SEMESTER 7

ROCKET PROPULSION

Course Code	**OEAOT721**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	Theory

Course Objectives:

1. Understand the principles and components of rocket propulsion systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of rocket engines: Fundamentals** and principles of rockets and its operation, types of rocket engines, basic principles and thrust equation, specific impulse, total impulse, exhaust velocity, characteristic velocity, thrust coefficient and mass flow coefficient, design parameters for rocket engine, energy flow and efficiencies. (Numerical)	9
2	**Solid propellant rocket motor**: General features, solid propellants and its chemical compositions, double basics propellant, composite propellant, desirable properties and its demerits, combustion of solid propellant, burning rate and its relation with temperature, erosive burning, combustion instability, strand, and T- burner, regressive, neutral and progressive, propellant grain configuration restricted and unrestricted burning, ignition, different loads on propellant during flight.	9
3	**Liquid propellant rocket engines**: Comparison with other propulsion system, disadvantages of liquid engines, liquid propellants, monopropellant, bi-propellant, selection of liquid propellants and bi-	9

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	propellant combination, pressure and turbo pump feed system, ignition of propellants, cooling system, regenerate cooling, injectors for liquid propellant rockets Thrust control and cooling in liquid propellant rockets and the associated heat transfer problems. Combustion instability in liquid propellant rockets. Problems associated with operation of cryogenic engines.	
4	**Advanced rocket engines:** Hybrid rocket engines, inverse hybrid rocket engines, comparisons and its limitations, types of nozzles used for rocket application, effect of back pressure on nozzles, over expanded under expanded and optimum expanded nozzles, effect of altitude on nozzle performance. Nuclear rockets, electric rocket engines, electro thermal propulsion, electrostatic propulsion, solar thermal rocket, solar sail	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

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Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO 1	Understand the operating principle of the rocket and spacecraft propulsion systems.	**K2**
CO 2	Understand the fundamental concepts and operational characteristics of solid propellant rocket motors	**K2**
CO 3	Understand the basic concepts and operating characteristics of liquid propellent rocket motors	**K2**
CO 4	Understand the working principles of advanced propulsion systems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	1
CO2	2	1	1	-	-	-	-	-	-	-	-	1
CO3	2	1	1	-	-	-	-	-	-	-	-	1
CO4	2	1	1	-	-	-	-	-	-	-	-	1

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Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Rocket Propulsion and Spaceflight Dynamics	J. W. Cornelisse, H. F. R. Schöyer, K. F. Wakker	Cambridge University Press	04 July 2016
2	Rocket and Spacecraft Propulsion	Truner Martin	Springer,	3rd edition, 2009
3	Elements of rocket propulsion	Sutton.G.P, Biblarz. O	John Wiley & Sons Inc	7th edition 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanics and Thermodynamics of Propulsion	Philip Hill and Carl Peterson	PEARSON	2009

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/101/104/101104078/

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