U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May / June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VIII**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS8PERPR **Max Marks: 100**
Course: Rocket Propulsion

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Describe the different types of chemical rocket engines. Explain their working principles with neat sketches.	*CO1*	*PO1*	**10**
	b)	Derive an expression for rocket equation. Write the velocity increment equation in terms of structural mass fractions, propellant mass fraction and payload mass fractions.	*CO1*	*PO2*	**10**
		OR			
2	a)	Compare air-breathing and non-air breathing engines.	*CO 1*	*PO 1*	**05**
	b)	Obtain an expression for Jet velocity, V_J from SFEE and Explain the various influencing factors for V_J.	*CO 1*	*PO 2*	**10**
	c)	List the various selection criteria of rocket propulsion system.	*CO1*	*PO1*	**05**
		UNIT - II			
3	a)	Illustrate the thrust vector controlling methods.	*CO 1*	*PO 1*	**08**
	b)	Consider a rocket engine burning hydrogen and oxygen; the combustion chamber temperature and pressure are 3517 K and 25 atm respectively. The molecular weight of the chemically reacting gas in the combustion chamber is 16 and $\gamma = 1.22$. The pressure at the exit of the CD rocket nozzle is 1.174×10^{-2} atm. The area of the throat is 0.4 m^2. Assuming a calorically perfect gas and isentropic flow, calculate i) the exit Mach number ii) the exit velocity iii) the mass flow through the nozzle iv) the area of the exit.	*CO2*	*PO2*	**12**
		OR			

	4	a)	Explain the working principle of a convergent-divergent (CD) nozzle. How does it facilitate supersonic flow in rocket propulsion?	*CO 1*	*PO 1*	**10**
		b)	Identify and explain the major losses associated with the operation of exhaust nozzles.	*CO 1*	*PO 1*	**10**
			UNIT - III			
	5	a)	Illustrate solid propellant grain configurations and their Thrust–Time, diagrams for progressive, regressive, and neutral burning.	*CO 2*	*PO 2*	**10**
		b)	An end-burning rocket uses a cylindrical double-base propellant grain with a diameter of 200 mm and generates a thrust of 350 N over a period of 300 s. The thrust coefficient is 1.15. The characteristics of the propellant are: Density of propellant grain = 1500 kg/m^3 a70 = 4 mm/s; n = 0.5 C^* =1500 m/s Determine: i) the length of the grain ii) throat diameter of the nozzle	*CO 3*	*PO 3*	**10**
			OR			
	6	a)	Describe the operation of a solid propellant rocket engine with a neat sketch along with components and their functions.	*CO 2*	*PO 2*	**10**
		b)	For a DB propellant do the evaluation of burn rate by energy balance and mass balance across a control volume and obtain the expression for burn rate.	*CO 2*	*PO 2*	**10**
			UNIT - IV			
	7	a)	Explain the working of gas generator cycle. Use necessary sketches.	*CO 1*	*PO 1*	**10**
		b)	Explain the various processes in the combustion chamber of a liquid propellant rocket engines. Use necessary sketches.	*CO 1*	*PO 1*	**10**
			OR			
	8	a)	Discuss Ignition systems in liquid propellant engines and explain the atomization process.	*CO 1*	*PO 2*	**10**
		b)	Explain the working principle staged combustion cycle in a liquid propellant rocket engine.	*CO 1*	*PO 2*	**10**
			UNIT - V			
	9	a)	Classify the different types of electric rocket engines. Explain the working principle of an electric rocket engine.	*CO 1*	*PO 1*	**10**
		b)	A 1.75 kW electrochemical rocket with helium as propellant is to be designed and developed using tungsten filament resistive	*CO 2*	*PO 2*	**10**

			heating element for obtaining the thrust coefficient of 1.8. Assuming the mass flow rate of propellant to be 0.12 g/s, determine the exit velocity, characteristics velocity, temperature of propellant gas, thrust, and specific impulse for electrochemical rockets with thruster efficiency of 0.85.			
			OR			
	10	a)	Explain the working principle of Gridded ion thruster.	*CO 1*	*PO 1*	**10**
		b)	Write a note on electrical thruster.	*CO 1*	*PO 1*	**04**
		c)	Compare chemical and non-chemical propulsion.	*CO1*	*PO1*	**06**

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