ROCKET AND MISSILES

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB40	ELECTIVE	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The students will try to learn:

I The fundamental concepts of various rocket propulsion systems, combustion process and forces/moments acting on the rocket under static and dynamic conditions.

II Various components and propellants of a chemical rocket propulsion system with its characteristics and applications.

III The operating principle of guided missile, and the guidance, control and instrumentation needed to acquire the target.

IV Properties of different materials that are used in manufacturing of various rocket and missile components.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1 **Understand** the working principle of different types of rocket propulsion systems and missiles and distinguish them based on the mission requirement.

CO 2 **Apply** Newton's law of motion to determine rocket thrust equation, for interpreting the physical significance of Payload ratio, specific impulse and equivalent velocity.

CO 3 **Explain** different design concepts implemented in chemical rocket engine by understanding appropriate parametric assumptions and limitations.

CO 4 **Identify** and obtain values of performance parametersof chemical rocket engine and relationship between them based on rocket thrust equations related to different practical scenarios.

CO5 **Describe** the properties and commonly used propellants of a chemical rocket engine for identifying the suitable engineering applications in different practical scenarios.

CO 6 **Explain** the different types of Pyrotechnics and their usage in real world applications by understand its limitations and safety measures.

CO 7 **Classify** types of combustion chamber and the effect of operating variables on its performance.

CO 8 **Explain** Missile guidance systems and its phases and select the appropriate guidance system for destroying target based on the mission requirements.

CO 9 **Discuss** the importance of multistage rocket over a single stage rocket,for generating maximum thrust by reducing weight of rocket.

CO 10 **Understand** selection criteria and properties of materials to perform under adverse conditions for design the new components as per the requirements.

CO 11 **Choose** an appropriate Thrust vector control and cooling mechanism for a particular application in a chemical rocket engine.

CO 12 **Design** of various rocket components for real world application and appraise their performance under different operating conditions using CFD.

MODULE-I	ROCKET DYNAMICS	Classes 09
Classification of launch vehicles and missiles, rocket systems, airframe components, forces and moments acting on a rocket, propulsion, aerodynamics, gravity, inertial and non-inertial frames, coordinate transformation, equations of motion for three-dimensional motion through atmosphere and vacuum, earth's atmosphere, numerical problems.		
MODULE -II	**SOLID PROPULSION AND PYROTECHNICS**	**Classes 09**
Solid propellant rockets, classification, components and their design considerations, propellant grain design, grain mechanical properties, ballistics and burn rate design issues, igniter design, types of nozzles, thrust vector control, pyrotechnic devices and systems, classification, mechanisms and application of pyrotechnic devices in rockets and missiles; design problems in rocket systems.		
MODULE -III	**LIQUID PROPULSION AND CONTROL SYSTEMS**	**Classes 09**
Liquid propellant rockets, classification and components, thrust chamber, feed systems, propellant tanks, turbo-pumps, types of valves and applications, design considerations. Different bipropellant systems like cryogenics and their characteristics, pogo and slosh engine gimbal systems and thrusters for control; Spacecraft propulsion and control systems design problems.		
MODULE -IV	**MULTI-STAGING OF ROCKET AND SEPERATION DYNAMICS**	**Classes 09**
Navigation and guidance systems in rockets and missiles, aerodynamic control systems of missiles, multistaging of rockets, vehicle optimization techniques, stage separation system, dynamics, separation techniques, rocket flight dispersion, numerical problems.		
MODULE -V	**DESIGN, MATERIALS AND TESTING OF ROCKETS**	**Classes 09**
Design requirements and selection, performance evaluation and assessment, space environment on the selection of materials for rockets and spacecraft, material selection for specific requirements, advance materials, super alloys and composite materials, qualification of rocket and missile systems, types of testing and evaluation of design and function		

Text Books:

1. Sutton, G.P., et al., ―Rocket Propulsion Elements‖, John Wiley & Sons Inc., New York, 1993.
2. Martin J.L Turner , ―Rocket & Space Craft Propulsion, Springers –oraxis publishing, 2001.

Reference Books:

1. Mathur, M., and Sharma, R.P., ―Gas Turbines and Jet and Rocket Propulsion‖, Standard Publishers, New Delhi 1998
2. Cornelisse, J.W., ―Rocket Propulsion and Space Dynamics‖, J.W., Freeman & Co. Ltd., London, 1982.
3. Parker, E.R., ―Materials for Missiles and Spacecraft‖, McGraw-Hill Book Co. Inc., 1982.