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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2004.

Seventh Semester

Aeronautical Engineering

AE 431 — ROCKETS AND MISSILES

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are called pyrogen igniters and pyrotechnic igniters?

2. What do you understand by detonation and why detonation occurs?

3. Mention the aerodynamic characteristics of air-to-surface missiles.

4. Distinguish between body upwash and downwash in missile aerodynamics.

5. What is a zero-lift trajectory and what is its importance?

6. What are the different phases in ballistic missile trajectory?

7. Differentiate between rocket stages and sub rockets.

8. What are the techniques that are used for stage separation of a space launch vehicle in space?

9. What is an adapted nozzle?

10. What is the need for using ceramic materials in missiles?

PART B — (5 × 16 = 80 marks)

11. (i) Derive the Tsiolkovsky's equation for rocket motion in free space. (6)

(ii) The specific impulse of a rocket vehicle is 282 seconds. Its structural efficiency is 0.093. The ideal velocity increment in free space conditions is estimated to be 8.92 km/s. Calculate payload ratio, mass ratio and propellant ratio. The specific thrust of the vehicle is 1.92 and is constant and the initial launch mass is 1812 kg. Also estimate the mass flow rate of the propellant at 8.9 seconds from the time of launch. (10)

12. (a) (i) What are the problems that are generally faced by a designer in liquid propellant tank outlet design? (8)

(ii) Distinguish between hypgolic and hypergolic propellants. (8)

Or

(b) (i) Explain the phenomenon of geysering in liquid propellant rockets. When does it occur? Explain your answer with neat sketches. (8)

(ii) Explain the phenomenon propellant hammer in a liquid propellant rocket engine with a neat sketch. (8)

13. (a) (i) What are the various components of drag experienced by a supersonic missile while passing through the atmosphere? Explain their relative significance in missile design. (8)

(ii) With the help of a neat sketch clearly explain how fins impart stability to a rocket in flight in atmosphere. (8)

Or

(b) (i) What is rocket dispersion? Explain the factors the cause rocket dispersion. (8)

(ii) Explain the various forces and moments acting on a missile while flying through atmosphere. (8)

14. a) (i) Derive an expression for culmination altitude reached by a sounding rocket. Neglect aerodynamic and gravitational forces. Assume constant thrust. (12)

(ii) Explain what a kick angle is. (4)

Or

(b) (i) What is thrust vector control? Explain the methods by which the thrust vector control could be achieved. (8)

(ii) Calculate the culmination range and altitude reached by a rocket after burnout with the following data. Specific impulse of the rocket = 278 seconds, thrust to weight ratio = 1.48, mass ratio = 5.2 and pitch angle = 41.2°. Assume that the rocket is tracing an inclined trajectory with constant pitch angle. Aerodynamic forces may be neglected and thrust can be assumed constant. (8)

15. (a) (i) What is coasting phase? What is its importance in the design philosophy of multistaging of a rocket vehicle? (8)

(ii) What are the possible materials that can be used for nose/fore body wings, and interstage couplings of short and long range ballistic missiles? Justify your answer. (8)

Or

(b) (i) What are the considerations for selection of materials to be used for the construction of thrust chambers of liquid rocket engines. (8)

(ii) Explain the ablation cooling method of re-entry bodies. (8)

S 435

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2005.

Seventh Semester

Aeronautical Engineering

AE 431 — ROCKETS AND MISSILES

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is propellant slosh in a liquid rocket engine?

2. What is gey sering effect in liquid rockets?

3. What is a pyrogen igniter?

4. What is the importance of boat–tailing in missiles?

5. How are missiles classified?

6. What is coasting phase with reference to the motion of a multistage launch vehicle?

7. Distinguish between constant thrust rocket motion and constant specific thrust rocket motion.

8. List the important stage separation techniques which are used in space.

9. Explain how the structural properties of aerospace materials are affected at low and high temperatures.

10. Define two–dimensional rocket motion. How many degress of freedom does a rocket have in such a motion?

PART B — (5 × 16 = 80 marks)

11. (i) What are the important design considerations in the selection of liquid rocket combustion chamber volume and shape? List and explain them briefly. (10)

(ii) Sketch and explain a typical one–dimensional model of combustion mechanism of a composite social prophellant. Sketch the temperature profile in both gas phase and condensed phase of the prophellant. (6)

12. (a) (i) Explain the phenomenon propellant hammer in liquid rocket engine operation. (6)

(ii) With neat sketches distinguish between body upwash and body downwash in missile aerodynamics. (10)

Or

(b) (i) Sketch self impinging type and splash plate type liquid rocket injectors and explain their advantages and limitations. (6)

(ii) Sketch the various forces and moments acting on a missile while passing through atmosphere. Assume that the thrust vector makes an angle of σ with the missile body axis. What is the condition for trim? (10)

13. (a) (i) What are the various aerodynamical shaped for forebodies of rockets and air breathing missiles? Sketch any two shapes and show the typical pressure coefficient variation over the aerodynamic surfaces. What factors need to be considered for their selection? (8)

(ii) What is wave drag? What is its relative importance in the total drag estimation of a supersonic missile? How is wave drag coefficient estimated for double wedge, modified double wedge and biconvex profiles of supersonic airfoils? (8)

Or

(b) (i) With a neat sketch explain the lateral aerodynamic moment of a rocket and briefly elucidate the variation of lateral aerodynamic moment coefficient variation with angle of attack. How does this variation affect the stability of the rocket flight? (8)

(ii) List any four basic aerodynamic design considerations for the development of air–to–air missiles. What factors limit the range of such missiles? (8)

14. (a) (i) Derive an expression for burnout time interms of specific impluse, mass ratio and thrust to weight ratio of rocket. Assume that rocket develops constant thrust. (6)

(ii) Obtain expressions for burnout altitude and culmination altitude attained by a sounding rocket. The thrust developed by the rocket is constant. Aerodynamic effects may be neglected. Assume that the rocket motion is in a homogeneous gravitational field. (10)

Or

(b) A rocket unit undergoes an inclined trajectory with constant pitch angle. The rocket develops constant thrust and its motion is in a homogeneous gravitational field. Derive expressions for burnout velocity and burnout-altitude and culmination time. Show that the vertical component of velocity is zero at culmination. Neglect aerodynamic forces in the derivation. (16)

15. (a) (i) Suggest materials for the following :

Re–entry nose cones, wing leading edges and rocket nozzle throat inserts. Justify the selection of materials for the above. (6)

(ii) Explain the principle behind secondary injection thrust vector control with a neat sketch. What are the various types of fluids that can be used for secondary injection? (10)

Or

(b) (i) What are the important criteria for the selection of materials for aerospace applications? (4)

(ii) What factors promote smooth stage separation for a multistage vehicle? (4)

(iii) Explain how vehicle optimization is carried out for a n–stage launch vehicle. (8)

Reg. No. :

J 3219

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fourth Semester

Instrumentation Engineering

EE 1209 — CONTROL SYSTEMS

(Regulation 2013)

Time : Three hours Maximum : 100 marks

(Graph, Sheet(s), Polar Sheet(s) are to be provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the transfer function.

2. What do transfer functions for mechanical networks look similar to (transfer functions for electrical networks)?

3. What is the main advantage of open loop system compared to closed loop system in terms of stability?

4. Name the two components of a signal flow graph.

5. What is meant by steady state error? Name the sources of it.

6. Give the Laplace transform of an impulse function.

7. State Gain Margin in Bode technique.

8. What is meant by the stability of the system?

9. Give the advantages in the design of digital control systems.

10. What is the use of Sample and Hold circuit in A/D conversion?