INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Title	**ROCKET AND MISSILES**				
Course Code	AAE518				
Programme	B.Tech				
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Course Type	Elective				
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Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
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	UNIT-I					
1	Define the Rocket engine.	A reaction engine that contains within itself, or carries along with itself, all the substances necessary for its operation or for the consumption or combustion of its fuel, not requiring intake of any outside substance and hence capable of operation in outer space.	Remember	CO1	CLO 1	AAE518.01
2	Elucidate Missile?	Missile, a rocket-propelled weapon designed to deliver an explosive warhead with great accuracy at high speed.	Remember	CO1	CLO 1	AAE518.01
3	Differentiate between Rockets and Airbreathing engines.	Thrust is essentially independent of speed and altitude. Thrust/Afrontal is largest of all known propulsion systems. Thrust/Wengine is largest of all known propulsion systems.No altitude ceiling (or depth floor)..	Remember	CO1	CLO 1	AAE518.01
4	Elucidate Ideal Rocket?	The working substance (propellant products) is homogeneous and invariant in composition throughout the rocket chamber and nozzle. The working substance obeys the perfect gas laws. 3. There is no friction.	Understand	CO1	CLO 2	AAE518.02
5	Elucidate the mass ratio?	It is ratio of final mass of the rocket after burnout and total mass of the rocket at takeoff	Understand	CO1	CLO 2	AAE518.02
6	Elucidate specific impulse?	Specific impulse is a measure of the efficiency of rocket and jet engines	Understand	CO1	CLO 2	AAE518.02
7	Define Chemical Propulsion	Chemical propulsion is propulsion in which the thrust is provided by the product of a chemical reaction, usually burning (or oxidizing) a fuel	Understand	CO1	CLO 2	AAE518.02
8	Describe Total Impulse.	The impulse, usually called the total impulse, of a rocket motor is the integral of the thrust, F, over the operating time, t.	Remember	CO1	CLO 2	AAE518.02
9	ElucidateGuided Missile?	A guided missile is broadly any military missile that is capable of being guided or directed to a target after having been launched.	Understand	CO1	CLO 2	AAE518.02
10	Elucidate Cruise Missile?	Cruise missiles are powered by air-breathing engines that provide almost continuous propulsion along a low, level flight path	Understand	CO1	CLO 2	AAE518.02
11	ElucidateBallistic Missile?	Ballistic missile is propelled by a rocket engine for only the first part of its flight; for the rest of the flight the unpowered missile follows an arcing trajectory.	Understand	CO1	CLO 2	AAE518.02
12	Categorize different Tactical guided Missiles?	There are five types, air-to-air, air-to-surface, surface-to-air, antiship, and antitank.	Understand	CO1	CLO 2	AAE518.02
13	Categorize different Ballistic Missiles?	Ballistic missiles are most often categorized as short-range, medium-range, intermediate-range, and intercontinental ballistic missiles.	Remember	CO1	CLO 2	AAE518.02
14	DescribeTsiolkovsy rocket equation ?	Ideal rocket equation is a mathematical equation that describes the motion of vehicles	Understand	CO1	CLO 2	AAE518.02

		that follow the basic principle of a rocket.				
15	Describe Inertia frame of Reference.	Inertial frame of reference is a reference frame in which an object stays either at rest or at a constant velocity unless another force acts upon it.	Remember	CO1	CLO 2	AAE518.02
16	Describe Non Inertia frame of Reference.	When a body does not seem to be acting in accordance with inertia, it is in a non-inertial frame of reference or accelerating..	Remember	CO1	CLO 2	AAE518.02
17	Describe Coriolis force.	The fictitious force causing the apparent deflection of moving objects when viewed in a rotating frame of reference.	Remember	CO1	CLO 2	AAE518.02
18	Describe Center of Pressure .	It is the point along the rocket z axis with the same amount of surface area on both sides.	Remember	CO1	CLO 3	AAE518.03
19	Elucidate Stability marigin	The stability margin (SM) is the distance between the center of gravity and center of pressure is divided by the diameter of the rocket body.	Understand	CO1	CLO 3	AAE518.03
20	Describe combustion efficiency.	The efficiency with which fuel is burned, expressed as the ratio of the actual energy released by the combustion to the potential chemical energy of the fuel.	Remember	CO1	CLO 3	AAE518.03
21	Elucidate Propellant mass fraction	It is defined as ratio of propellant mass at takeoff and total mass of rocket at tkeoff	Remember	CO1	CLO 3	AAE518.03
22	Describe Coasting	The behavior of rocket after the burnout condition and where the thrust becomes zero is termed as coastoing	Remember	CO1	CLO 3	AAE518.03
23	Describe Low earth orbit	A single stage to orbit is generally termed as low earth orbit and this type of mission, multistage vehicles are not employed.	Remember	CO1	CLO 3	AAE518.03
24	Define stationary satellite	If the orbital velocity of the earth satellite is equal to the angular velocity of the earth, it has zero velocity relative to the earth. Such a satellite is known as stationary satellite	Understand	CO1	CLO 3	AAE518.03
	Unit II					
1	Elucidate Solid Propellant?	The propellant is contained and stored directly in the combustion chamber, sometimes hermetically sealed in the chamber for long-time storage	Remember	CO2	CLO 4	AAE518.04
2	Describe grain of solid motor?	The *grain* is the solid body of the hardened *propellant* and typically accounts for 82 to 94% of the total motor mass.	Remember	CO2	CLO 4	AAE518.04
3	Define burning rate of grain	The burning surface of a propellant grain recedes in a direction essentially perpendicular to the surface. The rate of regression is defined as burning rate	Remember	CO2	CLO 4	AAE518.04
4	Elucidate binder?	The Binder is a thin layer of a sticky rubbery material that promotes the adhesion of the grain to the case.	Remember	CO2	CLO 4	AAE518.04

