ROCKET AND MISSILES

VIII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE518	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

COURSE OBJECTIVES:

The course should enable the students to:

- **I.** Learn Fundamentals of rocket and missile systems, functions and disciplines and the full spectrum of rocket systems, uses and technologies.
- **II.** Understand the Fundamentals and uses of solid, liquid and hybrid rocket systems and differences between systems built as weapons and those built for commerce.
- **III.** Explain the use of low and high fidelity performance modeling, including performance loss factors, Staging theory, performance and practices for multi-stage rockets.
- **IV.** Discuss the reliability issues in rocket systems, and strategies to improve reliability, including random and systematic failures, non-linier reliability curves.

COURSE OUTCOMES (COs):

CO 1: Describe the Classification of launch vehicles and missilesand its dynamics

CO 2: Differentiating the components of and the design considerations of solid and hybrid rocket systems and some design problems

CO 3: Understanding the concept of liquid propulsion system ,component classification and design problems in rocket systems

CO 4: Estimation of optimization techniques od navigation and guidance system in rockets ,missiles and its aerodynamics control systems

CO 5: Acquiring knowledge on design, materials and testing of rocketsspace environment on the selection of materials for rockets and spacecraft

COURSE LEARNING OUTCOMES (CLOs):

1. List out the classification of launch vehicles and missiles, rocket systems, airframe component
2. Acquire the basic knowledge on forces and moments acting on a rocket, propulsion, aerodynamics, gravity of rocket missiles
3. Examine the equations of motion for three-dimensional motion through atmosphere and vacuum, earth's atmosphere, numerical problems
4. Illustrate the solid propellant rockets and enlist components and their design considerations, propellant grain design
5. Demonstrate the ballistics and burn rate design issues, igniter design, types of nozzles, thrust vector control, pyrotechnic devices and systems
6. List out the classification, mechanisms and application of pyrotechnic devices in rockets and missiles; design problems in rocket systems
7. Describing the Liquid propellant rockets, classification and components
8. Understanding the concepts of thrust chamber, feed systems, propellant tanks, turbo-pumps, types of valves and applications, design considerations.
9. Differentiate the bipropellant systems like cryogenics and their characteristics
10. Interpret Navigation and guidance systems in rockets and missiles, aerodynamic control systems of missiles
11. Categorize multi-staging of rockets, vehicle optimization techniques, stage separation system
12. Identify the separation techniques which are used for rocket flight dispersion, numerical problems
13. Design requirements and selection, performance evaluation and assessment, space environment on the selection of materials for rockets and spacecraft
14. Describe the material selection for specific requirements, advance materials, super alloys and composite materials,
15. Examine the qualification of rocket and missile systems, types of testing and evaluation of design and function.

UNIT-1	ROCKET DYNAMICS	Classes: 10
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.		
UNIT -II	**SOLID PROPULSION AND PYROTECHNICS**	**Classes: 10**
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.		
UNIT-III	**LIQUID PROPULSION AND CONTROL SYSTEMS**	**Classes: 10**
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 slooh engine gimbal systems and thrusters for control; Spacecraft propulsion and control systems design problems.		
UNIT-IV	**MULTI-STAGING OF ROCKET AND SEPERATION DYNAMICS**	**Classes: 10**
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.		
UNIT-V	**DESIGN, MATERIALS AND TESTING OF ROCKETS**	**Classes: 10**
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		

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.

Web References:

1. https://www.tutorialspoint.com/materials for rockets & missiles.
2. https://www.geeksforgeeks.org/ rockets & missiles /
3. https://www.studytonight.com/ rockets & missiles/
4. https://www.coursera.org/specializations/ rockets & missiles –spacecraft.

E-Text Books:

1. https://www.scribd.com/doc/268924096/c-rockets&missiles-mathur-eBook
2. https://www.safaribooksonline.com/library/view/rockets&missiles-using/9789332524248/
3. https://www.amazon.com/rockets &missiles-C-sutton
4. https://www.scribd.com/doc/40147240/rockets and missiles-Using-c-by-parker-ER-94