B.E. (Aeronautical Engineering) Seventh Semester (C.B.S.)

Space Flight Mechanics

P. Pages : 2 **NIR/KW/18/3609**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. a) Classify the planets in all the three ways. **6**

b) Mention any 2 unique interesting feature of all planets in sequence. **7**

OR

2. Name the few natural satellites with their unique feature of all the 8 planets and the 3 dwarf planets. **13**

3. a) Derive the equation for N-Body problem. **5**

b) In an inertial co-ordinate system, position and velocity vectors of a satellite are, **8**

$\mu = (4.1852\ I + 6.2778\ J + 10.463\ K) \times 10^7 \text{ft}$

$\nu = (2.5936\ I + 5.1872\ J) \times 10^4 \text{ft}/\text{sec}$

where I, J & K are unit vectors Determine 'ξ' and 'h'. Also find the flight path angle ϕ.

OR

4. a) Derive the equation for conservation of mechanical energy 'ξ'. **5**

b) For a given satellite ξ is $-2\times10^8\ \text{ft}^2/\text{s}^2$ and e is 0.2. Determine its specific angular momentum 'h', semi-lotus rectum, and semi-major axis. **8**

5. a) Explain In-plane orbit change in detail. **5**

b) A communication satellite is in a circular orbit of radius 2 DU. Find the minimum ΔV required to double the altitude of a satellite. **8**

OR

6. a) Explain out of plane orbit charge in detail. **5**

b) It is desired to transfer supplies from a 1 DU circular parking orbit around earth to a space station in a 4 DU co-planar orbit. The transfer will be accomplished via an elliptical orbit tangent to lower orbit and crossing the high orbit at the end of the minor axis of the transfer orbit. **8**

7. a) Derive the equation for trajectory about the target planet. **5**

b) Calculate ΔV required for transfer between to coplanar circular orbit of radii $r_1 = 2\,\text{Du}$ & $\mu_2 = 5$ DU using transfer ellipse having parameter p = 2.11 Du & e = 0.76. **8**

OR

8. a) Derive 3 dimensional interplanetary trajectory. **5**

b) A space vehicle enters the sensible atmosphere of earth i.e. 300000 ft with a velocity of 25000 ft/sec at a flight path angle of -60 degrees. What is the velocity and flight path angle of the same at an altitude of 100 n.mi. during descents ? **8**

9. a) Derive the equation for Trajectory geometry. **11**

b) Consider an initial condition direct circular earth's orbit of radius 9100 km and a final direct coplanar elliptical orbit with radius 9000 km. What velocity change is required to transfer orbits e = 0.1. **3**

OR

10. a) Derive the equation for optimal flight. **11**

b) Determine the velocity change required to convert a direct circular earth orbit with a radius of 15000 km into a coplanar direct elliptical orbit with 500 km height e = 0.1 **3**

11. a) Explain space environment in detail. **7**

b) What are the materials used in space ? **7**

OR

12. a) How the space environment affect the spacecraft materials ? **7**

b) Explain how astronauts sustain in space environment ? **7**

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