5	Write down major applications of solid rocket motor	The major applications are at lower stages of long-range ballistic missiles, High acceleration: short-range bombardment, antitank missile and Defense against long- and medium-range ballistic missiles	Understand	CO2	CLO 4	AAE518.04
6	Classify solid rocket motor based on thrust action?	Solid rocket motor are classified into Progressive grain, regressive grain, neutral grain and pulse rocket.	Understand	CO2	CLO 4	AAE518.04
7	Elucidate Strand burners?	strand burner is a small pressure vessel (usually with windows) in which athin strand or bar of propellant is ignited at one end and burned to the other end.	Understand	CO2	CLO 4	AAE518.04
8	Elucidate Erosive burning?	*Erosive burning* refers to the increase in the propellant burning rate caused by the high-velocity flow of combustion gases over the burning propellant surface.	Remember	CO2	CLO 5	AAE518.05
9	Write various methods of holding the grain in the case	Various methods of holding the grain in the case are Cartridge loaded grain and case bonded grains	Understand	CO2	CLO 5	AAE518.05
10	*Progressive Burning:*	Burn time during which thrust, pressure, and burning surface area increase	Understand	CO2	CLO 5	AAE518.05
11	*Regressive Burning:*	Burn time during which thrust, pressure, and burning surface area decrease	Understand	CO2	CLO 5	AAE518.05
12	Silver	Unburned propellant remaining (or lost-that is, expelled through the nozzle) at the time of web burnout	Understand	CO2	CLO 5	AAE518.05
13	Neutral Burning	Motor burn time during which thrust, pressure, and burning surface area remain approximately constant	Remember	CO2	CLO 5	AAE518.05
14	Perforation	The central cavity port or flow passage of a propellant grain; its cross section may be a cylinder, a star shape,	Understand	CO2	CLO 5	AAE518.05
15	*Deflagration Limit:*	The minimum pressure at which combustion can still be barely self-sustained and maintained without adding energy. Below this pressure the combustion ceases altogether or may be erratic and unsteady with the plume appearing and disappearing periodically	Understand	CO2	CLO 5	AAE518.05
16	Classify rocket motor propellants	Rocket motor propellants are grouped into two classes: *double-base* propellants were used as the first production propellants, and then the development of polymers as binders made the *composite* propellants feasible.	Remember	CO2	CLO 6	AAE518.06
17	Describe propellant characteristics	High specific impulse, Non-toxic exhaust gases, predictable,reproducible, and initially adjustable burning rate and the pressure or burning rate exponent and the temperature coefficient should be small	Remember	CO2	CLO 6	AAE518.06
18	Describe Detonation	In a detonation the chemical reaction energy of the whole grain can be released in a very short time (microseconds), and in effect it becomes an explosive bomb.	Understand	CO2	CLO 6	AAE518.06

