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Question Paper Code : 70042

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Eighth Semester

Aeronautical Engineering

AE 6015 — ROCKETS AND MISSILES

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are anti-tank missiles?
2. Name any four currently operational Ballistic missiles of India.
3. Distinguish between supersonic and subsonic leading edges with reference to missile aerodynamics.
4. What is boat-tail and what is its purpose with reference to missile airframe design?
5. What is meant by impulse shot?
6. Differentiate burnout time and culmination time.
7. Define multistage optimization.
8. How is the burnout velocity achieved?
9. What is Reaction Control System ?
10. What are the methods available to find rocket vector control?

PART B — (5 × 13 = 65 marks)

11. (a) Discuss various methods of classification of missiles. And explain characteristic features of Ballistic missiles and Cruise missiles.

Or

- (b) Explain in detail about the special features of Indian space launch vehicles. And give advancement made in Indian rockets from 1960's.
12. (a) Explain the following :
- (i) Distinguish between tangent and secant ogival shapes of missiles forebodies. (3)
 - (ii) How nose and rocket diameter affect the drag? (3)
 - (iii) Explain in detail about forces acting on a Missile while passing through atmosphere. (7)

Or

- (b) Explain in detail about the different types of drag.
13. (a) (i) A rocket is tracing an inclined trajectory with a constant pitch angle of 67° . The initial launch mass and specific impulse of the rocket are 2834 kg and 298 seconds respectively. The rocket develops constant thrust and the mass flow rate of the propellant is 24 kg/s. Estimate flight path angle and angle of incidence of the rocket vehicle at a time of 24.3 seconds from launch event. (7)
- (ii) Estimate the burnout range attained by a rocket for the following data: Specific impulse 294 seconds, mass ratio 7.2, thrust to weight ratio = 1.38. Assume that the thrust developed by the rocket is constant and also neglect the effect of aerodynamic and gravitational forces. (6)

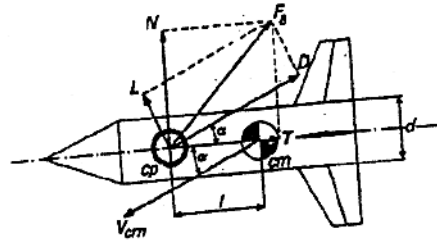
Or

- (b) Show that the specific thrust of a rocket moving in a gravity turn with constant pitch rate is $2 \sin \gamma$.
14. (a) Explain in detail about various drag components of a missile with suitable equations.

Or

- (b) Discuss in detail how the variation in rocket motor performance and thrust misalignment causes rocket dispersion.

15. (a) (i) Describe aerodynamic characteristics of canard control and wing control of a missile. (8)
- (ii) Write the expansion of the following letters indicated in the diagram of the rocket drawn below. (5)



Fa →

D →

N →

V_{cm} →

L →

T →

C_p →

d →

C_m →

S →

Or

- (b) (i) Explain any three thrust vector control methods in rocket vehicles. (9)
- (ii) Describe the principle involved in secondary fluid injection thrust vector control system. (4)

PART C — (1 × 15 = 15 marks)

16. (a) From fundamentals derive Tsiolkovsky's equation. Plot the variation of ideal velocity of a rocket with mass ratio for various specific impulse values.

Or

- (b) (i) What is the design philosophy behind multistaging of space launch vehicles? Explain your answer with a neat illustration. (8)
- (ii) In what way the aerodynamic design approach to airframe of rockets is different from that of airplanes? (7)