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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Rocket Propulsion **Semester: VIII**
Program: B.Tech (ASE) **Time 03 hrs.**
Course Code: ASEG 425 **Max. Marks: 100**
Instructions: All questions are compulsory. Assume data if missing.

SECTION A

S. No.		Marks	CO
Q 1	How the quantity of charge of an igniter for a solid rocket motor is decided?	**04**	**CO3**
Q 2	Describe the two types of propellant feed systems in a cryogenic engine.	**04**	**CO2**
Q 3	Briefly write the assumptions made for ideal rockets.	**04**	**CO1**
Q 4	What is optimum expansion of the nozzle and how choking of the flow occurs in the conventional nozzles.	**04**	**CO3**
Q 5	Explain TVC & its methods by which it can be achieved.	**04**	**CO3**

SECTION B

Q 6	Differentiate between the Under and Over-expanded Nozzles. **OR** Characterize Subsonic, Sonic and Supersonic nozzles based on throat velocity, exit velocity, mach number, pressure ratio and shapes.	**10**	**CO3**
Q 7	'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 8	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 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.	**10**	**CO1**
Q 9	Illustrate the physics of Lorentz force. Briefly explain the working principle of Lorentz Accelerator with emphasis on its applications.	**10**	**CO5**

SECTION-C			
Q 10	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: 10km/s Gravity loss factor: 2.5 Burn Time: $3.2x\ 10^7$ 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**
Q 11	Illustrate the operating principles of different types of electrical thrusters. With a neat diagram, analyze the operation of a Hall Effect Thruster by emphasizing on its various applications.	**20**	**CO5**

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Rocket Propulsion **Semester: II**
Program: B.Tech (ASE) **Time 03 hrs.**
Course Code: ASEG 425 **Max. Marks: 100**
Instructions: All questions are compulsory. Assume data if missing.

SECTION A

S. No.		Marks	CO
Q 1	Explain the types of propellant feed systems used in liquid rocket engines.	**04**	**CO2**
Q 2	What is the importance of igniters in rocket motors?	**04**	**CO2**
Q 3	Write the advantages and Disadvantages of Gelled Propellants.	**04**	**CO4**
Q 4	What are the advantages of electrical propulsion engines (thrusters) over chemical rocket engines?	**04**	**CO1**
Q 5	How Combustion Instability occurs in the rocket engines and explain the methods to control Instabilities?	**04**	**CO3**

SECTION B

Q 6	What are the principal losses that occurred in real nozzle when compared with ideal nozzle?	**10**	**CO3**
Q 7	Analyze the factors influencing injector behavior in the thrust chamber of Liquid Propellant rocket engines. **OR** Analyze the desirable propellant characteristics for the booster rocket motor with suitable propellant candidates.	**10**	**CO3**
Q 8	The following measurements were made in a sea level test of a solid propellant rocket motor: Burn duration 40 sec Initial mass before test 1210kg Mass of rocket motor after test 215kg Average thrust 62,250 N Chamber pressure 7.00 MPa Nozzle exit pressure 0.070 MPa Nozzle throat diameter 0.0855 m Nozzle exit diameter 0.2703 m Determine mass flow rate (m.), V_2, C^*, C, and Is at 1000 and 25000 m altitude. Assume an invariant thrust and mass flow rate and negligible short start and stop transients. (At 1000, Pa= 0.0898 MPa and At 25000 m, Pa= 0.00255 MPa)	**10**	**CO1**
Q 9	What do you understand by multiphase flow in the nozzle? How does it affect nozzle	**10**	**CO2**

	performance?		
SECTION-C			
Q 10	Consider two different engines, L110 Vikas and Vikas, used on the GSLV rocket. The engine use storable propellants called nitrogen tetroxide and UDMH25 (unsymmetrical dimethyl hydrazine with 25% hydrazine hydrate). The mixture is self-igniting and the constituents are liquid at standard temperature and pressure. The following information is available for the L110 Vikas and Vikas engines:	20	CO5

Engine	L110 Vikas	Vikas
Vacuum thrust	782 kN	815 kN
Sea-level thrust	667 kN	N/A
Specific impulse	263.4 seconds	286.5 seconds
Chamber pressure	53 bar	53.5 bar
Area ratio	10.5	30.8
Mass flow	264.3 kg/sec	271.0 kg/sec
Nozzle exit diameter	0.990 meters	1.700 meters

Calculate the thrust coefficients for these two engines and briefly discuss their difference.

OR

What is an Anti-satellite targeting missile? Analyze the propulsion systems used in these missions and briefly explain the Kessler syndrome proposed by Donald Kessler for LEO.

Q 11	Characterize the Electric Propulsion system and briefly explain them. Analyze the challenges faced by propulsion engineers while designing these systems.	20	CO5