Hall Ticket No | | | | | | | | | | | Question Paper Code:AAE012

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-I

Third Year B.Tech VI Semester End Examinations, May-2020

Regulations: IARE - R16

SPACE PROPULSION

(AERONAUTICAL ENGINEERING)

Time: 3hours **Max. Marks:70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

	UNIT – I	
1.	a) Describe the different types of orbits and mention their uses.	**[7M]**
	b) Discuss 'Elliptical transfer orbits' with the help of necessary equations and diagram.	**[7M]**
2.	a) Write the basic vehicle velocity equation and discuss the effect of mass ratio and effective exhaust velocity on it with the necessary diagram.	**[7M]**
	b) Explain thermal rocket engine with the help of sketches.	**[7M]**
	UNIT – II	
3.	a) Derive theTsiolkovsky's rocket equation.	**[7M]**
	b) Derive an equation for change in velocity for a case with external surface and body forces acting on the vehicle.	**[7M]**
4.	a) What is the safety provisions included for modern test facility of rocket engines?	**[7M]**
	b) A rocket of total mass 100 tones carrying a spacecraft of 5 tones and engine develop a constant exhaust velocity of 3500m/s. The structural mass is assumed to be 15% of the total mass. Calculate the final velocity of the rocket.	**[7M]**
	UNIT – III	
5.	a) Explain the process of initiating the combustion in a solid propellant rocket motor.	**[7M]**
	b) Describe the different phases of solid propellant burning from initial to the final phase.	**[7M]**
6.	a) Explain erosive burning in solid propellant rockets.	**[7M]**
	b) Explain the concept of strand burner and T- burner applications in solid rocket propulsion.	**[7M]**
	UNIT – IV	
7.	a) Write short note on a). Gas pressure feed system b). Turbo pump feed system.	**[7M]**
	b) Detail the selection criteria of liquid propellant rocket engine and give its importance.	**[7M]**

8.	a) With neat sketch explain the hybrid rocket propulsion system and label the parts	**[7M]**
	b) What are the advantages of liquid propulsion over Solid rocket propulsion?	**[7M]**
	UNIT – V	
9.	a) Describe the operating principles, components, system parameters, performance, and applications of the nuclear propulsion.	**[7M]**
	b) Explain the limitations of the nuclear propulsion. Also explain the advantages and applications of the same.	**[7M]**
10	a) Compare the performance of electric, ion and nuclear propulsion systems with chemical rocket propulsion systems.	**[7M]**
	b) Write a short note on Cryogenic Reactants and explain their significance in combustion of a chemical rocket.	**[7M]**

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COURSE OBJECTIVES:

S No	Description
I	**Appraise** various space missions, parameters to be considered for designing trajectories androcket mission profiles.
II	**Classify** the different chemical rocket propulsion systems, types of igniters and performanceconsiderations of rockets**.**
III	**Discuss** the working principle of solid and liquid propellant rockets and gain basic knowledge ofhybrid rocket propulsion.
IV	**Illustrate** electric propulsion techniques, ion and nuclear rocket and the performances ofdifferent advanced propulsion systems.

COURSE OUTCOMES (COs):

The course should enable the students to:	
CO 1	Evaluate various space missions, parameters to be considered for designing trajectories and rocket mission profiles.
CO 2	Classify the different chemical rocket propulsion systems, types of igniters and performance considerations of rockets.
CO 3	Discuss the working principle of solid propellant rockets, propellant grain designs and combustion.
CO 4	Demonstrate the working principle of liquid propellant rockets, feed systems and gain basic knowledge of hybrid rocket propulsion.
CO 5	Illustrate electric propulsion techniques, ion and nuclear rocket and the performances of different advanced propulsion systems.