19	Elucidate propellant ingredients of solid rocket motor	Propellant ingredients of solid rocket motor areoxidizer,fuel, binder, plasticizer, curing agent, etc …	Remember	CO2	CLO 6	AAE518.06
20	Which oxidizer is commonly used oxidizer in solid propellants	Ammonium perchlorate (NH_4Cl0_4) is the most widely used crystalline oxidizer in solid propellants	Remember	CO2	CLO 6	AAE518.06
21	Elucidate parameters influencing the burning rate of solid propellants	The burning rate of all propellants is influenced by pressure, the initial ambient solid propellant temperature, the burn rate catalyst, the aluminum particle sizes and their size distribution	Remember	CO2	CLO 6	AAE518.06
22	Describe Ignition process in a solid rocket motor	The Ignition process is divided into three phases: Ignition time lag, Flame-spreading interval and Chamber-filling interval	Remember	CO2	CLO 5	AAE518.05
23	Elucidate Flame-spreading interval?	The time from first ignition of the grain surface until the complete grain burning area has been ignited.	Remember	CO2	CLO 5	AAE518.05
24	When should we stop or extinguish the burning of a solid motor before all the propellant has been consumed.	When a flight vehicle has reached the desired flight velocity, To avoid collisions of stages during a stage separation maneuver (requiring a thrust reversal) for multistage flight vehicles, During research and development testing, when one wants to examine a partially burned motor.	Understand	CO2	CLO 5	AAE518.05
25	Describe combustion Instability	a set of acoustic resonances or pressure oscillations, which can occur with any rocket motor, and avortex shedding phenomenon, which occurs with particular types ofgrams.	Remember	CO2	CLO 5	AAE518.05
26	Elucidate Squib?	A small amount of sensitive powdered pyrotechnic housed within the initiator, commonly called the squib.	Remember	CO2	CLO 5	AAE518.05
27	Describe booster charge?	The charge ignited by heat released from the squib is called booster charge.	Remember	CO2	CLO 5	AAE518.05
28	Elucidate pyrogen Igniter	The pyrogen acts as a small self-contained rocket motor. The igniter is fired in the open with internal operating pressures taken by use of conventional pressure-sensing transducers and high-speed (e.g., 40 in./sec) recording equipment.	Remember	CO2	CLO 5	AAE518.05
29	Elucidate pyrotechnic Igniter	A pyrotechnic initiator (also initiator or igniter) is a device containing a pyrotechnic composition used primarily to ignite other, more difficult-to-ignite materials, e.g. thermites, gas generators, and solid-fuel rockets.	Remember	CO2	CLO 6	AAE518.06
	UNIT-III					
1	Describe Bipropellants.	Bipropellants refer to a propellant combination consisting of liquid fuel and a liquid, which when mixed, can react chemically to form hot combustion gas.	Remember	CO3	CLO 7	AAE518.07

2	Describe Burning Rate.	The Burning Rate is the rate of regression of the burning grain surfaces as propellant is consumed or burnt (inches per second) in a direction normal to the surface.	Remember	CO3	CLO 7	AAE518.07
3	Describe the Mixture Ratio.	Mixture Ratio is the ratio of the liquid oxidizer flow rate divided by the liquid fuel flow rate.	Remember	CO3	CLO 7	AAE518.07
4	Ellcidate various methods of Propellant feed systems	They are directly fed from pressurized tanks to the thrust chambers and also by a set of turbopumps	Remember	CO3	CLO 7	AAE518.07
5	Elucidate the Nozzle Area Ratio?	The Nozzle Area Ratio is the nozzle exit area divided by the nozzle throat area.	Understand	CO3	CLO 7	AAE518.07
6	Elucidate the control rocket?	A vernier or other rocket used to control the attitude of, or slightly change the speed of, a spacecraft.	Understand	CO3	CLO 7	AAE518.07
7	Describe cryogenic fuels?	A rocket fuel or oxidizer is liquid only at very low temperatures, e.g. liquid hydrogen which has a boiling point of -217.2oC (-423oF).	Understand	CO3	CLO 8	AAE518.08
8	Describe Cut-off.	The action of stopping a process abruptly, such as shutting off the flow of propellant to a rocket engine.	Remember	CO3	CLO 8	AAE518.08
9	Describe Hypergolic Propellants?	If the fuel and the oxidizer react spontaneously (a chemical reaction occurs When they come in contact with each other), they are called Hypergolic Propellants.	Understand	CO3	CLO 8	AAE518.08
10	Describe the principal components of a liquid rocket engine?	A Liquid Propellant Rocket Engine has these principal components: one or two Propellant tanks, one or more thrust chambers, a feed mechanism, piping and control valves, and sometimes servo- valves.	Understand	CO3	CLO 8	AAE518.08
11	Describe Internal Insulators?	Internal Insulators are layers on the inside of the case wall made of a material with low thermal conductivity; they protect the case from the hot combustion gases and prevent it from reaching the temperature where the case material loses its strength.	Understand	CO3	CLO 8	AAE518.08
12	ElucidateOptimum Expansion ratio	The Rocket Nozzle design that permits expansion of propellants products to the same pressure of surrounding fluid is called as Optimum expansion ratio	Understand	CO3	CLO 8	AAE518.08
13	Describevarious types of igniters used in liquid rockets	There are three types of igniters: Pyrotechnic, By using Hypergolic fluid and Pyrogenic	Remember	CO3	CLO 9	AAE518.09
14	Describe External Insulators?	External Insulators are applied to the outside of liquid propellant tanks or solid Propellant motor cases to protect against excessive heat transfer from hot air, when flying through the atmosphere at high speed.	Understand	CO3	CLO 9	AAE518.09
15	Elucidate Regenerative cooling?	Circulation of propellant through a jacket around the combustion chamber in order to cool the chamber wall, the propellant subsequently being injected into the	Understand	CO3	CLO 9	AAE518.09

