

VII SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER ONLINE PROCTORED EXAMINATIONS (PART B), DEC 2021

SUBJECT: ROCKET PROPULSION [AAE 4067]

REVISED CREDIT SYSTEM

(17/12/2021)

Duration: 75 minutes

Max. Marks: 20

Instructions to Candidates:

- Answer ALL the questions.
- Missing data if any, may be suitably be assumed.
- Use of supplied data sheet is permitted
- 1A A rocket nozzle is operating in vacuum with a chamber pressure of 2.0 MPa and (05) chamber temperature of 3000 K. If the products of combustion are assumed to behave as a perfect gas with constant specific heats ($\gamma = 1.3$ and molecular mass = 20), determine the thrust produced if nozzle throat area is 0.25 m² and exit pressure is 5.53 kPa.
- 1B Derive the expression for propulsive efficiency of a rocket engine in terms of velocity (03) ratio, r given by V/U, where V is the vehicle velocity and U is the exit velocity of the exhaust gases. Assume the flow to be optimally expanded through the nozzle. For r = 2, find the expression for thrust produced per unit jet velocity (F/U), and propulsive efficiency.
- 1C What are ablative materials? Briefly explain the ablation process and its application. (02)
- A rocket motor is designed with a cylindrical end burning propellant grain of length (04) 1.5 m and diameter 0.42 m. The density of the propellant grain is 1200 kg/m³. The specific impulse of the motor is 190 sec and the acceleration due to gravity is 9.8 m/s². If the propellant burns for a period of 185 sec, find the thrust produced by the rocket motor.
- 2B Derive the rocket equation. Explain how rocket staging helps in improving the (03) burnout velocity.
- 2C Derive the area-Mach number relation for a C-D nozzle and plot the graph for the (03) same to represent the subsonic and supersonic Mach number regime.