मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज-२११००४ भारत

Motilal Nehru National Institute of Technology Allahabad Prayagraj-211004 [India]

Mid Semester Examination 2022-23

Programme Name: B.Tech. **Semester: Odd**

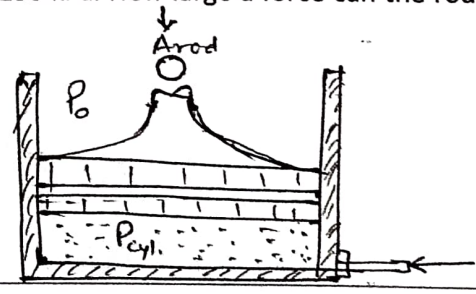
Course Code: CH2 **Course Name: Engineering Thermodynamics**

Branch: Chemical Engineering **Student Reg. No.:** 2 0 2 7 2 0 6 8

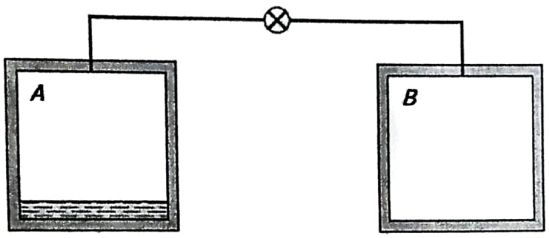
Duration: 90 minutes (28/12/2022) **Max. Marks: 25**

Instructions: (Related to Questions)

1. *Figures to the right indicate the full marks.*
2. *Attempt all the Questions and question no 1 should be tried on page 1.*

			Marks
Q 1	**a**	Does the specific internal energy of superheated water at 250^{0}C decrease or increase with an increase in pressure	**1**
	b	Separate the list P, V, ρ, T, U and S into intensive and extensive properties.	**1**
	c	What is the lowest temperature in degree Celsius and degree Kelvin?	**1**
	d	Two divers swim at 25 m depth. One of them swims right in under a cruise ship; the other stays away from the cruise ship. Who feels a greater pressure?	**1**
	e	Can a pure substance exist in liquid form below the triple point? Answer in one sentence.	**1**
Q 2		A hydraulic piston/cylinder in Figure 1 has a cylinder diameter, D = 0.1 m with a piston and rod mass of 25 kg. The rod has a diameter of 0.01 m with an outside atmospheric pressure of 101 kPa. The inside hydraulic fluid pressure is 250 kPa. How large a force can the rod push within the upward direction. F = 932 N 	**4**
Q 3		Fill out the following table for substance water:	**4**

	P [kPa]	*T* [°C]	*v* [m^3/kg]	*x*
a.	500	151.86	0.20	0.533
b.	1400	200		∞

Q 4		Draw and explain a P-T diagram for a pure substance including all points, lines and regions.	**4**
Q 5		Consider two tanks, A and B, connected by a valve, as shown in Fig. Each has a volume of 200 L, and tank A has R-~~410a~~ 134a at 25 °C, 10% liquid and 90% vapor by volume, while tank B is evacuated. The valve is now opened, and saturated vapor flows from A to B until the pressure in B has reached that in A, at which point the valve is closed. This process occurs slowly such that all temperatures stay at 25 °C throughout the process. How much has the quality changed in tank A during the process?  	**8**
		***************************Best of Luck****************************	

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Motilal Nehru National Institute of Technology Allahabad
Prayagraj-211004 [India]

End Semester Examination 2022-23

Programme Name: B.Tech. **Semester: Odd**

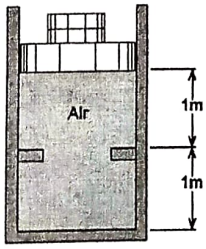
Course Code: CHN11102 **Course Name: Engineering Thermodynamics**

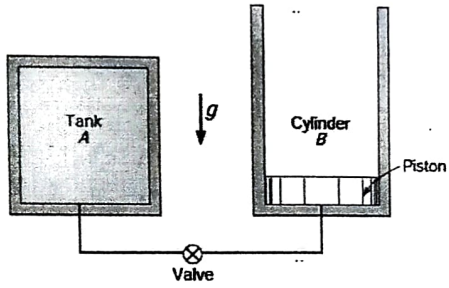
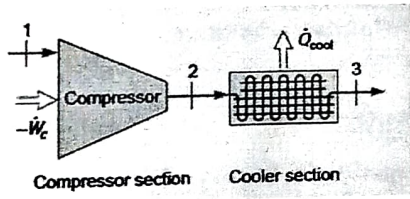
Branch: Chemical Engineering **Student Reg. No.:** 2 0 2 2 2 0 6 8

Duration: 2hr 30 minutes (01/03/2023) **Max. Marks: 50**

Instructions: (Related to Questions)

1. *Figures to the right indicate the full marks.*
2. *Attempt all the Questions ~~and question no 1 should be tried on page 1.~~*

			Marks
Q.1	a	Write the two statements of IInd Law of Thermodynamics. How the performance of heat engine, heat pump and refrigerator can be assessed? Derive.	5
	b	Using First and second law of thermodynamics, Find two important thermodynamic property relations for a simple compressible substance.	3
	c	Differentiate between reversible and irreversible process and list the reasons to cause irreversibility in a process. How entropy change can be given in reversible process?	2
Q.2		A piston/cylinder arrangement shown in Figure initially contains air at 150 kPa and 400◦C. The setup is allowed to cool to the ambient temperature of 20◦C. a. Is the piston resting on the stops in the final state? What is the final pressure in the cylinder? b. What is the specific work done by the air during the process? 	10
Q.3		Derive the general energy equation for steady state and transient processes using the First Law of Thermodynamics of a control volume.	10

Q.4		Consider the system shown in Figure below. Tank A has a volume of 100 L and contains saturated vapor R-134a at 30°C. When the valve is cracked open, R-134a flows slowly into cylinder B. The piston requires a pressure of 200 kPa in cylinder B to raise it. The process ends when the pressure in tank A has fallen to 200 kPa. During this process, heat is exchanged with the surroundings such that the R-134a always remains at 30 °C. Calculate the heat transfer for the process.  	**10**
Q 5.		The compressor in a plant receives carbon dioxide at 100 kPa, 280 K, with a low velocity. At the compressor discharge, the carbon dioxide exits at 1100 kPa, 500 K, with velocity of 25 m/s and then flows into a constant-pressure after cooler (heat exchanger) where it is cooled down to 350 K. The power input to the compressor is 50 kW. Determine the heat transfer rate in the after cooler.  	**10**
		****************************Best of Luck****************************	