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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech VI Semester End Examinations (Regular) - May, 2019

Regulation: IARE – R16

SPACE PROPULSION

Time: 3 Hours

(AE)

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. (a) Examine in detail the concepts of Vertical Take-Off and Landing(VTOL) with a neat sketch. [7M]
- (b) A space vehicle in a circular orbit at an altitude of 500km above the earth executes a Hoffmann transfer to a 1000 km circular orbit. Calculate the total delta-v requirement. [7M]
2. (a) Define specific impulse and explain its significance. Derive its unit. Mention the typical values of specific impulse for different chemical rockets. [7M]
- (b) A spacecraft is in a 300km circular orbit. Calculate [7M]
 - (i) The total delta-v required for the bi-elliptical transfer to a 3000km coplanar circular orbit
 - (ii) The total transfer time

UNIT – II

3. (a) Explain the operating principle of rockets. Classify various types of rocket igniters. [7M]
- (b) A space mission performed by an electrical rocket requires an incremental velocity of 10 Km/s. The mass of payload required is 1500 Kg. If the specific impulse of the propellant used is 18000 N-s/Kg and the structural mass fraction of the vehicle is 0.2, estimate [7M]
 - i. The propellant mass required,
 - ii. The overall mass.
4. (a) Describe the various factors to be considered for the design of a rocket. [7M]
- (b) For a given rocket: Thrust = 9000 KN, Propellant Consumption Rate = 3000 Kg/s. Determine [7M]
 - (i) Effective jet velocity
 - (ii) Specific impulse of the propellant
 - (iii) Propulsive efficiency when the rocket is traveling at a velocity of 2000 m/s.

UNIT – III

5. (a) Explain the concept of Strand burner and T- burner applications in solid rocket propulsion. [7M]
- (b) Describe the different phases of solid propellant burning from initial to the final phase. [7M]

6. (a) Explain the classification of different types of solid propellants. [7M]
(b) Describe the salient features of solid propellant rockets and give its merits and demerits. [7M]

UNIT – IV

7. (a) Classify and explain various types of injector patterns in liquid propellant rockets. [7M]
(b) Describe the selection criteria of liquid propellant rocket engine and give its importance. [7M]
8. (a) Mention the advantages of liquid propulsion over solid rocket propulsion? [7M]
(b) Discuss about various types of combustion instabilities in liquid propellant rockets. [7M]

UNIT – V

9. (a) Describe the principle of electric propulsion and mention its advantages and applications. [7M]
(b) Illustrate with a neat sketch, the working of an arcjet propulsion system. [7M]
10. (a) Explain with a neat sketch, the working of an Nuclear fusion reaction propulsion system. [7M]
(b) What is the concept involved in ion propulsion? Explain with the help of a diagram how an ion engine works. [7M]

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