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**B.M.S COLLEGE FOR WOMEN AUTONOMOUS**  
**BENGALURU – 560004**

**SEMESTER END EXAMINATION – SEPTEMBER -2023**

**B.Sc in PHYSICS**  
**Thermal Physics and Electronics**

**Course Code: PHY4DSC04**

**Duration: 2 ½ Hours**

**QP Code: 4013**

**Max marks: 60**

**Instructions: Answer any FOUR questions from each part**

**PART - A**

**I. Answer any FOUR questions out of SIX. Each question carries 8 marks. (4x8=32)**

1. a. Differentiate isothermal and adiabatic process.  
b. Derive an expression for work done in a adiabatic process for an ideal gas. (4+4)
2. a. Derive first T.dS equation.  
b. Show that ratio of specific heats for a monoatomic gas is  $\frac{5}{3}$ . (4+4)
3. a. Explain Rayleigh-Jeans law.  
b. Prove  $dS = \frac{dQ}{T}$ . (4+4)
4. Derive an expression for carrier concentration of electrons in intrinsic semiconductor. (8)
5. a. Study the input and output characteristics of common-emitter configuration.  
b. Mention any three characteristics of ideal op-amp (5+3)
6. a. Explain the working op-amp as inverting amplifier.  
b. Discuss NAND gate as universal gate with truth table. (4+4)

**PART -B**

**II. Answer any FOUR numerical out of SIX. Each question carries 5 marks. (4x5=20)**

7. In a Carnot engine the temperature of source and sink are 500K and 375K. If the engine consumes  $25 \times 10^5$  J per cycle, find the efficiency and work done per cycle.
8. Calculate the change in temperature when CO<sub>2</sub> gas suffers Joule-Thomson expansion at 300K when the pressure difference on the two sides of the plug is 5 atm.

Given  $a = 0.303 \text{ Nm}^4\text{mol}^{-2}$  and  $b = 4.24 \times 10^{-5} \text{ m}^3\text{mol}^{-1}$ .

9. The luminosity of star Rigel is 17,000 times that of sun. If surface temperature of sun is 6000K, calculate the temperature of the star.
10. A transistor has  $\beta = 150$ . Calculate collector and base current if the emitter current is 12mA.
11. Convert a. B6A to decimal number.  
b. 25.375 to binary number.
12. Prove that  $\{AB + \overline{A}C + \overline{B}C (AB + C)\} = 1$

### PART -C

**III. Answer any FOUR questions out of SIX. Each question carries 2 marks (Concept based questions). (4x2=8)**

13. An ideal gas is compressed adiabatically at constant temperature. Will its internal energy change?
14. Adiabatic expansion produces cooling. Explain.
15. What is ultraviolet catastrophe?
16. How does energy gap in intrinsic semiconductor vary with increase in temperature?
17. When a p-n junction is reverse biased, what happens to the thickness of depletion layer? Explain.
18. Can op-amp work as differential amplifier? Explain.

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