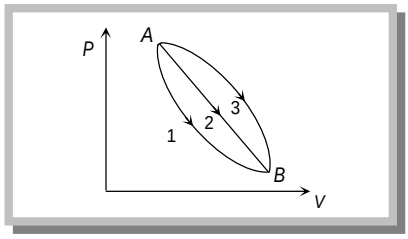
PAPER VI

Thermal Physics

Unit I

1. What is zeroth law of thermodyanics?
2. Write down the first law of thermodynamics.
3. Write down the second law of thermodynamics.
4. What is the significance of first law of thermodynamics?
5. What are the limitations of first law of thermodynamics?
6. What is a cyclic process?
7. Show that if internal energy U = a + $\frac{PV}{b}$, then in reversible adiabatic process PV(1+b) is constant where a and b are constants.
8. An ideal gas of mass *m* in a state *A* goes to another state *B* via three different processes as shown in figure. If Q_1, Q_2 and Q_3 denote the heat absorbed by the gas along the three paths, then



(a) $Q_1 < Q_2 < Q_3$

(b) $Q_1 < Q_2 = Q_3$

(c) $Q_1 = Q_2 > Q_3$

(d) $Q_1 > Q_2 > Q_3$

9. Water falls from a height of 210 *m*. Assuming whole of energy due to fall is converted into heat, find the rise in temperature of water would be (J = 4.3 *Joule*/*cal*).
10. If 150 *J* of heat is added to a system and the work done by the system is 110 *J*, then find the change in internal energy.]
11. 110 *J* of heat is added to a gaseous system, whose internal energy change is 40 *J*, then find the amount of external work done.
12. When an ideal diatomic gas is heated at constant pressure, find the fraction of the heat energy supplied which increases the internal energy of the gas.
13. If R = universal gas constant, find the amount of heat needed to raise the temperature of 2 *mole* of an ideal monoatomic gas from 273 *K* to 373 *K* when no work is done
14. One mole of O_2 gas having a volume equal to 22.4 *litres* at 0°*C* and 1 atmospheric pressure in compressed isothermally so that its volume reduces to 11.2 *litres*. Find the work done in this process
15. How much energy is absorbed by 10 *kg* molecule of an ideal gas if it expands from an initial pressure of 8 *atm* to 4 *atm* at a constant temperature of 27°*C*?

16. 5 *moles* of an ideal gas undergoes an isothermal process at 500*K* in which its volume is doubled. Find the work done by the gas system.

17. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. Find the ratio C_p / C_v for the gas.

18. An ideal gas at 27°*C* is compressed adiabatically to $\frac{8}{27}$ of its original volume. If $\gamma = \frac{5}{3}$, then find the rise in temperature.

19. If γ = 2.5 and volume is equal to 1/8 times to the initial volume then find the final the value of pressure *P'* (initial pressure = *P*)

20. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively, then find the value of T_1 / T_2 .

21. A gas has pressure *P* and volume *V*. It is now compressed adiabatically to $\frac{1}{32}$ times the original volume. If $(32)^{1.4} = 128$, the calculate the final pressure.

22. Find the coefficient of performance of a Carnot refrigerator working between 30°*C* and 0°*C*.

23. A Carnot engine working between 300 *K* and 600 *K* has work output of 800 *J* per cycle. What is amount of heat energy supplied to the engine from source per cycle?

24. A Carnot engine takes 103 *kcal* of heat from a reservoir at 627°*C* and exhausts it to a sink at 27°*C*. Find the efficiency of the engine.

25. What is carnots theorem?

UNIT II

1. What do you mean by entropy of a system?
2. Write down the physical significance of entropy of a system.
3. “Entropy of universe increases” – explain.
4. State third law of Thermodynamics.
5. What is the physical significance of Gibb's free energy?
6. 1 g of water at 0^0C is heated upto 100^0C and then vaporised at the same temperature. Calculate the change in entropy of the system. Given latent heat of fusion 540 cal/g.

7. Calculate the change in entropy when a body of mass 5 g is heated from 100K to 300K. The specific heat of the body is 0.1 cal/g/degree.

