Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Vellore – 632014, Tamil Nadu, India

SCHOOL OF MECHANICAL ENGINEERING

FALL SEMESTER 2023-2024

Slot : A2+TA2

Continuous Assessment Test - II

Programme Name & Branch: B.Tech. Mechanical, B.Tech. Computer Science (SCORE)

Course Code/Name : BMEE203L / Engineering Thermodynamics

Faculty Name(s) : Dr. Kamatchi R, Dr. Gaurav Gupta, Prof. Anoop Kumar M, Dr. Praveen Kumar G

Class Number(s) : VL2023240101646, 1645, 1643, 1880

Duration: 90 min. **Max. Marks: 50**

Date of Examination: 15-10-2023

General instruction(s):

(i) Assume if any values are need with proper justifications
(ii) Use of Steam table, Mollier and ph charts are allowed.

Q.No	Question	Marks	Course Outcome (CO)	Bloom's Taxonomy (BL)
1.	In the premises of VIT hostel, there is a need for a heat transfer rate of 30MW to dry clothes at 60°C, and an additional 20 MW of power for drive washing machine. The engine operates between a heat source at 800°C and the surroundings at 10°C. Two engineering options are under consideration: Option A involves a reversible heat engine to generate the required 20 MW of power. Additionally, direct heat transfer occurs from the source at 800°C to the process at 60°C. Option B employs a reversible heat pump operating between the surroundings at 10°C and the process at 60°C. It is coupled with a reversible power cycle that generates the total required power for both the heat pump and other purposes. Calculate the total heat transfer rate (MW) required for the high temperature source for both options A and B. Then, using second law arguments, explain why option A or B is inherently better than the other.	10	4	BL5

2.	A heat engine receives 1000 kW of heat at constant temperature of 285°C. The heat is rejected at 5°C. The possible heat rejected is (a) 840 kW, (b) 492 kW, (c) 300kW. Comment on possibility of cycle based on Clausius inequality.	10	4	BL2
3	Air at 15°C and 1.05 bar occupies 0.02 m^3. The air is heated at constant volume until the pressure is 4.2 bar, and then cooled at constant pressure back to the original temperature. Calculate the net heat flow to or from the air and the net entropy change. Assume Cp, Cv and R of air for ideal condition.	10	4	BL3
4	In an iron process industry, there is a requirement for 40 MW of electricity, which is supplied by a concentrated solar thermal-operated steam plant working on Rankine cycle operates between boiler pressure of 4 MPa and condenser pressure of 10 kPa. The steam leaves the boiler and enters the steam turbine at 400°C. The isentropic efficiency of the steam turbine is 85%. Determine (i) the cycle efficiency (ii) the quality of steam from the turbine and (iii) the steam flow rate in kg per hour. Consider pump work.	10	5	BL3
5.	Using the data in question 4, Calculate a) Carnot cycle efficiency b) Change in entropy of the fluid across the turbine under real conditions. c) Pump work d) Heat rejection from condenser e) Draw the cycle in T-s and h-s diagram	10	5	BL4