Reg. No.

A Constituent Institute of Manipal University, Manipal

VII SEMESTER B.TECH MECHANICAL/I.P ENGG. END SEMESTER

MAKE-UP EXAMINATIONS, DECEMBER 2017

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 may be suitably assumed.
- **1A.** What is Thrust Augmentation in Turbojet engines? Explain the three **4** methods of Thrust Augmentation.
- **1B.** Explain the forward and rearward thrust generation in a typical turbojet **3** engine.
- **1C.** Derive an expression for thrust equation of a gas turbine and hence thrust **3** power with suitable assumptions.
- **2A.** The following data apply to a turbojet aircraft flying at an altitude of 6.1 km 4 where the ambient conditions are 0.458 bar and 248 K. Speed of the aircraft: 805 km/h Pressure ratio of compressor: 4:1 Combustion chamber pressure loss: 0.21 bar Turbine inlet temperature: 1100 K Intake duct efficiency: 95% Isentropic Efficiency of compressor: 0.85 Isentropic efficiency of turbine: 0.90 Mechanical efficiency of transmission: 99% Nozzle efficiency: 95% Nozzle outlet area: 0.0935 m² L.C.V of fuel: 43 MJ/kg Find the thrust and specific fuel consumption in kg/Nh of thrust. Assume convergent nozzle. Take $C_{pa} = 1.005 \text{ kJ/kgK}$ and $\Upsilon = 1.4$, $C_{pg} = 1.147 \text{ kJ/kgK}$ and $\Upsilon = 1.33$.
- **2B.** Explain the importance of Inlet Diffuser and hence derive an expression for **3** diffuser efficiency.
- **2C.** With a neat sketch, explain the working of a Turboshaft engine.

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- **3A.** Derive the rocket equation and discuss propellant and load mass fractions. 4
- 3B. Define Propulsive efficiency and hence derive an expression for the 3 Propulsive efficiency of a rocket.
- Explain Underexpanded, Ideally expanded and Over expanded nozzle 3 3C. configurations with suitable sketches.
- 4A. Define the following with respect to grain configurations: (a) Liner (b) 2 Inhibitor (c) Action Time (d) Perforation
- **4B.** With a neat sketch, explain the working of a gas pressure feed system for **3** Liquid Propellant rockets. 3
- **4C.** Explain the working of a Hybrid rocket propellant system.
- **4D.** What are the desirable properties of a Liquid propellant? 2
- **5A.** With a neat sketch, explain the working of Ion Propulsion system. 4
- **5B.** With a neat sketch, explain the working of an Arciet electrical rocket.
- **5C.** With a neat sketch, explain the principle of working of a solar sail and its 3 potential future applications.

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