8. Calculate the change in entropy when 1 g of water at 100^0C changes into steam at the same temperature.

9. Calculate the change in entropy when 300g of Pb melt at 600K. Pb has latent heat 2.45 x 10^4 J/Kg.

10. Show that change in entropy is zero in reversible process.

11. Write the Mayers hypothesis.

12. What is first order phase transition?

13. Show that entropy increases in irreversible process.

14. Why Entropy Decreases With Increase In Temperature?

15. Entropy is maximum in which state?

16. What is the unit of entropy in SI system?

17. What is quasi static process?

18. What is the importance of S-T diagram?

19. What is the physical significance of S-T diagram?

20. Show that an increase in entropy is always followed by the loss of available energy.

21. Show that the process which tends to equalise temperature of the parts of a system increases entropy.

22. Entropy increases in natural process – explain.

23. What are extensive parameters?

24. What are intensive parameters ?

25. Show that entropy is an extensive parameter.

UNIT III

1. Write down the Maxwells thermodynamic relations.

2. Define degrees of freedom.

3. State the law of equipartition of energy.

4. Write down two assumptions of kinetic theory of gas.

5. On reducing the volume of a gas at constant temperature, the pressure of the gas increases. Explain it on the basis of kinetic theory.

6. Why do the gases at low temperature and high pressure show large deviations from ideal behaviour?

7. In the kinetic theory of gases, why do we not take into account the changes in gravitational potential energy of the molecule?
8. Explain qualitatively how the extent of Brownian motion is affected by the (a) size of the Brownian particle, (b) density of the medium, (c) temperature of the medium, (d) viscosity of the medium?
9. When do the real gases obey more correctly the gas equation:
PV=nRT?
10. For Brownian motion of particles of suspensions in liquids, what should be the typical size of suspended particles? Why should not the size of the particles be too small (say of atomic dimensions 10^{-10}m) or too large (say of the order of 1m)?
11. A box contains equal number of molecules of hydrogen and oxygen. If there is a fine hole in the box, which gas will leak rapidly? Why?
12. At a given temperature, equal masses of monoatomic and diatomic gases are supplied equal quantities of heat. Which of the two gases will suffer a larger temperature rise?
13. For an ideal gas, the internal energy can only be translational kinetic energy. Explain.
14. Why temperature less than absolute zero is not possible?
15. On which factors does the average kinetic energy of gas molecules depend: Nature of the gas, temperature, volume?
16. On which factor does the average kinetic energy of gas molecules depend??
17. What is the average velocity of the molecules of an ideal gas?
18. At what pressure and temperature a gas behaves as an ideal gas?
19. What is most probable speed?
20. Define mean free path.
21. Why Cp > Cv?
22. Why gas have two specific heats?
23. Define specific heat of gas at constant volume.
24. Define specific heat of gas at constant pressure.
25. Establish the relation $\gamma = 1 + \frac{2}{f}$ where the symbols have their usual meanings.

UNIT IV

1. What is transport phenomena of a gas?
2. What is Brownian motion?
3. Write down the properties of Brownian motion.

4. Write down the physical significance of Brownian motion.

5. What are critical constants of a gas?

6. Find the Van der Waal constants in terms of critical constants.

7. Find the value of critical constants of a gas in terms of van der waal constants.

8. Write down the difference between real and ideal gas.

9. State the law of corresponding states.

10. What is triple point?

11. 1 mole of SO_2 occupies a volume of 350 ml at 300K and 50 atm pressure. Calculate the compressibility factor of the gas.

12. Van der waals constant for a gas are a = 6.9 x 10^{-2} Jm^3mole^{-2} and b = 2.9 x 10^{-5} m^3 $mole^{-1}$.Calculate the critical temperature of the gas.

13. Define critical pressure.

14. Define critical temperature.

15. Define critical volume of a gas.

16. Find the value of critical coefficient of a gas.

17. Find the value of critical volume in terms of vander waal constant.

18. Find the value of critical pressure in terms of vander waal constant.

19. Find the value of critical temperature in terms of vander waal constant.

20. What is temperature of inversion?

21. What is throttling process?

22. What is Joule Thomson effect?

23. Write the difference between Joule Thomson effect and adiabatic expansion.

24. What is liquefaction of gas?

25. Which parameter remains constant in joule Thomson experiment?

PAPER VII

UNIT I

1. Draw the block diagram of CRO.

2. What are the advantages of IC?

3. What are the drawbacks of IC?

4. What do you mean by a positional weighted system?

5. Why the binary number system used in digital systems?

6. Convert $(4BAC)_{16}$ to binary.

7. Convert 4057.06_8 to decimal.

8. What do you mean by universal logic gates?

9. Construct OR gate using NAND logic.
10. Construct OR gate using NOR logic.
11. Construct AND gate using NAND logic.
12. Construct AND gate using NOR logic.
13. Construct XOR gate using discrete components.
14. Construct XNOR gate using discrete components.
15. What is the difference between analog and digital circuits?
16. Draw a NOT circuit using transistor.
17. What is VLSI?
18. What is Demorgans theorem?
19. What is an IC?
20. Why are ICs so cheap?
21. Why do ICs need small power for their operation?
22. Why are ICs more reliable than discrete circuits?
23. What are the advantages of ICs over discrete component circuits?
24. What are the important IC technologies used?
25. What is monolithic IC?

