HallTicketNo | | | | | | | | | | | Question Paper Code:AAE012

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

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) Discuss the development of modern rocketry during the post-world war era.	**[7M]**
	b) Write short notes on (i). Launch trajectories (ii) The rotation of the Earth and (iii) The velocity increment needed for launch.	**[7M]**
2.	a) Distinguish between SSTO and TSTO design considerations.	**[7M]**
	b) Discuss different types of launch assist technologies with their advantages.	**[7M]**
	UNIT – II	
3.	a) Derive an equation for the change in velocity for a case with no external surface or body forces acting on the vehicle.	**[7M]**
	b) Give a brief note on performance characteristics of rockets.	**[7M]**
4.	a) Illustrate the concepts of air augmented rockets.	**[7M]**
	b) A spacecraft's dry mass is 75,000 kg and the effective exhaust gas velocity of its main engine is 3,100 m/s. How much propellant must be carried if the propulsion system is to produce a total v of 700 m/s?	**[7M]**
	UNIT – III	
5.	a) Explain in detail about Solid Rocket propulsion.	**[7M]**
	b) Explain the burning rate relation with pressure and temperature.	**[7M]**
6.	a) Describe the selection criteria of solid propellant grains for various grain configurations.	**[7M]**
	b) Explain the combustion instabilities in solid propellant rockets and the corrective measure to minimize the effect.	**[7M]**
	UNIT – IV	
7.	a) Explain film cooling and transpiration cooling applied to rocket engine nozzles and turbine blades.	**[7M]**
	b) Explain injection process in liquid propellant rocket system.	**[7M]**

8.	a) Illustrate the combustion mechanism in a hybrid rocket propulsion system with necessary diagrams.	**[7M]**
	b) List out the essential differences from liquid propellant rocket engines to solid propellant rocket. Comment and justify the preferable propellant system for space travel.	**[7M]**
	UNIT – V	
9.	a) Discuss the working of ion rocket propulsion with the help of a neat sketch.	**[7M]**
	b) Explain electric rocket propulsion system with examples and neat sketches.	**[7M]**
10	a) Explain the nuclear rocket engine with neat sketches.	**[7M]**
	b) Enumerate the future applications of electric propulsion systems.	**[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	AAE012.02	Discuss the development of modern rocketry during the post-world war era.	CO1	Remember
	b	AAE012.03	Write short notes on (i). Launch trajectories (ii) The rotation of the Earth and (iii) The velocity increment needed for launch.	CO1	Understand
2	a	AAE012.02	Distinguish between SSTO and TSTO design considerations.	CO1	Understand
	b	AAE012.01	Discuss different types of launch assist technologies with their advantages.	CO1	Understand
3	a	AAE012.04	Derive an equation for the change in velocity for a case with no external surface or body forces acting on the vehicle.	CO2	Remember
	b	AAE012.05	Give a brief note on performance characteristics of rockets.	CO2	Understand
4	a	AAE012.6	Illustrate the concepts of air augmented rockets.	CO2	Understand
	b	AAE012.07	A spacecraft's dry mass is 75,000 kg and the effective exhaust gas velocity of its main engine is 3,100 m/s. How much propellant must be carried if the propulsion system is to produce a total v of 700 m/s?	CO2	Remember
5	a	AAE012.08	Explain in detail about Solid Rocket propulsion	CO3	Understand
	b	AAE012.08	Explain the burning rate relation with pressure and temperature.	CO3	Remember
6	a	AAE012.07	Describe the selection criteria of solid propellant grains for various grain configurations.	CO3	Remember
	b	AAE012.08	Explain the combustion instabilities in solid propellant rockets and the corrective measure to minimize the effect.	CO3	Understand
7	a	AAE012.12	Explain film cooling and transpiration cooling applied to rocket engine nozzles and turbine blades.	CO4	Understand
	b	AAE012.10	Explain injection process in liquid propellant rocket system.	CO4	Remember
8	a	AAE012.11	Illustrate the combustion mechanism in a hybrid rocket propulsion system with necessary diagrams.	CO4	Understand
	b	AAE012.13	List out the essential differences from liquid propellant rocket engines to solid propellant rocket. Comment and justify the preferable propellant system for space travel.	CO4	Remember
9	a	AAE012.14	Discuss the working of ion rocket propulsion with the help of a neat sketch.	CO5	Remember
	b	AAE012.15	Explain electric rocket propulsion system with examples and neat sketches.	CO5	Understand
10	a	AAE012.14	Explain the nuclear rocket engine with neat sketches.	CO5	Understand
	b	AAE012.15	Enumerate the future applications of electric propulsion systems.	CO5	Remember

Signature of Course Coordinator **HOD,AE**