DY-003-1014002   Seat No. _____

B. Sc. (Sem. IV) (CBCS) Examination

April - 2022

Physics : Paper - 401

(Thermodynamics & Electronics) (New Course)

Faculty Code : 003

Subject Code : 1014002

Time : $2\frac{1}{2}$ Hours]   [Total Marks : **70**

Instructions :   (1)   Symbols and notations have their usual meaning.
(2)   Total marks of the question is indicated on the right side of the question.
(3)   Attempt any five questions out of the following ten questions.

1   (a)   Give the correct answers of following questions :   4
(1)   What is Mayer's formula ?
(2)   Define Zeroth law of thermodynamics.
(3)   Can work be done by a system without changing its volume ? (Yes or No)
(4)   If the work is done by some external agency on the system then ΔW is _____.

(b)   Find the efficiency of the Carnot's engine working between the steam point and the ice point.   2

(c)   Discuss Quasi static process, Isothermal process and adiabatic process.   3

(d)   Discuss Porous plug experiment.   5

2   (a)   Give the correct answers of following questions :   4
(1)   The first law of thermodynamics is a statement of _____.
(2)   Define Isochoric process.
(3)   What is heat engine ?
(4)   If the heat is taken by the system than ΔQ is _____.

(b) An inventor claims to have developed an engine working in between 800 K to 300 K capable of having efficiency 65%. Comment on his claim.   **2**

(c) Discuss reversible and irreversible process.   **3**

(d) Explain Carnot cycle.   **5**

3 (a) Give the correct answers of following questions :   **4**
   (1) What is the SI unit of entropy ?
   (2) The entropy of a system increases in all _____ processes.
   (3) Define Stefan - Boltzman law.
   (4) At absolute zero temperature, the entropy tends to _____.

(b) 1 kg of water at 273 K is brought in contact with a heat reservoir at 373 K. What is the change in entropy of water as its temperature reaches 373 K?   **2**

(c) Write note on Temperature - Entropy diagram.   **3**

(d) Discuss the principle of increase of entropy.   **5**

4 (a) Give the correct answers of following questions :   **4**
   (1) The concept of entropy was first introduced by _____.
   (2) At absolute zero temperature, the entropy tends to _____.
   (3) For a completely black body, spectral emissive power is _____.
   (4) Define Wien's displacement law.

(b) Calculate the energy radiated per minute from the filament of an incandescent lamp at 1500 K if the surface area is 5×10^{-5} m^2 and its emittance is 0.85. [$\sigma = 5.7 \times 10^{-8}$ MKS unit]   **2**

(c) What is a black body ? Explain Wien's black body.   **3**

(d) Discuss Stefan - Boltzman law in detail.   **5**

5 (a) Give the correct answers of following questions :   **4**
   (1) A thermodynamic potential is a _____ quantity.
   (2) What is Gibbs free energy (G) ?
   (3) The Helmhotz energy is commonly used for system held at constant _____.
   (4) What is the specific heat equation for a perfect gas ?

(b) Find the increase in the boiling point of water at 100°C when the pressure is increased by one atmosphere. Latent heat of vaporization of steam is 540 cal/gram and 1 gram of steam occupies a volume of 1700 cm. **2**

(c) Derive the formula for Maxwell's 4th relation. **3**

(d) Derive an equation for Maxwell's thermodynamical relation and express the formula for Maxwell's first thermodynamical relation. **5**

6 (a) Give the correct answers of following questions : **4**
(1) What is Enthalpy ?
(2) What is Maxwell's second relation ?
(3) Clausius - Clapeyron's equation is also known as _____ equation.
(4) The grand potential is used for _____ processes in open system.

(b) By using Maxwell's thermodynamical relations, **2**

show that $\left(\dfrac{\partial C_p}{\partial P} \right) = T \left(\dfrac{\partial^2 S}{\partial P \partial T} \right) = -T \left(\dfrac{\partial^2 P}{\partial T^2} \right)_P$.

(c) Derive TdS equations. **3**

(d) Discuss Joule - Thompson effect with its co-efficient. **5**

7 (a) Give the correct answers of following questions : **4**
(1) FET works on the basis of _____ field effect.
(2) A JFET is a _____ controlled device.
(3) Convert the decimal into binary :
$(23)_{10}$ = _____.
(4) What is the full form of LSD ?

(b) A JFET has a drain current $I_D = 2.5\,\text{mA}, R_D = 5\,\text{k}\Omega$, **2**

$R_S = 200\,\Omega, V_{DD} = 40\,\text{V}$ find out V_{DS} and V_{GS}.

(c) Discuss the advantages of JFET. **3**

(d) Discuss the Construction and working of UJT. **5**

8 (a) Give the correct answers of following questions : 4
    (1) What is the unit of transconductance ?
    (2) Q - point term is related to UJT characterization. [True / False]
    (3) What is the boolean expression for Ex - OR gate ?
    (4) For the Boolean expression $(A+A) \square (B+C) = $ _____ .

(b) Prove $\overline{\overline{A \square B} + \overline{A} + A \square B} = 0$. 2

(c) Discuss Analog and Digital signal. 3

(d) Why NAND and NOR gates are known as universal logic gate ? Explain in detail with appropriate diagram. 5

9 (a) Give the correct answers of following questions : 4
    (1) All the ac bridges are based on _____ bridge.
    (2) The perfect balance can be obtained only in the case of air capacitor for De Sauty's bridge. [True/ False]
    (3) An Oscillator converts _____ .
    (4) LC oscillators are suitable for generating _____ frequencies.

(b) At what frequency does a $1 K\Omega$ resistor in series with a 2H choke coil offer an impedance of 1200Ω ? 2

(c) Explain Kohlraush's bridge in detail. 3

(d) Explain Maxwell's LC bridge in detail. 5

10 (a) Give the correct answers of following questions : 4
    (1) What is the use of Owen's Bridge ?
    (2) Except in special cases, all ac bridges involve a single balance. [True/False]
    (3) How many phase shift is produced by single RC section in phase shift oscillator ?
    (4) What is tapped in Hartley oscillator ?

(b) In the phase shift oscillator $R_1 = R_2 = R_3 = 1 M\Omega$ 2
and $C_1 = C_2 = C_3 = 68 \, pF$. Find the frequency of oscillator.

(c) Discuss Wien Bridge oscillator. 3

(d) Explain phase shift oscillator in detail. 5

_____