UNIT II

1. What is Boolean algebra?
2. What are the basic operations in Boolean algebra?
3. What do you mean by Axim?
4. What is a Multiplexer?
5. What is a De-multiplexer?
6. What is Decoder?
7. What is Encoder?
8. What are expandable gates?
9. What is the use of Demorgans theorem?
10. What do you mean by assertion level?
11. What is the advantage of SOP over POS?
12. What are don't cares?
13. What is a K map?
14. What is minterm?
15. What is maxterm?
16. Reduce using mapping

f = Σ m (0,1,2,3,5,7,8,9,10,12,13)

17. Reduce using mapping

f = Π M (2,8,9,10,11,12,14)

18. Convert A ($\bar{A}$ + B) ($\bar{A}$ + B + $\bar{C}$) into min terms.

19. Simplify Y = A + AB +ABC + ABCD + ABCDE + ……

20. Convert A ($\bar{B}$ + A) B into maxterm

21. Convert A + BC into minterms.

22. What is meant by SOP form?

23. What is meant by POS form?

24. What are the advantages of K – map?

25. What are the disadvantages of K – map?

UNIT III

1. Distinguish between combinational and sequential circuits.

2. What do you mean by stable state?

3. What is a flip flop?

4. What are the two types of flip flops?

5. What do you mean by toggling?

6. What are PRESET and CLEAR inputs?

7. What do you mean by time race?

8. What is a counter?

9. What are the applications of counter?

10. What is a multivibrator?

11. Draw and write the truth table of SR flipflop.

12. Draw and write the truth table of JK flipflop.

13. What are buffer registers?

14. What are the applications of shift registers?

15. What do you mean by a loading a register?

16. What is a single bit register?

17. What do you mean by parallel data?

18. What do you mean by serial data?

19. What is the difference between a shift register and a counter?

20. What is UART?

21. What is universal shift register?

22. What is static shift register?
23. What is dynamic shift register?
24. Draw the block diagram of IC 555.
25. What is a ring counter?

UNIT IV

1. What is a Microprocessor?
2. What are the flags in 8086?
3. Why crystal is a preferred clock source?
4. In 8085 which is called as High order / Low order Register?
5. What is Tri-state logic?
6. What happens when HLT instruction is executed in processor?
7. Which Stack is used in 8085?
8. What is Program counter?
9. What are the various registers in 8085?
10. What is 1st / 2nd / 3rd / 4th generation processor?
11. Name the processor lines of two major manufacturers?
12. Have you studied buses? What types?
13. How Many Interrupts Are There In 8085?
14. What is Non-Maskable interrupts?
15. What Are The Various Registers In 8085?
16. What Are The Various Flags Used In 8085?
17. What Is Stack Pointer?
18. What Is Program Counter?
19. Which Stack Is Used In 8085?
20. What Happens When Hlt Instruction Is Executed In Processor?
21. What Is Meant By A Bus?
22. What Is Tri-state Logic?
23. Give An Example Of One Address Microprocessor?
24. In What Way Interrupts Are Classified In 8085?
25. Name 5 Different Addressing Modes?

PAPER V

UNIT I

1. What are fourier coefficients?
2. How does Fourier series make it easier to represent periodic signals?
3. Fourier series uses which domain representation of signals?
4. What is the disadvantage of exponential Fourier series?
5. What is the polar form of the fourier series?
6. Which are the fourier coefficients in the following?

a) a_0, a_n and b_n

b) a_n

c) b_n

d) a_n and b_n

7. A "periodic function" is given by a function which

(A)has a period $T = 2\pi$

(B)satisfies f (t + T) = f (t)

(c) has a period $T = \pi$

(d) satisfies f (t + T) = - f (t)

8. Which of the following is an "even" function of t?

(a) t2

(b) t2 – 4t

(c)t3 + 6

(d) sin (2t) + 3t

UNIT II

1. Show that

$$\overline{|n+1} = n\,\overline{|n}$$

2. Show that

$$\overline{|n+1} = \underline{|n}$$

3. $Evaluate \int_0^\infty \sqrt[4]{x}\, e^{-\sqrt{x}}\, dx$

4. $Evaluate \int_0^\infty \sqrt{x}\, e^{-\sqrt[3]{x}}\, dx.$

5. $Evaluate \int_0^\infty x^{n-1} e^{-h^2x^2}\, dx.$

6. *Evaluate* $\int_0^\infty \frac{x^a}{a^x} dx.$

7. *Evaluate* $\int_0^1 x^{n-1} . \left[\log_e . \left(\frac{1}{x} \right) \right]^{m-1} . dx$

