Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, May 2021

Course: Rocket Propulsion **Semester: VIII**
Program: B. Tech ASE **Time 03 hrs.**
Course Code: ASEG 4011P **Max. Marks: 100**

Instructions: a) All questions are compulsory.
b) Assume any suitable value for the missing data

SECTION A

Q 1	Briefly write the assumptions made for ideal rockets.	**5**	**CO1**
Q2.	How the quantity of charge of an igniter for a solid rocket motor is decided?	**5**	**CO2**
Q3	Explain TVC & its methods by which it can be achieved.	**5**	**CO1**
Q4.	How Combustion Instability occurs in the rocket engines and explain the methods to control Instabilities?	**5**	**CO3**
Q5	A rocket engine moving at 500 m/s produces a total thrust of 9563 N, consuming propellants at the rate of 4.55 kg/s. The energy content of the propellants is 5.35 MJ/kg. Find the effective exhaust velocity.	**5**	**CO3**
Q6	Why is multi-staging necessary in rocket propulsion?	**5**	**CO5**

SECTION B

Q 1	Analyze the factors influencing injector behavior in the thrust chamber of Liquid Propellant rocket engines.	**10**	**CO4**
Q 2	Illustrate the physics of Lorentz force. Briefly explain the working principle of Lorentz Accelerator with emphasis on its applications.	**10**	**CO5**
Q 3	Derive an equation relating the mass ratio MR and the propellant mass fraction. **OR** Characterize Subsonic, Sonic and Supersonic nozzles based on throat velocity, exit velocity, mach number, pressure ratio and shapes.	**10**	**CO3**
Q 4	'The functions of the injector are similar to those of a carburetor of an internal combustion engine.' Justify this statement with respect to LPE.	**10**	**CO4**
Q 5	A rocket projectile has the following characteristics: Initial mass: 200 kg Mass after rocket operation: 130 kg Payload, nonpropulsive structure, etc.: 110 kg Rocket operating duration: 3.0 sec Average specific impulse of propellant: 240 sec	**10**	**CO1**

	Determine the vehicle's mass ratio, propellant mass fraction, propellant flow rate, thrust, thrust-to-weight ratio, acceleration of vehicle, effective exhaust velocity, total Impulse and the impulse-to-weight ratio.		
	SECTION-C		
Q 1	A probe to the jovian system is to be transported there by a Solar Electric Propulsion module. The required Delta-V is 10 km/s and the gravity loss factor is 2.5. In order to identify the optimum exhaust velocity three different engines with exhaust velocities of 20.60 and 200 km/s are under consideration. Using the data given below, for each exhaust velocity a) Calculate the ratio of the mass of the electric power supply to the mass of propellant required (M_E/M_P). b) Calculate the ratio of mass of the payload to the mass of propellant required (M_S/M_P). c) Calculate the mass of propellant and the mass of the power supply, and the mass of the propulsion unit. Identify the optimum exhaust velocity. How would the result change if the burn time were longer? **Data:** Mission Delta-V: 10 km/s Gravity loss factor: 2.5 Burn Time: 3.2×10^7 s Thruster Efficiency: 0.6 Solar panel power to mass ratio: 200 w/kg **OR** Explain the working principle of the Nuclear Thermal Rocket Engine. Analyze the necessary steps taken for the management of its radiation and briefly explain the potential applications of nuclear engines.	**20**	**CO5**