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 **PRESIDENCY UNIVERSITY**

  **Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 09/01/2025 **Time:** 01:00 pm – 04:00 pm |

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| **School:** SOE | **Program:** B.Tech- MEC/MCM |
| **Course Code :** MEC4001 | **Course Name** : Basic Thermodynamics |
| **Semester**: III | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **24** | **24** | **26** | **26** | **\_**  |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** |
| **1** | Define, System, Surroundings, boundary and Universe. | **2 Marks** | **L1** | **CO1** |
| **2** | What is adiabatic wall? Explain. | **2 Marks** | **L1** | **CO1** |
| **3** | What is heat? Explain. | **2 Marks** | **L1** | **CO2** |
| **4** | Give Mechanics definition of work. | **2 Marks** | **L1** | **CO2** |
| **5** | State Kelvin Plank Statement of 2nd Law of thermodynamics. | **2 Marks** | **L1** | **CO3** |
| **6** | What is entropy? Define properly. | **2 Marks** | **L1** | **CO3** |
| **7** | What is available energy? | **2 Marks** | **L1** | **CO3** |
| **8** | Define Pure substance. | **2 Marks** | **L1** | **CO4** |
| **9** | What is triple point? Explain. | **2 Marks** | **L1** | **CO4** |
| **10** | Define Ideal Gas. | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions Total 80 Marks.** |
| **11.** | **a.** | Explain thermodynamic equilibrium. | **08 Marks** | **L2** | **CO1** |
| **b.** | The readings tA and tB of two Celsius Thermometers A and B agree at the ice point (0oC) and steam point (100o), but elsewhere they are related by the equation, tA = l + m tB + n tB2 where, l, m and n are constants. When both the thermometers are immersed in a well stirred bath, A registers 51oC whereas B registers 50oC. (a) Determine the reading on B when A registers 30oC and (b) which thermometer is correct?  | **12 Marks** | **L3** | **CO1** |
| **or** |
| **12.** | **a.** | Differentiate between Macroscopic and Microscopic approaches. | **08 Marks** | **L2** | **CO1** |
|  | **b.** | The e.m.f. in a thermocouple with the test junction at toC on the gas thermometric scale and reference junction at ice point is given by ɛ = 0.20 t – 5 x10-4 t2 mV. The mili-volt meter is calibrated at the ice and steam points. What will be the thermocouple read in a place where the gas thermometer reads 50oC?  | **12 Marks** | **L3** | **CO1** |
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| **13.** | **a.** | What is work? List the different types of work and explain any two. | **08 Marks** | **L2** | **CO2** |
| **b.** | Consider the expansion of air inside a cylinder as shown in figure below. The initial volume is 0.025 m3 and the initial pressure is 10 MPa. If the air undergoes quasi-static process, according to the law, pV1.4 = constant to a final volume of 0.2 m3, determine (i) total work done by air, and (ii) amount of work done against the spring. Assume atmospheric pressure to be 101.325 kPa. | **12 Marks** | **L3** | **CO2** |
| **or** |
| **14.** | **a.** | Show that heat is a path function. | **08 Marks** | **L2** | **CO2** |
| **b.** | One kg of a fluid is flowing steadily in a rotary device in which 24 kJ of heat is transferred out of the device. The fluid properties at the entry are, 5 bar, 227degC, 50 m/s and 0.78 cubic meters /kg. The corresponding properties at the exit are, 1 bar, 57degC, 100 m/s and 0.97 cubic meters /kg. If the inlet manifold is 5 m above the exit manifold, find the work output in kJ/kg. Take internal energy as a function of temperature only and Cv = 0.7 kJ/kg K. | **12 Marks** | **L3** | **CO2** |

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| **15.** | **a.** | State and prove 2nd law of thermodynamics with violation of any one statement. | **08 Marks** | **L2** | **CO3** |
| **b.** | The COP of a heat pump is 5 and the power required to drive it is 35 kW. (a) Evaluate the heat transfers from and to the working fluid. (b) the heat transfer from the heat pump is used to heat the water circulating the radiators of a building. Determine the mass flow rate of water required, if its temperature increases by 20o C. | **12 Marks** | **L3** | **CO3** |
| **Or** |
| **16.** | **a.** | Explain the Principle of increase of Entropy of the Universe. | **08 Marks** | **L2** | **CO3** |
| **b.** | A heat engine operating in a cycle receives heat from a high temperature heat reservoir TH and rejects heat to a low temperature heat reservoir, TL. Determine whether the engine is reversible, irreversible or impossible for the following cases if TH =1000 K and TL = 150 K:1. Heat received by engine = 1000 J and work output = 900 J
2. ii) Heat received by engine = 2000 J and heat rejected by engine = 300 J

iii) Work out put = 900 J and heat rejected by the engine = 500 J | **12 Marks** | **L3** | **CO3** |

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| **17.** | **a.** | With the help of T-h diagram, explain the formation of steam at constant temperature. | **08 Marks** | **L2** | **CO4** |
| **b.**  | 10 kg of water at 2 bar and 45oC is heated at constant pressure until its temperature reaches 300oC. Determine the changes in volume, enthalpy, internal energy and entropy. Also determine the heat transfer for the process.  | **12 Marks** | **L3** | **CO4** |
| **Or** |
| **18.** | **a.** | What are the different properties available on the steam table? Explain. | **08 Marks** | **L2** | **CO4** |
| **b.** | A rigid vessel of volume 0.86 m3 contains 1 kg of steam at a pressure of 2 bar. Evaluate the specific volume, temperature, dryness fraction, internal energy, enthalpy and entropy of steam. The above vessel is heated to raise its temperature to 150oC. Show the process on p-v diagram and evaluate the final pressure, change in enthalpy, change in entropy and the heat transfer for the process. Also evaluate the pressure at which steam becomes dry saturated  | **12 Marks** | **L3** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***