8. Show that

$$\Gamma \frac{1}{2} = \sqrt{\pi}$$

9. Evaluate : $\Gamma -\frac{1}{2}$

10. Evaluate : $\Gamma \frac{-3}{2}$

11. Evaluate : $\Gamma \frac{-15}{2}$

12. Evaluate : $\Gamma \frac{7}{2}$

13. Evaluate : $\Gamma 0$

14. Evaluate : $\int_0^\infty \sqrt{x}\ e^{-x} dx$

15. Evaluate : $\int_0^\infty x^4\ e^{-x^2} dx$

16. Evaluate : $\int_0^\infty e^{-h^2 x^2} dx$

17. What do you mean by random error?

18. What is systematic error?

19. Write the normal law of error.

20. What is percentage error?

21. What are different sources of errors?

22. How can we minimize errors?

23. What are the different ways of expressing an error?

24. Define accuracy.

25. What is meant by precision? Can we say an instrument of high precision is accurate?

UNIT III

1. Show that

$$J_{1/2}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \sin x$$

2. Show that

$$J_{-1/2}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \cos x$$

3. Show that $x J_n' = n J_n - x J_{n+1}$

4. Show that $x J_n' = -n J_n + x J_{n-1}$

5. Show that $2 J_n' = J_{n-1} - J_{n+1}$

6. Show that $2 n J_n = x (J_{n-1} + J_{n+1})$

7. Show that $\frac{d}{dx}(x^{-n} \cdot J_n) = -x^{-n} J_{n+1}$

8. Show that $\frac{d}{dx}(x^n J_n) = x^n J_{n-1}$

9. *Express* $f(x) = 4x^3 + 6x^2 + 7x + 2$ *in terms of Legendre Polynomials.*

10. *Prove that* $P_n(1) = 1$.

11. Show that $nP_n = (2n-1) x P_{n-1} - (n-1) P_{n-2}$.

12. Show that $x P_n' - P'_{n-1} = nP_n$.

13. Show that $P_n' - x P'_{n-1} = nP_{n-1}$

14. Show that $P'_{n+1} - P'_{n-1} = (2n+1) P_n$

15. Show that $(x^2 - 1) P_n' = n [x P_n - P_{n-1}]$

16. Show that $(x^2 - 1) P_n' = (n+1)(P_{n+1} - x P_n)$

UNIT IV

Form the partial differential equation

1. $z = (x + a)\,(y + b)$

2. $(x - h)^2 + (y - k)^2 + z^2 = a^2$

3. $2z = (a\,x+y)^2 + b$

4. $ax^2 + by^2 + z^2 = 1$

5. $x^2 + y^2 = (z - c)^2 \tan^2 \alpha$

6. $z = f(x^2 + y^2)$

7. $2z = \dfrac{x^2}{a^2} + \dfrac{y^2}{b^2}$

8. $f(x+y+z,\ x^2+y^2 + z^2) = 0$

Solve the following:

9. $\dfrac{\partial^2 z}{\partial x \partial y} = xy^2$

10. $\dfrac{\partial^2 z}{\partial x \partial y} = e^y \cos x$

11. $\dfrac{\partial^2 z}{\partial x \partial y} = \dfrac{y}{x} + 2$

12. $\dfrac{\partial^2 z}{\partial x^2} = a^2 z$, when $x = 0, \dfrac{\partial z}{\partial x} = a \sin y$ and $\dfrac{\partial z}{\partial y} = 0$

13. $\dfrac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ if $\dfrac{\partial z}{\partial y} = -2 \sin y$ when $x = 0$, and $z = 0$ when y is an odd multiple of $\dfrac{\pi}{2}$.

14.

Solve the following partial differential equation

$yq - xp = z$. *where* $p = \dfrac{\partial z}{\partial x}, q = \dfrac{\partial z}{\partial y}$.