		combustion chamber.				
16	Describe Throttle.	To decrease the supply of propellant to an engine, reducing thrust. Liquid propellant rocket engines can be throttled; solid rocket motors cannot.	Remember	CO3	CLO 8	AAE518.08
17	Describevarious methods employed of cooling.	Regenerative cooling, radiation cooling, Heat sink cooling, Ablative cooling, Ceramic Insulation cooling.	Remember	CO3	CLO 7	AAE518.07
18	Elucidatethe events leading to pressure oscillation in rocket combustion?	The the events leading to pressure oscillation in rocket combustion are Chugging, Buzzing and Screaming.	Understand	CO3	CLO 8	AAE518.08
19	Describe Burnout Velocity.	The velocity of a rocket, rocket-powered aircraft, or the like at the time the fuel or oxidant or both are depleted. Also called burnt velocity.	Remember	CO3	CLO 7	AAE518.07
20	Describe Burst.	A single pulse of radio energy; specifically such a pulse at radar frequencies.	Remember	CO3	CLO 7	AAE518.07
21	Describe buzz.	Sustained oscillation of an aerodynamic control surface caused by intermittent flow separation on the surface, or by a motion of shock waves across the surface, or by a combination of flow separation and shock-wave motion on the surface.	Remember	CO3	CLO 9	AAE518.09
22	DescribeOptimum mixture ratio.	A certain ratio of oxidizer weight to fuel weight in a Bipropellant combustion chamber will yield maximum performance volume called Optimum Mixture ratio	Remember	CO3	CLO 9	AAE518.09
23	Elucidate Storable Liquid Propellants.	Liquid Propellants are stable over a reasonable range of temperatures and pressures and are sufficiently non reactive with construction materials to permit storage in closed container for period of years	Remember	CO3	CLO 9	AAE518.09
24	Elucidate the bumping phenomenon?	A form of combustion instability in a rocket engine, characterized by a pulsing operation at a fairly low frequency, sometimes Described as occurring between particular frequency limits; the noise made in this kind of combustion. Also called chuffing, bumping.	Understand	CO3	CLO 9	AAE518.09
25	Describe combustion efficiency.	The efficiency with which fuel is burned, expressed as the ratio of the actual energy released by the combustion to the potential chemical energy of the fuel.	Remember	CO3	CLO 9	AAE518.09
26	Elucidate cryo pumping?	The process of removing gas from a system by condensing it on a surface maintained at very low temperatures.	Understand	CO3	CLO 9	AAE518.09
27	DescribeDensity Impulse.	Total Impulse delivered per unit volume of propellant	Remember	CO3	CLO 9	AAE518.09

