offered by a lifting re-entry vehicle? How does a space shuttle use lift to reach the runway?
   (b) A vehicle attempting to aero-brake into orbit around Mars needs to achieve an equivalent ΔV_{retro} of 2 kms^{-1}. If the entire aero-braking maneuver lasts for 10 minutes, estimate the drag force attained in the process, in terms of g's. [7+8]

5. (a) Write a detailed note on the effect of ambient pressure on the nozzle flow in case of a rocket.
   (b) With the help of neat sketches, discuss in brief the nozzle designs in which the divergence loss and nozzle length are greatly reduced as compared to De Laval type nozzle. [7+8]

6. Obtain an expression for the period of a satellite in elliptical orbital motion in a two-body motion. [15]

7. Consider a Hohmann transfer from a circular orbit of radius r_1 to another coplanar circular orbit or radius r_2. Let Δv be the sum of the two velocity increments required for the maneuver. Show that for a fixed gravitational parameter and radius r_1, the maximum required Δv occurs for r_2= 15.58 r_1. [15]

8. (a) Explain how the attitude of a non-spinning satellite is controlled.
   (b) Describe the Yo-Yo mechanism, its purpose and how the purpose is served, with relevant equation. [8+7]

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