| PRN: | | Course Code : | PAS102 |
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| | | 000459 | |
| First Year **M.Tech** End Semester Examination Winter 2024 | | | |
| **Rocket Propulsion** | | | |
| Day and Date: Mon:- 2 DEC 2024 | | Max Marks: | **100** |
| Time : | 10:30AM To 01:30PM | Duration: | **03** hrs |

Instructions: All questions are compulsory.

| | | | Marks | Bloom's Level | CO |
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| Q.1 | | **Attempt the following** | | | |
| | a) | Explain the following parameters<br>• Thrust exhaust velocity<br>• Energy and efficiencies<br>• Typical performance values. | 08 | 2 | 1 |
| | b) | An aircraft flies at 960Kmph. One of its turbojet engines takes in 40 kg/s of air and expands the gases to the ambient pressure .The air –fuel ratio is 50 and the lower calorific value of the fuel is 43 MJ/Kg .For maximum thrust power determine (a)jet velocity (b) thrust (c) specific thrust (d) thrust power (e) propulsive, thermal and overall efficiencies and (f) TSFC | 08 | 3 | 1 |
| | | OR | | | |
| | b) | An aircraft flies at a speed of 520 kmph at an altitude of 8000 m. The diameter of the propeller of an aircraft is 2.4 m and flight to jet speed ratio is 0.74. Find the following:<br>(i) Thrust produced<br>(ii) Specific thrust<br>(iii) Thrust power Given | 08 | 3 | 1 |
| Q.2 | | **Attempt the following** | | | |
| | a) | Consider the isentropic flow through a convergent-divergent nozzle with exit-tothroat area ratio of 5.9. The chamber (inlet) pressure and temperature are 2 atm and 330 K, respectively. Calculate the temperature at both the throat and the exit if the flow is supersonic at the exit? | 08 | 3 | 2 |
| | b) | Calculate Nozzle area ratio with varying mach number and plot on a graph. | 08 | 4 | 2 |
| | | OR | | | |
| | b) | Consider the isentropic flow over an airfoil. The freestream conditions correspond to a standard altitude of | 08 | 3 | 2 |

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| | | 10,000 ft and Mo = 0.82. At a given point on the airfoil, M = 1.0. Calculate P and T at this point. | | | |
| Q.3 | | **Attempt any two from the following** | | | |
| | a) | Explain with neat sketch working principle of Liquid Propellant rocket engine with pump feed system and its advantages and disadvantages. | 08 | 2 | 3 |
| | b) | What is cryogenic propulsion system, explain special features of cryogenic system. | 08 | 2 | 3 |
| | c) | list out the differences between propellent feed system and turbo pump feed system. | 08 | 2 | 3 |
| Q.4 | | **Attempt any two from the following** | | | |
| | a) | Briefly explain propellent grains and grain configurations. | 08 | 2 | 4 |
| | b) | A solid propellant rocket motor is tested on a static thrust stand. The exhaust exits at a mass flow rate of 200 kg/s, a velocity of 2000 m/s, and a pressure of 150 kPa. The exit area of the rocket is 0.5 m2 and the ambient pressure is 100 kPa. Determine: (1) The thrust transmitted to the stand. (2) The specific impulse. | 08 | 3 | 4 |
| | c) | A Rocket flies at a speed of 20000kmph with an effective exhaust jet velocity of 1400 m/s and the heat produced by the propellant is 7000 kJ/kg. If the propellant flow rate is 5.4 kg/s. Determine i) Propulsive efficiency ii) Propulsion power iii) Engine output iv) Overall efficiency. | 08 | 3 | 4 |
| Q.5 | | **Attempt any Two of the following** | | | |
| | a) | Compare the performance of Electric, Nuclear and ion propulsion system with chemical rocket propulsion. | 09 | 2 | 5 |
| | b) | Explain the manufacturing methods for low and high thrust engines. | 09 | 3 | 5 |
| | c) | Briefly explain engine system integration and fuels, oxidizers. | 09 | 2 | 5 |
| Q.6 | | **Attempt any Two of the following** | | | |
| | a) | Explain any one electrical rocket propulsion system with neat sketch. | 09 | 2 | 5 |
| | b) | Explain the following<br>(a) Chemical rocket propulsion (b) Solar sail | 09 | 2 | 5 |
| | c) | Explain the following<br>• Electric propulsion<br>• Nuclear rocket<br>• Ion propulsion | 09 | 2 | 5 |

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