Fourth Semester B.Sc., Degree Examinations

May / June 2026

(Semester Scheme NEP 2021 onwards CBCS)

PHYSICS

Paper : IV : DSC 4 : NSD0210 : Thermal Physics and Electronics

Time: 2 hrs.] *[Max.Marks:60*

Instructions to Students :

1. ***The students should legibly write section number along with question number.***
2. ***The answer without section number and question numbers will not be valued.***
3. ***The question numbers should be legibly written within margin only.***
4. ***The question paper consists of four Sections I, II, III and IV.***
5. ***Answer all the questions (MCQ type) in Section - I, five questions in section-II Section - III and two questions in Section - IV.***
6. ***Draw the neat labelled diagrams wherever necessary.***
7. ***Take necessary data from tables.***
8. ***Symbols used have their usual meaning.***
9. ***Use of scientific calculator is allowed.***
10. ***Section - I question should be answered in first page of answer booklet.***

SECTION- I

I. *Select the most appropriate answer from options provided :* *10X 1= 10 Marks*

I-1) Internal energy during an adiabatic process _____

(a) Changes (b) Zero

(c) Infinity (d) remains constant

I-2) Adiabatic elasticity is always _____ isothermal elasticity

(a) less than (b) equal to

(c) more than (d) none of these

I-3) The work done on the system _____ the internal energy of the system.

(a) increases (b) decreases

(c) has no effect on (d) none of these

I-4) Entropy is ..... in a reversible process.

(a) infinity (b) increases

(c) zero (d) decreases

Contd...2

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I-5) Helmholtz free energy, F is given by _____

(a) F=U+PV (b) F = U-TS

(c) F=H-TS (d) none of these

I-6) Average energy associated with each degree of freedom in a molecule is _____

(a) KT (b) $\frac{3}{2}$ KT

(c) ½ KT (d) $\frac{5}{2}$ KT

I-7) Emitter-Base junction in BJT is _____ biased when connected as an amplifier.

(a) zero (b) highly

(c) reverse (d) forward

I-8) Gain value is usually set to _____ in an op-amp when used as a voltage follower.

(a) unity (b) zero

(c) infinity (d) None of these

I-9) Binary form of a decimal number 128 is

(a) 1010101010 (b) 1000100001

(c) 10000000 (d) None of these

I-10) Using a XOR gate, it is possible to construct _____ gate.

(a) OR (b) AND

(c) NOT (d) none of these

SECTION- II

II. ***Answer/Write notes on any FIVE of the following questions.*** ***5X 3= 15 Marks***

II-1) What is meant by Heat Death? Explain.

II-2) Show that the adiabatic curve at any point is steeper than Isothermal Curve.

II-3) A standard refrigerator working between -15°C and 30°C has to transfer at an average 200J of heat per second. Find coefficient of performance and power consumed by the refrigerator.

Contd...3

II-4) If molar enthalpy of fusion for ice 6.01 kJ/mol. Calculate entropy change when 72.0 g of ice melts at 273 K and 1 atm. (Note: molar mass of H_2O is 18g).

II-5) A transistor has $\alpha = 0.99$. If it is connected in CE mode with an input base current 10 μA, estimate the output collector current.

II-6) Give any five ideal characteristics of an op-amp.

II-7) Convert this binary number 11111101000 into a decimal number.

II-8) Explain briefly the reverse bias characteristic of a zener diode to verify its applicability as a voltage regulator.

SECTION- III

III. ***Answer any THREE of the following questions.*** ***3X 5= 15 Marks***

III-1) Obtain the equations of state of an adiabatic process.

III-2) State and Prove Carnot's theorem.

III-3) State Stefan's law of blackbody radiation and discuss the characteristics of black body spectrum.

III-4) Explain the working of voltage divider bias or self biasing of a npn transistor in CE mode.

III-5) Construct OR gate and AND gate using NAND gates.

SECTION- IV

IV. ***Answer the following:*** ***2X 10= 20 Marks***

IV-1) (a) Derive an expression for efficiency of Carnot's heat Engine. **(10 Marks)**

OR

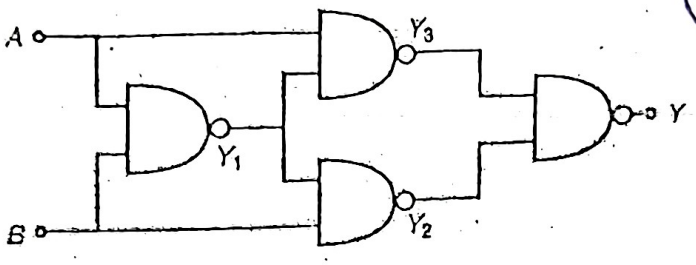
(b) Obtain Maxwell's thermodynamic relations and discuss its application to water-vapour transition to obtain clausius-clapeyron equation **(6+4 Marks)**

IV-2) (a) Explain the theory of op-amp inverting and non-inverting amplifier and hence obtain expressions for closed loop voltage gain. **(5+5 Marks)**

OR

Contd...4

(b) Verify that following circuit is an EX-OR gate by solving Boolean expressions and drawing truth table.



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