

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

CLASS: MTECH  
BRANCH: SER

SEMESTER : I  
SESSION : MO/18

SUBJECT: SR501 ELEMENTS OF ROCKET PROPULSION

TIME: 03:00 Hrs.

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.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
- 

- Q.1(a) Differentiate between a ramjet and scramjet engine. Explain clearly the challenges associated with the scramjet engine for practical applications. [4]
- (b) Explain clearly the working principles of an Ion thruster with suitable sketches. What are various cares needs to be taken to avoid the losses of its performance? [4]
- (c) What are the thrust producing devices in a turbofan engine? [2]
- Q.2(a) What are the various parameters to be considered for designing a liquid rocket engine? Explain how each parameter is linked with the designing processes. [5]
- (b) What are various ingredient used for making a composite solid propellant grain? Explain the appropriate percentage of each to be used with the reasons for selecting so. [5]
- Q.3(a) Show analytically and also through pressure differential sketches that the over-expansion through nozzle gives the maximum thrust in a rocket propulsion system. [5]
- (b) What are the advantages of the non-conventional types of nozzles over the conventional nozzles? Show various types of non-conventional nozzles suitable for practical applications with its under and over expended flow boundaries. [5]
- Q.4(a) Derive specific impulse equation ( $I_{sp}$ ) in terms of thrust coefficient ( $C_f$ ) and characteristics velocities ( $C^*$ ). [5]
- (b) The combustion product exiting from the rocket nozzle balances a weight of 350 kg. The  $I_{sp}$  is 3500 N-s/kg. Calculate the nozzle throat diameter if the rocket is operating at a chamber pressure or  $P_c$  of 3.5 MPa and the characteristic velocity or  $C^*$  for the these propellant combination at this chamber pressure is 1750 m/s. [5]
- Q.5(a) What are various safeguard procedures needs to be followed prior to performing any type of rocket testing? Explain with an example that is practically being followed. [5]
- (b) What are the various instrumentations and the data being measured or recorded during the rocket testing? [5]

\*\*\*\*\*28.11.18\*\*\*\*\*M