Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **17PH2003** | **Duration :** | **3hrs** |
| **Sub. Name :** | **HEAT AND THERMODYNAMICS** | **Max. Marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Explain in detail with a neat schematic diagram, Joule-Thomson’s porous plug experiment. | CO1 | 15 |
| b. | Van der Waal’s constants for a gas are a = 6.9 x 10-2 J m3 mole-2 and b = 2.9 x 10-5 m3 mole-1. The universal gas constant is R = 8.31 J  mole-1 K-1. Calculate the critical temperature of the gas. | CO1 | 5 |
| (OR) | | | | |
| 2. | a. | Using Joule-Thomson effect and the principle of regenerative cooling, discuss how Linde was successful in liquifying air with a neat experimental setup diagram. | CO1 | 15 |
| b. | Arrive at an expression connecting Boyle temperature, temperature of inversion and critical temperature of real gases. | CO1 | 5 |
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| 3. | a. | A gas is allowed to expand at first isothermally and then in an adiabatic fashion. Calculate the amount of work done in both these processes. | CO2 | 15 |
| b. | Find the efficiency of a Carnot’s engine working between the steam point and the ice point. | CO2 | 5 |
| (OR) | | | | |
| 4. | a. | Derive an expression for Clausius-Clapeyron’s first latent heat equation. | CO2 | 15 |
| b. | A Carnot’s engine whose low temperature reservoir is at 7 ºC has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased? | CO2 | 5 |
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| 5. | a. | No engine can be more efficient than a perfectly reversible engine working between the same two temperatures. Validate this statement with necessary equations. | CO3 | 15 |
| b. | A Carnot’s refrigerator takes heat (80,000 calories) from water at  0 ºC and discards it to a room temperature at 27 ºC. 1 kg of water at  0 ºC is to be changed into ice at 0 ºC. How many calories of heat are discarded to the room? What is the work done by the refrigerator in this process? | CO3 | 5 |
| (OR) | | | | |
| 6. | a. | A Carnot’s engine can be also made to work as a refrigerator. Discuss this process in detail and hence, find the coefficient of performance of a refrigerator. | CO3 | 15 |
| b. | Find the efficiency of a Carnot’s engine working between 127 ºC and 27 ºC. It absorbs 80 cals of heat. How much heat is rejected? | CO3 | 5 |
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| 7. | a. | Based on T-S diagram (temperature-entropy), calculate the amount of external work done in a reversible Carnot’s cycle and hence find the efficiency of Carnot’s engine. | CO4 | 15 |
| b. | Calculate the change in entropy when 5 kg of water at 100 ºC is converted into steam at the same temperature. (Latent heat of steam = 540 cal/gram). | CO4 | 5 |
| (OR) | | | | |
| 8. | a. | Find the entropy of a perfect gas in terms of   1. Temperature and volume. 2. Temperature and pressure. | CO4 | 15 |
| b. | Calculate the change in entropy when 10 grams of ice at 10 ºC is converted into water at the same temperature. (Latent heat of ice = 80 cal/gram). | CO4 | 5 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Derive the general expression for Maxwell’s thermodynamic relations from first principles. | CO5 | 15 |
| b. | Calculate the specific heat of saturated steam given that the specific heat of water at 100 ºC = 1.01 and latent heat of vaporization decreases with size in temperature at the rate of 0.64 cal/K. Latent heat of vaporization of steam is 540 cal. | CO5 | 5 |