

Code No: 56072

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, May - 2019

AEROSPACE PROPULSION-II

(Aeronautical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions

All questions carry equal marks

1. Derive an expression for the following parameters in mission propulsion requirements:
 - a) Breguet Range
 - b) Incremental Flight Velocity. [7+8]

2. A ramjet is propel an aircraft at Mach 3 at high altitude where the ambient pressure is 8.5 kPa and the ambient temperature T_a is 293 K. The turbine inlet temperature TIT is 2450 K. If all components of the engine are ideal that is frictionless, Determine:
 - a) Thermal efficiency
 - b) Propulsive efficiency and
 - c) Overall efficiency. [15]

- 3.a) The inlet conditions for a rocket nozzle are given by total temperature of 2800 K, total pressure of 43×10^5 Pa. and the inlet velocity can be neglected when compared to nozzle outlet velocity. The nozzle throat diameter is 5.2 cm. Estimate the mass flow rate through the nozzle. Assuming optimum expansion at sea level, Determine nozzle exit velocity, exit Mach number and the thrust developed by the rocket unit. Take the ratio of specific heats as 1.35.
- b) Discuss in detail the frozen equilibrium and shifting equilibrium related to chemical rockets. [9+6]

- 4.a) Explain the types of liquid propellants used with one example.
- b) Discuss the type of injectors with neat sketch. [7+8]

- 5.a) The following measurements were made in a sea level test of a solid propellant rocket motor.

Initial mass before test	1200 kg
Mass of rocket motor after test	210 kg
Average thrust	62000 N
Chamber Pressure	7 MPa
Nozzle exit pressure	0.070 MPa
Nozzle throat Diameter	0.0855 m
Nozzle exit diameter	0.2703 m

Determine \dot{m} , C^* , V_{je} , and I_{sp} at sea level, and I_{sp} at 1,000 and 25,000 m altitude. Assume an invariant thrust, mass flow rate and negligible short start and stop transients. Where \dot{m} is mass flow rate, C^* is characteristic velocity, V_{je} is effective jet velocity and I_{sp} is specific impulse.

 - b) Explain why burning rate index of a solid propellant should be less than unity. [10+5]

- 6.a) Why electric rockets are called essentially power limited systems? Discuss briefly on existing electric space power supplies.
- b) What are the major elements of electrostatic thruster? Explain its operational functions with suitable sketches. [7+8]
- 7.a) Explain with neat diagram the working principle of nuclear propulsion. Also write the advantages and disadvantages of nuclear propulsion.
- b) Suggest the alternative types of reactors with their salient features. What kind of safety issues to be adopted for nuclear reactors? [8+7]
- 8.a) What are the current fundamental limits of propulsion? How it can overcome with the concept of coupling of gravity and electro magnetism?
- b) Explain the significance of MEMS in micro propulsion with its merits, demerits and applications. [7+8]

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