ROCKET AND MISSILE TECHNOLOGY

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC27	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Knowledge of Aerodynamics and Aerospace propulsion

I. COURSE OVERVIEW:

This course deals with fundamental aspects of rockets and the current trends in rocket propulsion. It includes the combustion process, propellants and various components of chemical rocket propulsion systems and their applications. The course compares and contrasts various thrust vector control mechanisms of nozzle and cooling systems of combustion chamber. It discusses on various materials and its properties that are used for manufacturing of rocket and missiles. This course also covers the basic concepts of guidance of missile and various types of tactical guidance systems and techniques.

II. COURSE OBJECTIVES:

The student 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. The operating principle of guided missile, and the guidance, control and instrumentation needed to acquire the target.
III. The Properties of different materials that are used in manufacturing of various rocket and missile components.

III. COURSE OUTCOMES:

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

CO 1	**Utilize** the working principle of different types of rocket propulsion systems for distinguishing them based on the missionrequirement.	Apply
CO 2	**Discuss** different design concepts implemented in solid rocket motor and liquid rocket engine for selecting the best propellant	Understand
CO 3	**Identify** performance parameters of chemical rocket and propellants for relating thrust and burn characteristics.	Apply
CO 4	**Summarize** various combustion process and commonly used propellants of a chemical rocket engine for identifying the optimalcombinations based on specific application	Understand
CO 5	**Categorize** various missiles and their appropriate guidance system to provide sufficient capability (speed, range, and maneuverability) and accomplish the mission planned for thesystem	Understand
CO 6	**Understand** selection criteria and properties of materials to perform under adverse conditions for design of new components asper the requirements.	Understand

IV. COURSE SYLLABUS:

MODULE-I: ROCKET DYNAMICS (10)

Classification and application of rocket propulsion, rocket systems, airframe components, rocket principle and its equation, forces and moments acting on a rocket, inertial and non-inertial frames, Propulsive efficiency and performance parameters of a rocket, rocket nozzle and flow separation, Multistage of rockets, numerical problems.

MODULE –II: SOLID PROPULSION AND PYROTECHNICS (10)

Solid propellant rockets, classification, components and their characteristics, criteria for choice of propellants, propellant grain configuration, grain mechanical properties, factors influencing the ballistics and burn rate, Ignition of solid rocket motor, types of nozzles, thrust vector control, design problems in rocket systems.

MODULE –III: LIQUID PROPULSION AND CONTROL SYSTEMS (8)

Liquid propellant rockets, classification and components, thrust chamber, propellant feed system and engine cycles for pump feed system, types of valves, injectors and applications.

Liquid monopropellant and different bipropellant systems, cryogenic propellants, cooling of thrust chamber, pogo and slosh combustion instability and thrusters for control and numerical problems.

MODULE –IV: MISSILE AERODYNAMICS AND GUIDANCE SYSTEMS (09)

Guided missile systems, Indian missile program, structure of the missile and its aerodynamics, aerodynamic characteristics of complete structure, wing design, warheads and fuzzes, Guidance phases during flight, standard terminologies in missile guidance, classification of guidance systems in missiles.

MODULE –V: DESIGN, MATERIALS AND TESTING OF ROCKETS (08)

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.

V. TEXT BOOKS:

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons, New York, 1993.
2. Martin J.L Turner, "Rocket & Spacecraft Propulsion", Springers Oraxis Publishing, 2001.
3. T V Karthikeyan, "Guided Missiles", Defence Scientific information and Documentation Centre, 1990.

VI. 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, 1982.