

SRINIVASAN ENGINEERING COLLEGE, PERAMBALUR

AE1451

ROCKET AND MISSILES

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ROCKET AND MISSILES

UNIT I

1. What are the types of igniters?
Gaseous igniter
Liquid igniter
Solid igniter
2. Define gaseous igniter.
The propellants used in the igniter are of gaseous state. Reaction gaseous mixture stored in a very thin tube with high pressure. Hazardous in nature. Used only for space application.
3. Write down the characteristics of hypergolic liquids with example.
Very high bulk density.
Chemically stable.
Low vapour pressure.
Good heat transfer characteristics.
4. Explain bag igniter with advantage.
It is a old primitive igniter, that we don't have much control over ignition. After the ignition of fully charged bag igniter, the heat is released & the pressure generation occurs.
Its rate of increase is very high. So burst may occur.
The main advantage is easy to fabricate & cost of production is very low.
5. What do you meant by jelly roll?
A jell roll is a film coated pyrotechnic & binder is rolled over a rod. After rolling remove the rod very carefully. Give the squib support at the front & back & rubber support externally.
6. What is alcojet?
Its a type of ballistically controlled igniter in which booster charge is ignited that is located in the annular spacing between the tubes. The ignition passes through the perforation in the inner wall to the main charge. There is perforation in the outer tube through which the flames come out.
7. Explain the purpose of squib.
Squib is primary element of the ignition train that affects the conversion of electrical impulse from the control console to chemical reaction in the rocket motors.
8. Difference between gas pressure & turbo pump feed system.
Gas pressure feed system:
Inert gas is carried separately..
No moving parts.
System is simple.
Unsuitable for large rocket engines& low range missiles.
Turbo pump feed system:
Not necessary to carry inert gas.
Having moving parts.
System is quite complex.
Suitable for large rocket engines& long range missiles.
9. Define combustion instability.
If the process of rocket combustion is not controlled, then combustion instability occurs which can occur very quickly cause excessive pressure, vibration force or excessive heat transfer. When the fluctuations interact with the natural frequencies of the propellant feed system periodic superimposed collision referred as instability.
10. What is proof test load?
Proof test load is applied to engines & their components during development & manufacturing inspection. It is often equal to the design limit load.

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UNIT II

1. What are the components of rockets and missiles?

The body of the missiles may be divided into three major sections, the forebody, or nose, the mid-section, and the aft or boattail, section.

2. Mention the shapes of forebody?

There are three types of forebody, they are

- a) Conical forebody.
- b) Ogival forebody.
- c) Hemispherical forebody.
- d)

3. What is boattail?

The tapered portion of the aft section of a body is called the boattail. The purpose of the boattail is to decrease the drag of a body which has a "squared-off" base.

4. What is base pressure?

At supersonic velocities the base of the body experiences a large negative pressure resulting in a substantial increase in missile drag. An accurate determination of this base pressure coefficient is also quite involved since it depends in many parameters including boattail angle, Mach number, and boattail length.

5. What are the effects of aspect ratio?

The effects of increasing aspect ratio are as follows:

- i) Increase c_{N0} , $CD0$.
- ii) Increase $(L/D)_{max}$.
- iii) Increase span.
- iv) Reduce wing area.
- v) Increase structural area.
- vi) Negligible effect on centre of pressure.

6. What are the classifications of missiles?

Most missiles can be classified into four general classes:

1. AAM- Air to Air Missiles.
2. SAM - Surface to Air Missiles.
3. ASM- Air to Surface Missiles.
4. SSM- Surface to Air Missiles.

7. What are the types of rocket dispersion?

There are two types of rocket dispersion, such as;

- i. In-plane dispersion.
- ii. Lateral dispersion.

8. What are the perturbing factors causing angle of attack?

- a. Asymmetry of thrust force manufacturing defects in nozzle gas flow.
- b. Perturbations when the rocket leaves the launcher.

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UNIT III

1. Define Newton's law of gravitation.

According to Newton's law of gravitation, "Any two particles attract each other with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them and acts along the line joining particles".

2. Define Thrust Vector Control.

Thrust vector control (TVC) is the internal change of direction of the thrust vector with respect to the symmetry axis.

