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Department Name: Mechanical-Mechatronics Engineering

Engineering Thermodynamics MME209

Exam Type (Mid Term)

Time: 90 minutes **Date:** 25/09/2018 **Max. Marks:** 30

Instruction: *Answer must be brief and to the point. All questions carry equal weightage. Attempt all the questions. Suitable assumptions may be taken for any data required. Steam tables are allowed.*

Q.1 (a) Define the entropy and prove that the entropy of the universe is increasing.

(b) Steam flows steadily through an adiabatic turbine. The inlet conditions of the steam are 4 MPa, 500°C and 80 m/s and the exit conditions are 30kPa, 92 percent quality and 50 m/s. The mass flow of the steam is 12 kg/s. Determine (a) the change in kinetic energy (b) the power output and (c) the turbine inlet area. **[4+6]**

x = 0.92 c

work done
Work done in pump

Q2. (a) Define the second law efficiency and explain its physical significance.

(b) Steam (207 kPa abs./422 K) enters a diverging nozzle and exits as a saturated vapor at 422 K. The steam inlet velocity= 447m/s and nozzle exit velocity = 23m/s. The nozzle has an exit area of 0.0464 m^2. The environmental temperature is 298K. Determine (i) the rate of entropy generation (ii) the rate of exergy dissipation. **[3+7]**

Q3. (a) Differentiate between the Refrigerator and Heat Pump with neat sketches. How do you define the performance of such reversed heat engine devices?

(b) An IC engine discharges exhaust gas (800°C/1 bar) after extracting 1050 kJ of work per kg of gas. Calculate: (i) how much available energy per kg of the gas is lost with the discharge? (ii) the ratio of the lost available exhaust gas energy to the engine work. Given: c_p (for exhaust gas)= 1.1 kJ/kg.K, surrounding air temperature is 30°C. **[3+7]**