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**PRESIDENCY
UNIVERSITY**

BENGALURU

School of Engineering

Mid - Term Examinations - November 2024

Semester: III

Date: 06-11-2024

Course Code: MEC4001

Time: 11:45pm – 01:15pm

Course Name: Basic Thermodynamics

Max Marks: 50

Program: B. Tech.

Weightage: 25%

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks.

5Qx2M = 10M

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|---|---|---------|----|------|
| 1 | Define temperature. | 2 Marks | L1 | C001 |
| 2 | State Zeroth Law of Thermodynamics | 2 Marks | L1 | C001 |
| 3 | What is thermometric property? Explain with few examples. | 2 Marks | L1 | C001 |
| 4 | Define thermodynamic work. | 2 Marks | L1 | C002 |
| 5 | Provide sign conventions for work and heat. | 2 Marks | L1 | C002 |

Part B

Answer ALL Questions. Each question carries 10 marks.

4QX10M=40M

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|----|--|----------|----|-------|
| 6 | Define with sketches, System, Surroundings, boundary and Universe. | 10 Marks | L2 | CO 01 |
| or | | | | |
| 7 | Define Process, Path, equilibrium process and quasi static process. Draw diagrams wherever possible. | 10 Marks | L2 | CO 01 |

- 8** A thermometric property X (length of mercury column in mercury in glass thermometer) is equal to 7.5 cm and 52.5 cm when the thermometer is in thermal equilibrium with ice point and steam point respectively. The temperature varies linearly with X. Now, assume that the temperature t^* on a certain temperature scale is defined by the equation, $t^* = a + b X^2$, where $t^* = 320$ and 2120 at the ice point and steam point respectively, with a and b as constants. Find the temperature t^* on this scale when the temperature is 1000 on the Fahrenheit scale. **10 Marks L3 CO 01**
- or**
- 9** The readings t_A and t_B of two Celsius Thermometers A and B agree at the ice point (00°C) and steam point (1000), but elsewhere they are related by the equation, $t_A = l + m t_B + n t_B^2$ where, l, m and n are constants. When both the thermometers are immersed in a well stirred bath, A registers 510°C whereas B registers 500°C . (a) Determine the reading on B when A registers 250°C and (b) which thermometer is correct? **10 Marks L3 CO 01**
- 10 10a** List different types of work. **03Marks L2 CO 02**
- 10b** Explain p-dV work with equations and diagram **07 Marks L2 CO 02**
- or**
- 11 11a** List the different modes of Heat transfer. **03 Marks L2 CO 02**
- 11b** Show that work is a path function. **07 Marks L2 CO 02**
- 12** A gas is compressed from an initial volume of 0.42 m^3 to a final volume of 0.12 m^3 . During this quasi-static process, the pressure changes with volume according to the relation, $p = a + b V$, where, $a = 600 \text{ kPa}$ and $b = -1200 \text{ kPa/m}^3$. Calculate the displacement work during the process by, (i) plotting the process on p-V diagram and finding the area and (ii) integration of the general formula for displacement work. **10 Marks L3 CO 02**
- or**
- 13** Consider the expansion of air inside a cylinder as shown in figure below. The initial volume is 0.025 m^3 and the initial pressure is 10 MPa . If the air undergoes quasi-static process, according to the law, $pV^{1.4} = \text{constant}$ to a final volume of 0.2 m^3 , determine (i) total work done by air, and (ii) amount of work done against the spring. Assume atmospheric pressure to be 101.325 kPa . **10 Marks L3 CO 02**