3. Define burnout range

the propellant consumption as a function of time. $m = m(t)$ has to be known. In the following we will derive the expression for the range for different propellant consumption such as

i) constant thrust

ii) constant specific thrust

3. Define impulsive shot.

The burning time decreases if ϕ_0 increases. In that case all the propellant is consumed instantaneously. This is called as impulsive shot.

4. Define gravity terms

To reduce the aerodynamic forces on a rocket during its flight through the atmosphere, one will endeavour to keep the angle of attack as small as possible.

5. Define lateral dispersion during powered flight

If the perturbing factors are at work, the axis of the rocket will in general deviate from the tangent to the trajectory of the mass center by an angle known as angle of attack.

6. Define perturbing factors causing angle of attack

i) asymmetry of thrust force manufacturing defects in nozzle gas flow

ii) perturbation when the rocket leaves the launcher.

7. What are the types of rocket dispersion

There are two types of rocket dispersion such as

i) In plane dispersion

ii) lateral dispersion

8. Define wing tail interference

When a missile with fore and aft wing location is inclined at an angle of attack to the airstream, the original flow deflection will be changed as the air

leaves the forward lifting surfaces.

9. Define body up wash

It is of great importance in the analysis of flow conditions around bodies of revolution with wing surfaces at angle of attack with increases of flow velocity.

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UNIT IV

1. Define Thrust Vector Control.

Thrust vector control (TVC) Is the internal change of direction o the thrust vector with respect to the symmetry axis.

2. Define jetvane thrust control

Two opposing vanes moving in a same direction, where used pitch and yaw control.

all four moved clockwise or anticlockwise for roll control.

3. Define swivelling control

Thrust direction control can also be obtained in solid propellant rockets by connecting the nozzles to propellant chamber by flexible.

4. Explain SITVC

Secondary Injection Thrust Vector Control.

A flued injected at one or more points in the nozzle .

A local shock wave results causing the flow to become asymetrical.

- 5.Mention the shapes of forebody?

There are three types of forbody,they are

- e) Conical forebody.
- f) Ogviafor body.
- g) Hemispherical forebody.

- 6.Thrust Magnitude Control

It allows for large thrust variations usually wuith small variations in camber pressure.

In someliquied propellant rocket motors, TMC has been used without varing the throat area.

7. Thrust Termination

The engine thrust must be cut off the instant proper velocity is achieved is concerned fuel and or obtained the desire orbit.

8. separation of stages with in the atmosphere

The burnout of the first stage generally occurs with in the upper region of the atmosphere i) firing in the hole technique ii) ullage rocket techniques.

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- 10.Define combustion instability.

If the process of rocket combustion is not controlled, then combustion in stability occurs which can occur very quickly cause excessive pressure, vibration force or excessive heat transfer. When the fluctuations interact with the natural frequencies of the propellant feed system periodic superimposed collision reffered as instability.

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UNIT V

1. What are the selection criteria for materials for spacecraft structure?
Extreme working temperature.
Huge temperature gradient.
High strength to weight ratio.
Should not have buffeting.
2. What are the effects of space environment on material?
The effects of space environment on material are:
Effect of radiation
Energy spectrum effect
Radiation induced changes
UV radiation
High geomagnetic radiation belt
3. What are aerodynamic heating problem?
In the ballistic missiles, the airframe of missile experience high temperature due to aerodynamic heating. This leads to very high surface temperature at the nose, molecules start vibrates & changed into atoms.
Inert gas changed into plasma.
4. What are ceramic material?
Ceramics are used in missiles as either sprayed or protective coating or monolithic field body.
No plastic deformation
No effect in temoeraturerise.Very weaker in tension than compression
5. Define thermal shock.
When the material is rapidly heated as in the case of re-entry body or throat of a rocket nozzle.
6. What are the material selection consideration for rockets?
High strength at elevated temperature
Ease of fabrication
High thermal conductivity
Resistance to corrosion
7. Name the materials used for fins & wings in short range missiles.
Normally Al alloy plates
Reinforced fibre glass resin impregnated composite structure\
8. Name the materials used for nose selection for long range missiles.
Austenitic stainless steel type of AISI347 & AISI 321 types with ablative