**2023/TDC(CBCS)/ODD/SEM/
PHSHCC–302T/152**

TDC (CBCS) Odd Semester Exam., 2023

PHYSICS

(Honours)

(3rd Semester)

Course No. : PHSHCC–302T

(Thermal Physics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

SECTION—A

Answer *ten* questions, selecting any *two* from each Unit :   2×10=20

UNIT—I

1. State the first law of thermodynamics.

2. Distinguish between isothermal and adiabatic processes.

3. Why a heat engine with 100% efficiency cannot be designed?

(*Turn Over*)

(2)

UNIT—II

4. Explain the concept of entropy.

5. State the third law of thermodynamics.

6. Define internal energy of a thermodynamic system. Is it a state function?

UNIT—III

7. Write Maxwell's thermodynamic relations.

8. Define Joule-Kelvin coefficient. What is its value for ideal gas?

9. Show that an adiabatic expansion always results in a fall of temperature.

UNIT—IV

10. What do you mean by r.m.s. and most probable speed?

11. Define free path and mean free path.

12. What is the effect of temperature and pressure on the coefficient of thermal conductivity of gas?

(3)

UNIT—V

13. In what way does a real gas differ from an ideal gas?

14. State the law of corresponding states.

15. What is temperature of inversion?

SECTION—B

Answer *five* questions, selecting *one* from each Unit : 6×5=30

UNIT—I

16. (a) Show that for one mole of an ideal gas $C_p - C_v = R$, where symbols have their usual meanings. 3

    (b) Obtain an expression for work done during an isothermal process. 3

17. (a) Explain the concept of reversible and irreversible processes with examples. 3

    (b) A Carnot engine is operated between the ice-point and steam-point. The engine receives 746 cal from the hot reservoir in each cycle.

       (i) How much heat does it reject to the cold reservoir?

       (ii) How much work is done by the engine in each cycle? 2+1=3

(4)

UNIT—II

18. *(a)* State and prove Clausius theorem. 3

(b) 1 kg of ice at 0 °C is converted into water at the same temperature. Find the change in entropy (given, $L = 80$ cal per gm). 3

19. *(a)* Discuss the unattainability of absolute zero. 3

(b) Define enthalpy, Helmholtz free energy and Gibb's free energy. 3

UNIT—III

20. *(a)* Obtain Maxwell's first thermodynamic relation. 3

(b) Establish the first energy equation. 3

21. *(a)* Explain first- and second-order phase transitions with examples. 3

(b) Deduce the Clausius-Clapeyron equation. 3

UNIT—IV

22. *(a)* Using Maxwell-Boltzmann distribution law of velocities, find an expression for the mean speed in an ideal gas. 3

(b) Briefly discuss Doppler broadening in spectral lines. 3

(5)

23. *(a)* Related to the transport phenomenon in ideal gases, give a brief concept of *(i)* viscosity, *(ii)* thermal conductivity and *(iii)* diffusion. 3

(b) What is Brownian motion? Mention the characteristics of Brownian motion. 1+2=3

UNIT—V

24. Write van der Waals equation of state for real gases. Write the SI units of van der Waals constants *a* and *b*. Obtain an expression for the inversion temperature from van der Waals equation. 1+(1+1)+3=6

25. Briefly describe Joule-Thomson porous plug experiment mentioning the findings of the experiment. 3+3=6

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