

Enrollment No.....



Faculty of Science
End Sem (Even) Examination May-2018
BC3CO08 Physics-II

Programme: B.Sc.(CS)

Branch/Specialisation: Computer Science

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. Zeroth law of thermodynamics forms the basis of: **1**
 (a) Temperature (b) Volume
 (c) Pressure (d) Internal energy
- ii. In a cyclic process, the change in internal energy is: **1**
 (a) Infinite (b) Constant (c) Zero (d) None of these
- iii. According to the principle of increase of entropy, in a natural process: **1**
 (a) $\Delta S \geq 0$ (b) $\Delta S \leq 0$ (c) $\Delta S = 0$ (d) $\Delta S > 0$
- iv. When 10 g of ice at 0 °C changes into water at the same temperature, the change in entropy is:
 (a) 0.293 Cal/K (b) 2.93 Cal/K
 (c) 293 Cal/K (d) 29.3 Cal/K
- v. The following is not a function of state of the system: **1**
 (a) T, U, V (b) P, T, U (c) S, T, W (d) V, T, S
- vi. The Gibb's free energy is not equal to: **1**
 (a) H-TS (b) U-TS (c) U+PV-TS (d) F+PV
- vii. Three identical coins are tossed several times. The probability to get head in two coins and tail in one coin uppermost is: **1**
 (a) 1/8 (b) 1/64 (c) 2/3 (d) 3/8
- viii. The number of coordinates of a single particle in phase space is: **1**
 (a) 6 (b) 2 (c) 3 (d) 5
- ix. The particles in a system obeying the Maxwell-Boltzmann statistics are: **1**
 (a) Identical but distinguishable (b) Only identical
 (c) Identical but indistinguishable (d) Only indistinguishable

[2]

- x. The spin of Bosons is: **1**
 (a) 1 (b) -1/2 (c) 0 (d) 1/2

- Q.2 i. State and explain the first law of thermodynamics. **2**
 ii. The efficiency of a Carnot engine working between temperatures 600 K and 300 K is same as that of working between x K and 600 K. Calculate the value of x . **3**
 iii. Explain the reversible and irreversible process. Write the condition for the process to be reversible. Give the one example of each process. **5**

- OR iv. Show that the efficiency of Carnot engine depends only on the temperatures between which it works. Explain the possible way to improve the efficiency of Carnot engine. **5**

- Q.3 i. Draw the neat and clean T-S and P-V diagram of Carnot cycle. **2**
 ii. Calculate the increase in entropy when 20 gm of water at 20 °C is changed into water at 100 °C. (Take: specific heat of water = 4.2 J/g °C) **3**
 iii. Explain the need of second law of thermodynamics. State its both statement and show their equivalence. **5**

- OR iv. What is entropy? Deduce the expression for the change in entropy of a perfect gas in terms of its pressure, volume and specific heats. **5**

- Q.4 i. Differentiate between extensive and intensive property of system. **2**
 ii. Using Maxwell's thermodynamic relations prove that: **3**

$$\left(\frac{\partial U}{\partial P}\right)_T = -P \left(\frac{\partial V}{\partial P}\right)_T - T \left(\frac{\partial V}{\partial T}\right)_P$$

- iii. State and prove the Gibb's – Helmholtz equations. **5**
 OR iv. Define and deduce the Maxwell's thermodynamical relation from internal energy and Helmholtz free energy. **5**

- Q.5 i. Define statistical probability. Explain it with suitable example. **2**
 ii. Four particles a, b, c and d are distributed in two identical boxes A and B with equal probabilities. State the possible macrostate and microstate. **3**
 iii. State the statistical interpretation of entropy and deduce the Boltzmann's entropy probability relations. **5**

[3]

- OR iv. A single particle of mass m is enclosed in a vessel of volume V . Find the number of accessible microstate in the energy range (i) 0 to E and (ii) E to $E + dE$. **5**

- Q.6 i. Write the postulates of Bose – Einstein and Fermi –Dirac statistics. What similarities and dissimilarities you find between them. **4**
 ii. Deduce expression for the average energy of a one dimensional oscillator using the Boltzmann canonical law. **6**

- OR iii. What is meant by the spectrum of black body radiation? Describe the Rayleigh-Jean's law to explain spectral distribution. **6**

Marking Scheme BC3CO08 Physics-II

Q.1	i. Zeroth law of thermodynamics forms the basis of: (a) Temperature	1				
	ii. In a cyclic process, the change in internal energy is: (c) Zero	1				
	iii. According to the principle of increase of entropy, in a natural process: (d) $\Delta S > 0$	1				
	iv. When 10 g of ice at 0 °C changes into water at the same temperature, the change in entropy is: (b) 2.93 Cal/K	1				
	v. The following is not a function of state of the system: (c) S, T, W	1				
	vi. The Gibb's free energy is not equal to: (b) U-TS	1				
	vii. Three identical coins are tossed several times. The probability to get head in two coins and tail in one coin uppermost is: (d) 3/8	1				
	viii. The number of coordinates of a single particle in phase space is: (a) 6	1				
	ix. The particles in a system obeying the Maxwell-Boltzmann statistics are: (a) Identical but distinguishable	1				
	x. The spin of Bosons is: (c) 0	1				
Q.2	i. Statement Description	1 mark 1 mark	2			
	ii. Solution: Given $T_1 = 600 \text{ K}$, $T_2 = 300 \text{ K}$ $T'_1 = x \text{ K}$, $T'_2 = 600 \text{ K}$ $\eta = 1 - \frac{T_2}{T_1}$ $\eta = 1 - \frac{T'_2}{T'_1}$		3			
				$1 - \frac{T'_1}{T'_2} = 1 - \frac{T_1}{T_2} \Rightarrow 1 - \frac{600}{x} = 1 - \frac{300}{600}$ $x = 1200 \text{ K}$		
				iii. Definition of reversible process Definition of irreversible process Condition of reversible Example of both	1 mark 1 mark 2 marks 1 mark.	5
			OR	iv. Complete derivation of efficiency Way to improve efficiency	3 marks 2 marks	5
			Q.3	i. T-S and P-V diagram of Carnot cycle 1 mark for each figure	(1 mark * 2) 1 mark	2 3
				ii. Formula – Solution with correct answer	2 marks	3
				iii. Kelvin –Planck statement Clausius –Clapeyron statement Equivalence of both	1.5 mark 1.5 mark 2 marks	5
			OR	iv. Definition of Entropy Expression of all three	2 marks 3 marks	5
			Q.4	i. Extensive property Intensive property	1 mark 1 mark	2
				ii. Complete derivation	3 marks	3
				iii. First equation Second equation	2.5 marks 2.5 marks	5
			OR	iv. Internal energy Helmholtz free energy	2.5 marks 2.5 marks	5
			Q.5	i. Definition Example	1 mark 1 mark	2
				ii. Complete table	3 marks	3
				iii. Explanation of entropy Derivation	2 marks 3 marks	5
			OR	iv. Total phase cell equation 0 to E E to E +dE	1 mark 2 marks 2 marks	5

Q.6	i.	2 postulates from each	2 marks	4
		Similarities	1 mark	
		Dissimilarities	1 mark	
OR	ii.	Planck's concept	2 marks	6
		Energy equation	2 marks	
		Zero point energy	2 marks	
OR	iii.	Black body spectrum meaning	2 marks	6
		Spectrum graph	2 marks	
		Rayleigh – Jean's law	2 marks	
