GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: AERONAUTICAL ENGINEERING
SUBJECT NAME: ROCKET & MISSILE TECHNOLOGY
SUBJECT CODE: 2170104
B.E. 7th SEMESTER

Type of course: Engineering Science

Prerequisite: Basics of Flight Mechanics, Aerodynamics I, Aerodynamics II, Propulsion,

Rationale: Rocket Missile Technology is one of the core areas in the field of aviation as well as Space. The concepts of Rocket Missile Technology are vitally important to the aeronautical engineer.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	0	4	70	20	10	0	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**General Aerodynamics Design Considerations** Introduction Missile, Missile Classifications, Types of Design and Control	3	10%
2	**Aerodynamics Characteristics of Airframe Components** Introduction, Bodies of Revolution, Forebody: Conical, Ogival, Hemispherical and other shapes, Mid-Section and Boattail, General Aerodynamics of Airfoil, Aspect ratio, wing planform, Airfoil sections, Wing area, Subsonic characteristics of Airfoil, Aerodynamics Controls & Jet Controls	10	20%
3	**Missile Performance** Introduction, Friction drag, Pressure drag, induced drag, Interference drag, Boost- Glide Trajectory, Boost - Sustain Trajectory, Long range Cruise Trajectory, Long range Ballistic Trajectory, Maneuvering Flight: Flat turns, Pull- ups & Relation between Maneuverability & Static stability margin	10	20%

4	**Power Plant design considerations** Introduction, Fundamentals of Rocket engines, Rocket motor design considerations	**5**	**15%**
5	**Rocket Propellants:-** **Liquid Propellants** Propellant loading tolerances, inventory & concept of ullage, Volume versus mass loading & Loading measurement and control, Outage control, Fundamentals of liquid rocket combustion chamber, Injectors, propellant feed lines, propellant tank outlet design. **Solid Propellants** Igniter & Ignition system, Single base propellants - Double base propellants - Composite propellants – CMBD propellants - and their ingredients, Introduction to different fuels and oxidizers of composite propellants, Manufacturing techniques of solid propellant, Properties of solid propellant and solid propellant Grain design Fundamentals of combustion of solid propellants	**20**	**35%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40%	**30%**	**20%**	**5%**	**5%**	**0%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Missile Configuration Design by S. S. Chin, McGraw-Hill Book Company, Inc
2. Rocket Propulsion Elements", George P. Sutton and Oscar Biblarz, Wiley-Interscience
3. Propellants and Pressurization system by Elliot Ring

Course Outcome:

After learning the course the students should be able to:

Understand basic terms and fundamentals of Rocket Propellants and missiles.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.