

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION MO-2022)

CLASS: M.TECH  
BRANCH: SER

SEMESTER : I  
SESSION : MO/2022

TIME: 03 HOURS

SUBJECT: SR501 ELEMENTS OF ROCKET PROPULSION

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.

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- Q.1(a) Why the bypass ratio of a turbofan engine is lower for the military aircraft compared to that used in a civilian aircraft? [2]
- Q.1(b) How the temperature and the pressure changes along the length of turbojet engine along the various component of the engine? Show it by suitable sketches and also explain few points about it. [3]
- Q.1(c) Write the working principle of a MPD arc jet thruster. Also write its merits and demerits with respect to arc jet thruster. [5]
- Q.2(a) Why ullage is provided in liquid propellant tanks? [2]
- Q.2(b) How a T-S diagram of solid rocket is different from the turbojet engine? [3]
- Q.2(c) Inserting the wires in a solid propellant is said to improve its burn rate. How it improves the burn rate? Explain it with suitable sketches and also write its challenges in implementing it in practical application. [5]
- Q.3(a) Why C-D nozzle is used in a rocket propulsion system? [2]
- Q.3(b) Under what condition the specific impulse is considered to be same as the exit velocity? [3]
- Q.3(c) Derive the equation for the exit velocity and show that it is only a function combustion chamber temperature. [5]
- Q.4(a) Why regenerative cooling is said to be the most efficient methods of cooling for liquid rocket engine? [2]
- Q.4(b) Derive thrust equation of a non-airbreathing engine. [3]
- Q.4(c) Show through derivation that Specific impulse ( $I_{sp}$ ) is a function of characteristic velocity ( $C^*$ ) and thrust coefficient ( $C_f$ ). [5]
- Q.5(a) Why monitoring the test facilities using a CCTV camera is important? [2]
- Q.5(b) What are the important parameters that are measured during the rocket testing? [3]
- Q.5(c) Write all the major system and requirements that a rocket test facilities should have? [5]

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