Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2019

SUBJECT: ROCKET PROPULSION [AAE 3103]

REVISED CREDIT SYSTEM
(22/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- (Thermodynamics data hand book will be provided)

1A. The air moving at a velocity of 150 m/s. The static conditions are 100 kPa and 25^{o} C. Calculate the Mach number and stagnation properties. **(02)**

1B. A ramjet engine flies at an altitude of 6500 m and the flight Mach number is M=1.2. The diameter of inlet diffuser at entry is 50 cm and stagnation temperature at the nozzle entry is 1500K. The calorific value of the fuel used is 40 MJ/kg. The properties of the combustion gases are same as those of air (k=1.4; R=287 J/kgK). The velocity of the air at the diffuser exit is negligible. The efficiency of the diffuser =0.9, Combustor =0.98 and the nozzle =0.96 **(05)**

Calculate: (i) the efficiency of the ideal cycle (ii) Flight speed (iii) Air flow rate (iv) Diffuser pressure ratio (v) fuel air ratio (vi) Nozzle jet mach number.

1C. Describe the working of a valved type and valveless pulse jet engine with neat sketch. **(03)**

2A. Explain with a neat sketch the characteristic differences between bell nozzle, expansion deflection nozzle, and aerospike nozzles **(03)**

2B. A rocket projectile has the following characteristics: **(04)**

Initial mass =200kg; Mass after rocket operation = 130 kg
Payload, non propulsive structure = 110 kg; Rocket operating duration = 3.0 second; Average specific impulse of propellant =240 second

Determine, the vehicles mass ratio, propellant mass fraction, propellant flow rate, thrust, thrust to weight ratio, effective exhaust velocity, total impulse, and the impulse to weight ratio

2C. Derive the expression for thrust coefficient (C_F) from fundamentals and show that the obtained expression is dependent on gas property (γ), nozzle geometry (ε), and pressure distribution through the nozzle (P_1/P_2) **(03)**

3A. What are the differences between an inhibitor, liner and internal insulator used in solid propellants? Give any 2 examples of each. What are the properties required for an effective inhibitor? **(04)**

3B. With neat sketches describe the various tank arrangements for large turbo-fed liquid propellant rocket engines **(02)**

3C. Explain with a neat sketch the difference between the gas generator cycle and combustion tap of cycle **(04)**

4A. Explain the main ingredients in the manufacture of composite propellants. Give examples for each **(04)**

4B. What are Pyrofuse and ZPP initiators made up of? What is the function of an initiator? **(03)**

4C. What are the methods used for thrust extinction in case of solid propellant rockets? **(03)**

5A. Compare the combustion characteristic of Solid propellant, Liquid propellant and Hybrid propulsion systems with neat sketches **(04)**

5B. List any 4 fuels & oxidizers used in hybrid propulsion rockets? **(02)**

5C. Explain with neat diagram the construction and working of Magneto-Plasma Rocket Engine **(04)**