VIT
Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST – I
FALL SEMESTER 2023-2024

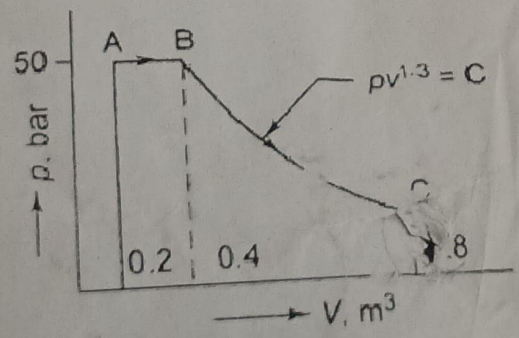
Reg. No.

Programme Name & Branch	: B.Tech. Mechanical Engg
Course Code	: BMEE203L
Course Name	: Engineering Thermodynamics
Faculty Name(s)	: Dr. Kamatchi R, Dr. Mohan CG, Prof. Anoop Kumar, Dr. Premkartikumar SR, Dr. Vijesh V Joshi and Dr. Nishant Tiwari
Class Number(s)	: VL2023240504670
Slot	: 32+TB2
Date of the Exam	: 26 Aug 2024
Exam Duration	: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer all the questions
- Assume suitable data if required

Q.No	Question	Marks
1.	680 kg of fish at 5°C are to be frozen and stored at – 12°C. The specific heat of fish above freezing point is 3.182 kJ/kg K, and below freezing point is 1.717 kJ/kg K. The freezing point is – 2°C, and the latent heat of fusion is 234.5 kJ/kg. How much heat must be removed to cool the fish, and what percent of this is latent heat?	10
2.	Derive the work done for the process AB and BC which is shown in Fig. 1. Also, find the total work done by a gas system following an expansion process.  Fig. 1	10
3.	A gas undergoes a thermodynamic cycle consisting of the following processes: (i) Process 1–2: Constant pressure p = 1.4 bar, $V_1 = 0.028\ m^3$, $W_{12} = 10.5$ kJ (ii) Process 2–3: Compression with pV = constant, $U_3 = U_2$ (iii) Process 3–1: Constant volume, $U_1 - U_3 = -26.4$ kJ. There are no significant changes in KE and PE. (a) Sketch the cycle on a p–V diagram (b) Calculate the net work for the cycle in kJ (c) Calculate the heat transfer for process 1–2 (d) Show that $\sum Q_{cycle} = \sum W_{cycle}$	10

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4.	Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg, and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas.	10
5.	A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. (a) Find the velocity at exists from the nozzle. (b) If the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate. (c) If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of the nozzle.	10

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