

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL/ AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: THERMODYNAMICS [AAE 2104]

REVISED CREDIT SYSTEM (04/01/2017)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- ✤ Use of thermodynamic data hand book is permitted.
- 1A. Distinguish between path functions and point functions using suitable examples. (04)
- **1B.** State the Zeroth law of thermodynamics and give its significance. (02)
- 1C. The cargo space of a refrigerated truck with inner dimensions are (04) 12 m × 2.3 m × 3.5 m is to be precooled from 25°C to an average temperature of 5°C. If the ambient temperature is 25°C, determine how long it will take for a system with a refrigeration capacity of 8 kW to precool the cargo space.
- 2A. An insulated rigid tank initially contains 0.7 kg of helium gas at 27°C and 350 (03) kPa. A paddle wheel with a power rating of 0.015kW is operated within the tank for 30 minutes. Determine
 - i) Final Temperature
 - ii) Final Pressure if c_v (helium)=3.1kJ/kgK
- **2B.** Prove that Internal energy is a property of a given system. (03)
- **2C.** Distinguish between thermal energy reservoirs and mechanical energy **(04)** reservoirs.
- **3A.** The heat supply to a heat engine 'A' takes place as follows: (02)
 - i. 200 kW at 200°C
 - ii. 140 kW at 140°C
 - iii. 400 kW at 210°C

The heat rejection from the heat engine 'A' takes place as follows:

- i. 215 kJ/s are rejected at 9.5°C
- ii. 150 kJ/s are rejected at 10.5°C
- iii. 75 kJ/s are rejected at unknown temperature 'T_k'

If the above cycle has to be reversible, determine the value of 'Tk'.

- **3B.** Define the following terms:
 - i. Sensible heat of water
 - ii. Triple line
 - iii. Critical point
 - iv. Compressed liquid
 - v. Latent heat of sublimation
- 3C. A pressure cooker has been securely fastened with a lid. A small opening with (03) cross sectional area 5 mm² is covered with a regulator weight that can be lifted to let steam escape. How much mass should the regulator possess to allow boiling at 125°C with the outside atmosphere at 101.3 kPa?
- **4A.** Derive Maxwell's relations using the different thermodynamic potentials. (06)
- **4B.** Argon in a light bulb is at 90 kPa, 20°C when it is turned on, and electric input **(02)** then heats it to 60°C. Find the specific entropy increase of the argon gas.
- **4C.** Why is Carnot cycle not practical?

(02)

- **5A.** Illustrate the working of an ideal gas turbine cycle using P-v and T-s plots. Derive **(06)** the thermal efficiency for this cycle.
- 5B. In a Brayton cycle, the inlet is at 300 K and 100 kPa. The combustion of fuel (04) adds 670 kJ/kg during the constant pressure heat addition process. The maximum temperature is 1200 K due to material considerations. Find the maximum permissible compression ratio and for that ratio, the cycle efficiency.