Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH (MECHANICAL/IP ENGG.) END SEMESTER MAKE-UP EXAMINATIONS, DECEMBER 2018

SUBJECT: JET PROPULSION AND ROCKET TECHNOLOGY

[MME 4011]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any may be suitably assumed.

1A. Derive the thrust equation and hence thrust power of a typical gas turbine engine with suitable assumptions. **3**

1B. Explain the variation of forward and rearward gasloads in various components in a gas turbine with a neat sketch. **3**

1C. Explain the any two methods of thrust augmentation in gas turbines. **4**

2A. Compare the Ideal and Actual Brayton cycles as applied on Gas turbines. **2**

2B. Explain the working of a Mixed flow turbofan engine. **3**

2C. A turbojet engine has the following data: **5**

Compressor pressure ratio = 8	Isentropic efficiency of intake = 0.9
Combustion chamber temperature = 1200 K	Isentropic efficiency of compressor and turbine = 0.9
Air mass flow rate = 15 kg/s	Combustion chamber pressure loss = 6% of delivery pressure
Aircraft flight speed = 260 m/s	Combustion chamber efficiency = 0.95
Ambient temperature = 242.7 K	Calorific value of fuel = 43,000 kJ/kg
Ambient pressure = 41.06 kPa	Isentropic efficiency of nozzle = 0.9

Calculate the propelling nozzle area, the net thrust developed, and the TSFC.

3A. Derive an expression for area ratio of a rocket nozzle in terms of γ and explain its significance. **3**

3B. Explain Over-expanded flow in a rocket nozzle giving various points along its expansion flow. **3**

3C. A rocket of total mass 100 tons carries a spacecraft of 1 ton. The engines develop a constant exhaust velocity of 2700 m/s. The structural mass is assumed to be 10% of the propellant mass. Compare the velocity increment for the rocket if the rocket is operated in **4**

(i) Single stage
(ii) Two stages with equally shared structural and propellant mass
(iii) Three stages with equally shared structural and propellant mass.

4A. Explain the importance of Inhibitor and Liner in Solid Propellant systems **3**

4B. What are cryogenic propellants? Explain the procedures involved to keep the propellants in cryogenic state. **3**

4C. Explain gas generator and expander cycles in Liquid Propellant systems with neat sketches. **4**

5A. Explain the working of a Resistojet thruster. **3**

5B. With a neat sketch, explain the working of a Solid Fuel Nuclear Rocket engine. **3**

5C. Explain the working of an Electro-magnetic thruster with neat sketch. **4**