	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Minor Degree in Aerospace Engineering**	Year of Regulation	**2026**
Department	**Mechanical Engineering**	Semester	**IV**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
ME264	**Rocket Propulsion and Spaceflight Dynamics**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To develop fundamental understanding of rocket propulsion systems, missiles, and space mission architecture, including vehicle types, components, and performance parameters. To apply and analyze principles of launch physics, orbital mechanics, and spaceflight dynamics for solving engineering problems related to space missions and trajectory design.	Course Outcomes	ME264.1	Explain the classification, working principles, and applications of rocket propulsion systems, advanced propulsion systems, and missile technologies.
			ME264.2	Apply rocket propulsion principles and performance relations to determine thrust, specific impulse, exhaust velocity, and flight performance parameters.
			ME264.3	Apply engineering principles to analyze solid and liquid rocket propulsion systems, including propellants, feed systems, and injector mechanisms.
			ME264.4	Analyze orbital mechanics using Newton's law of gravitation and Kepler's laws for determining orbital parameters, orbital motion, and spacecraft trajectories.
			ME264.5	Evaluate orbital maneuvers and interplanetary transfer techniques such as Hohmann transfer, rendezvous, patched-conic approximation, and gravity assist trajectories.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	ME264.1														
2	ME264.2														
3	ME264.3														
4	ME264.4														
5	ME264.5														

SYLLABUS

No.	Content	Hours	COs
I	Rocket Propulsion: Classification and applications of rocket propulsion systems – launch vehicles, spacecraft/satellites, missiles. Advanced propulsion systems – Electrical, nuclear and solar thermal rockets.	**04**	ME264.1
II	Rocket performance parameters – Thrust, specific impulse, mass ratio, effective exhaust velocity, characteristics velocity.	**04**	ME264.2
III	Space mission: phases of space mission; Launch vehicles – phases of launch vehicle ascent; Anatomy of spacecraft – Payload and bus; Classification of spacecraft and satellites; Classification of missiles – ballistic and cruise missiles, strategic and tactical missiles.	**04**	ME264.1
IV	Solid rocket motors and their applications, Types of solid propellants; Liquid rocket engines and their applications, types of liquid propellants; Gas pressure and turbo-pump feed systems; Injectors, Hybrid rockets and hybrid propellants.	**10**	ME264.3
V	Flight performance of rocket vehicles - Gravity free drag free spaceflight, Flight maneuvers.	**02**	ME264.2
VI	Order-of-Magnitude Estimates: Orbital Speeds, Escape Velocities on Earth/Moon/Mars, Calculations of Circular Orbit Velocity and Escape Velocity. Gravitation and the Two-Body Problem, Newton's Law of Universal Gravitation and Reduction to the One-Body Problem, Conservation of Energy and Angular Momentum, Keplerian Orbits and Orbital Elements, Kepler's Three Laws derived from Newton, Geometry of Elliptical Orbits, Semi-Major Axis a, Eccentricity e, Periapsis/Apoapsis, Classical Orbital Elements, Orbit Equation and Period, Introduction to Kepler's Equation and Time-of-Flight.	**10**	ME264.4
VII	Maneuvers and Transfers: Thrust vector control Coplanar Maneuvers, Hohmann Transfer, Circularization Burns, Rendezvous Basics, Circularization Burns, Bi-Elliptic Transfers, Interplanetary Trajectories, Patched-Conic Approximation and Sphere of Influence, Gravity Assists and Velocity Change Calculation, Lambert's Problem, Brief Three-Body Problem and Lagrange Points.	**08**	ME264.5
	Total Hours	**42**	

Essential Readings

1. P. G. Hill, C. R. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison-Wesley Publishing Company, 1992.
2. T. A. Ward, Aerospace Propulsion Systems, Wiley, 2010.
3. G. P. Sutton and O. Biblarz, "Rocket Propulsion Elements", John Wiley, 9th Edition, 2017.
4. H.D. Curtis, Orbital Mechanics for Engineering Students, 2010.

Supplementary Readings

1. J. W. Cornelisse, H. F. R. Schöyer, K. F. Wakker, "Rocket Propulsion and Spaceflight Dynamics", Pitman, 1979.
2. M. J. L. Turner, "Rocket and Spacecraft Propulsion: Principles, Practice and New Developments", Springer Praxis Publishing, 2009.