

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: MTech/Pre-PhD
BRANCH: SER**

**SEMESTER: I
SESSION: MO/2024**

SUBJECT: SR501 ELEMENTS OF ROCKET PROPULSION

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
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			CO	BL
Q.1(a)	Why turbojet engine is less preferred than a turbofan engine?	[2]	CO1	L2
Q.1(b)	Among the centrifugal and axial compressor, which compressor is more beneficial for airbreathing engine? Give justification for your answer.	[3]	CO1	L3
Q.1(c)	Explain the working principle of a Magnetoplasma dynamic (MPD) arcjet thruster with suitable sketch? What are its drawbacks in terms of development for practical application?	[5]	CO1	L4
Q.2(a)	Differentiate between a Plateau and a Mesa burning propellant?	[2]	CO2	L2
Q.2(b)	Explain why increase in chamber pressure of a solid rocket motor increases the burn rate of the solid propellant?	[3]	CO2	L3
Q.2(c)	Explain the combustion mechanism of a hybrid rocket motor with suitable sketch.	[5]	CO2	L4
Q.3(a)	What are the main assumptions made in solving nozzle equation?	[2]	CO3	L2
Q.3(b)	Give justification why optimally expanded flow ($p_e = p_a$) is said to give maximum thrust?	[3]	CO3	L3
Q.3(c)	Derive equation for specific impulse in terms of characteristic velocity and thrust coefficient.	[5]	CO3	L4
Q.4(a)	Why C_f is called thrust coefficient?	[2]	CO4	L2
Q.4(b)	Derive thrust equation for the non-airbreathing propulsion.	[4]	CO4	L4
Q.4(c)	A Deepawali rocket generates a chamber pressure (P_c) of 1.9 bar and the ambient pressure (P_a) of 1 atm. Assume flow to be optimally expanded that is $P_e = P_a$. The chamber temperature (T_c) was 2800 K, molecular weight was 22, $\gamma = 1.2$. It gives 8 N of thrust. Calculate the specific impulse I_{sp} and the thrust coefficient C_F generated by the rocket.	[4]	CO4	L4
Q.5(a)	Why toxic gases released from the rockets needs to be controlled?	[2]	CO5	L2
Q.5(b)	What are post-accident procedures that are followed at the rocket launch site?	[4]	CO5	L3
Q.5(c)	What are the main test facilities arrangements available for the rocket testing?	[4]	CO5	L3

:19/11/2024:E