28	Describe the heat of ablation.	A measure of the effective heat capacity of an ablating material, numerically the heating rate input divided by the mass loss rate which results from ablation.	Remember	CO3	CLO 8	AAE518.08
29	Describe ignition lag.	The time-lapse occurring between the instance of an igniting action of fuel and the onset of a specified burning reaction. Also called.	Remember	CO3	CLO 8	AAE518.08
30	Elucidate Passive Cooling?	Passive cooling: The use of painting, shading, reflectors and other techniques to cool a spacecraft.	Understand	CO3	CLO 9	AAE518.09
	UNIT-IV					
1	Describe Inertial guidance.	It involves knowing your starting point, knowing the location of your target, and using Newtonian laws of classical mechanics to launch a trajectory.	Remember	CO4	CLO 10	AAE518.10
2	Elucidate terminal control?	A terminal control aims to change the plant stage from initial stage to final stage in aspecified time by applying a controlled input in a fixed control interval. Ex: Guidance of spacecrafts and rockets.	Remember	CO4	CLO 10	AAE518.10
3	Elucidate tracking control?	The objective of tracking control system ids to maintain the plant state quite close to nominal, reference state, that is available as a solution to the unforced plant state by application of control input. Ex: Orbital control of spacecraft.	Remember	CO4	CLO 10	AAE518.10
4	Ellcidate different types of tracking control?	Tracking control are further classified into state feedback and open feedback systems	Remember	CO4	CLO 10	AAE518.10
5	DescribeLinear time invariant tracking system?	Any flight vehicle has 2 control systems: firstly, control of position and linear velocity relative to planet fixed frame. Secondly, control of vehicle orientation w.r.t frame of reference.	Understand	CO4	CLO 10	AAE518.10
6	Elucidate flight vehicles?	Vehicleds capable of sustained motion through air or space are termed as flight vehicles	Understand	CO4	CLO 10	AAE518.10
7	Describe Gyroscope?	Device consisting of a wheel or disc mounted so that it can spin rapidly about an axis which is itself free to alter in direction.Gyroscopes are essential to practical all types of missiles for stabilization purpose	Understand	CO4	CLO 10	AAE518.10
8	Describe Guidance system	Guidance system compares the vehicle actual position and velocity with nominal ones and produces linear acceleration commands in order to correct the errors .	Remember	CO4	CLO 10	AAE518.10
9	Elucidate Multistage rockets?	A rocket having two or more engines, stacked one on top of another and firing in succession is called a multi-stage.	Understand	CO4	CLO 11	AAE518.11

10	What is the need for multistage rocketing?	Multistage rockets allow improved payload capabilities vehicles with high change in velocity requirements such as launch vehicle..	Understand	CO4	CLO 11	AAE518.11
11	Describe Flight stability?	Stability of vehicle is achieved when the vehicle does not oscillate or rotate in flight. Unstable flights leads to increase in drag and cause problems with sensors and instruments.	Understand	CO4	CLO 11	AAE518.11
12	Elucidate Gimbaled Engine	If Engine uses Swivel arrangement to point the assembly in liquid propellant systems, then engines are known as gimbaled Engine.	Understand	CO4	CLO 11	AAE518.11
13	Describe initial to final mass ratio	It is the ratio between the rocket stage's full initial mass and the rocket stage's final mass once all of its fuel has been consumed	Remember	CO4	CLO 11	AAE518.11
14	Elucidate Structural ratio?	It is the ratio between the empty mass of the stage, and the combined empty mass and propellant mass .	Understand	CO4	CLO 11	AAE518.11
15	Elucidate payload ratio?	is the ratio between the payload mass and the combined mass of the empty rocket stage and the propellant.	Understand	CO4	CLO 11	AAE518.11
16	Explain various guidelines to follow in order to reach optimal staging.	Initial stages should have lower I_{sp}, and later/final stages should have higherI_{sp}. The stages with the lower I_{sp} should contribute more ΔV. The next stage is always a smaller size than the previous stage. Similar stages should provide similar ΔV..	Remember	CO4	CLO 11	AAE518.11
17	Describe tandem staging.	A rocket system that implements tandem staging means that each individual stage runs in order one after the other.	Remember	CO4	CLO 11	AAE518.11
18	Elucidate parallel staging?	A rocket that implements parallel staging has two or more different stages that are active at the same time. For example, the space shuttle rocket has two side boosters that burn simultaneously.	Understand	CO4	CLO 11	AAE518.11
19	Describe Thrust vector control.	Controlling the flight path by redirecting the thrust vector to provide directional control for the flight vehicle path.	Remember	CO4	CLO 12	AAE518.12
20	Classify various methods of vector control of liquid rockets.	Various methods of vector control of liquid rockets are Vernier rockets, jetvanes and gimbaled engines.	Remember	CO4	CLO 12	AAE518.12
21	Classify various methods of vector control of solid rockets.	Various methods of vector control of solid rockets are rotating nozzle, swivel nozzle, and movable control nozzle.	Remember	CO4	CLO 12	AAE518.12
22	Elucidate the word Ballistic.	It is a branch of science which deals with study of projectile behavior in a trajectory	Remember	CO4	CLO 12	AAE518.12
23	What do you meant by force vector diagram.	It shows the net force to be at ana angle to the flight path which will be curved.	Remember	CO4	CLO 12	AAE518.12
24	Elucidate Jet vanes?	*Jet vanes* are pairs of heat-resistant, aerodynamic wing-shaped surfaces submerged	Understand	CO4	CLO 12	AAE518.12

		in the exhaust jet of a fixed rocket nozzle..				

Signature of the Faculty **Signature of HOD**