COURSE LEARNING OUTCOMES (CLOs):

AAE012.01	Demonstrate the basic principles of space propulsion and its applications in different types of orbits.
AAE012.02	Describe the concept of orbital elements and basic orbital equations.
AAE012.03	Adapt the concepts of vertical takeoff and landing for space applications and launch trajectories.
AAE012.04	Explain the operating principle of rocket engine and demonstrate the rocket equation.
AAE012.05	Discuss the different Newton's laws of motion and the relation of thrust generation to different laws of motion.
AAE012.06	Describe the different types of propulsion systems and preliminary concepts in nozzle less propulsion and air augmented rockets.
AAE012.07	Demonstrate the salient features of solid propellants rockets and estimate the grain configuration designs suitable for different missions.
AAE012.08	Understand the erosive burning, combustion instability, and burners.
AAE012.09	Remember the applications and advantages of solid propellant rockets
AAE012.10	Recognize the salient features of liquid propellant rockets, various feed systems and injectors.
AAE012.11	Understand the thrust control cooling, heat transfer problems, combustion instability in liquid propellant rockets
AAE012.12	Understand the peculiar problems associated with the operation of cryogenic engines in different missions.
AAE012.13	Recognize the standard and reverse hybrid systems, combustion mechanism, applications, and limitations.
AAE012.14	Understand the different types of Electric, Ion and Nuclear propulsion systems.
AAE012.15	Identify the future applications of the electric propulsion system

MAPPING OF SEMESTER END EXAMINATION TO COURSE OUTCOMES

SEE Question No.		Course Outcomes		COs	Blooms' Taxonomy Level
1	a	AAE012.01	Describe the different types of orbits and mention their uses.	CO1	Remember
	b	AAE012.03	Discuss 'Elliptical transfer orbits' with the help of necessary equations and diagram.	CO1	Understand
2	a	AAE012.02	Write the basic vehicle velocity equation and discuss the effect of mass ratio and effective exhaust velocity on it with the necessary diagram.	CO1	Understand
	b	AAE012.01	Explain thermal rocket engine with the help of sketches.	CO1	Understand
3	a	AAE012.04	Derive the Tsiolkovsky's rocket equation.	CO2	Remember
	b	AAE012.05	Derive an equation for change in velocity for a case with external surface and body forces acting on the vehicle.	CO2	Understand
4	a	AAE012.04	What is the safety provisions included for modern test facility of rocket engines?	CO2	Understand
	b	AAE012.05	A rocket of total mass 100 tones carrying a spacecraft of 5 tones and engine develop a constant exhaust velocity of 3500m/s. The structural mass is assumed to be 15% of the total mass. Calculate the final velocity of the rocket.	CO2	Remember
5	a	AAE012.08	Explain the process of initiating the combustion in a solid propellant rocket motor.	CO3	Understand
	b	AAE012.07	Describe the different phases of solid propellant burning from initial to the final phase.	CO3	Remember
6	a	AAE012.09	Explain erosive burning in solid propellant rockets.	CO3	Remember
	b	AAE012.08	Explain the concept of strand burner and T- burner applications in solid rocket propulsion.	CO3	Understand
7	a	AAE012.12	Write short note on a). Gas pressure feed system b). Turbo pump feed system.	CO4	Understand
	b	AAE012.11	Detail the selection criteria of liquid propellant rocket engine and give its importance.	CO4	Remember
8	a	AAE012.13	With neat sketch explain the hybrid rocket propulsion system and label the parts	CO4	Understand
	b	AAE012.10	What are the advantages of liquid propulsion over Solid rocket propulsion?	CO4	Remember
9	a	AAE012.14	Describe the operating principles, components, system parameters, performance, and applications of the nuclear propulsion.	CO5	Remember
	b	AAE012.15	Explain the limitations of the nuclear propulsion. Also explain the advantages and applications of the same.	CO5	Understand
10	a	AAE012.15	Compare the performance of electric, ion and nuclear propulsion systems with chemical rocket propulsion systems.	CO5	Understand
	b	AAE012.14	Write a short note on Cryogenic Reactants and explain their significance in combustion of a chemical rocket.	CO5	Remember

Signature of Course Coordinator **HOD,AE**