Solve the following partial differential equations :

15. $p\tan x + q\tan y = \tan z$

16. $y\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = z^2 + 1$

17. $(y - z)p + (x - y)q = z - x$

18. $(y + zx)p - (x + yz)q = x^2 - y^2$

19. $zx\frac{\partial z}{\partial x} - zy\frac{\partial z}{\partial y} = y^2 - x^2$

20. $pz - qz = z^2 + (x+y)^2$

21. $p + q + 2xz = 0$

22. $x^2p + y^2q + z^2 = 0$

23. $(x^2 + y^2)p + 2xyq = (x + y)z$

24. $\frac{\partial z}{\partial x} - 2\frac{\partial z}{\partial y} = 2x - e^y + 1$

25. $p + 3q = 5z + \tan(y - 3x)$

PASS

Unit I

1. What is zeroth law of thermodyanics?
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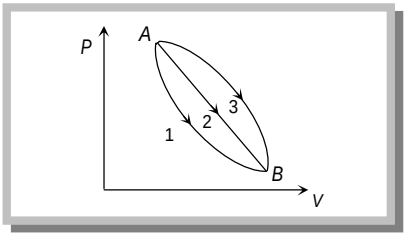

(a) $Q_1 < Q_2 < Q_3$

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9. Water falls from a height of 210 *m*. Assuming whole of energy due to fall is converted into heat, find the rise in temperature of water would be (*J* = 4.3 *Joule*/*cal*).

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14. Why Entropy Decreases With Increase In Temperature?
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20. Show that an increase in entropy is always followed by the loss of available energy.
21. Show that the process which tends to equalise temperature of the parts of a system increases entropy.
22. Entropy increases in natural process – explain.
23. What are extensive parameters?

24. What are intensive parameters ?

25. Show that entropy is an extensive parameter.

UNIT III

1. What is transport phenomena of a gas?

2. What is emissive power?

3. What is absorptive power?.

4. What is a black body?

5. State Planks law of black body radiation.

6. Show that $\gamma = 1 + \frac{2}{f}$

7. State Newtons law of cooling.

8. State Kirchoffs law of black body.

9. State Wiens law of black body.

10. State Stefans law of black body.

11. 1 mole of SO_2 occupies a volume of 350 ml at 300K and 50 atm pressure. Calculate the compressibility factor of the gas.

12. Van der waals constant for a gas are a = 6.9 x 10^{-2} $Jm^3 mole^{-2}$ and b = 2.9 x 10^{-5} m^3 $mole^{-1}$.Calculate the critical temperature of the gas.

13. Define critical pressure.

14. Define critical temperature.

15. Define critical volume of a gas.

16. Find the value of critical coefficient of a gas.

17. Find the value of γ for triatomic gas.

18. Find the value of γ for diatomic gas.

19. Find the value of γ for monatomic gas.

20. What is temperature of inversion?

21. What is throttling process?

22. What is Joule Thomson effect?

23. Write the difference between Joule Thomson effect and adiabatic expansion.

24. What is liquefaction of gas?

25. Which parameter remains constant in joule Thomson experiment?

UNIT IV

1. Define macrostate.

2. Define Microstate.
3. What is thermodynamic probability?
4. Write down the relation between thermodynamic probability and probability of occurrence.
5. Two particles are to be distributed in two non degenerate states. Find out the number of distributions according to MB statistics.
6. Two particles are to be distributed in two non degenerate states. Find out the number of distributions according to BE statistics.
7. Two particles are to be distributed in two non degenerate states. Find out the number of distributions according to FD statistics.
8. Write down the difference among MB, BE and FD statistics.
9. Consider a system of two identical particles each of which can be in any one of three single particle states.How many states of the systems are possible if they obey MB statistics?
10. Consider a system of two identical particles each of which can be in any one of three single particle states.How many states of the systems are possible if they obey BE statistics?
11. Consider a system of two identical particles each of which can be in any one of three single particle states.How many states of the systems are possible if they obey FD statistics?
12.What do you mean by phase cell?
13. What is phase space?
14. What is density of states?
15. What are the limitations of MB statistics?
16. State equipartition theorem.
17. Sketch FD distribution function for T = 0 K and T>0K.
18. Write the difference between classical and quantum statistics.
19. What is a system?
20. What is an ensemble?
21. Which statistics will you see for the systems having electron, proton, positron, muon, neutrino, alpha particle, He atom at low temperature, oxygen molecule, photon, holes, mesons.
22. Find the value of f(E)for FD distribution function at T = 0 K.
23. Find the value of f(E)for FD distribution function at T>0K.
24. Find the number of ways in which two indistinguishable particles can be distributed in 5 states if the particles obey FD statistics.

25. Find the number of ways in which two indistinguishable particles can be distributed in 5 states if the particles obey BE statistics.