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| Bon Secours College for Women Nationally Accredited with “A” Grade by NAAC (Affiliated to Bharathidasan University, Trichy-24) Recognized by UGC Under Section 2(f) & 12 (B)    Vilar Bypass, Thanjavur-613 006. |

**DEPARTMENT OF PHYSICS**

**THERMAL PHYSICS AND STATISTICAL MECHANICS**

**UNIT – I**

**2 Marks**

1. State and explain the Zeroth law of thermodynamics.
2. Give the general expression for the efficiency of heat engines.
3. Define thermal conductivity.
4. Give clausius statement of the second law of thermodynamics.
5. State the law of increase of entropy.
6. Prove that PVγ = constant in an adiabatic transformation.
7. What is transport phonomena?
8. Define entropy.
9. State and explain Maxwell’s law of distribution of velocities.
10. Find the efficiency of the carnots engine working between the steam point and ice point.
11. State and first law of thermodynamics.
12. Define thermal equilibrium.
13. Define specific heat.
14. Define Isochoric process.
15. Define Isobaric process.
16. What is heat engine?
17. Define efficiency.
18. What is adiabatic expansion?
19. What is isothermal expansion?
20. Give Planck statement of the second law of thermodynamics
21. Give Kelvin statement of the second law of thermodynamics
22. Define Third law of thermodynamics.
23. What is Clausius – Clapeyrons equation?
24. Define thermodynamic potentials.

**5 Marks**

1. Obtain expression for the viscosity of gases using transport phenomenon.
2. What is temperature - entropy diagram? What is its significance? Deduce an expression for its efficiency.
3. Briefly explain about transport phenomenon. State and explain first law of thermodynamics.
4. Briefly explain about Maxwell’s law of distribution of velocity by experimentally.
5. Explain thermal conductivity of gases using transport phenomenon.
6. Write note on reversible and irreversible processes in thermodynamics
7. Obtain a relation between diffusion coefficient density and viscosity.
8. Briefly explain carnots theorem.
9. Obtain an expression for the coefficient of viscosity of gas.
10. Write a note irreversible process.
11. State and explain Kelvin – Planck and Claussius statement of second law of thermodynamics.
12. Find the efficiency of carnots engine working between 227˚C and 27˚C.
13. Deduce the Clausius – Clapeyrons equation.
14. Discuss about the principles of increase of entropy.
15. Write a note a Heat engine.
16. Discuss about second law of thermodynamics.
17. Write a note an application of first law of thermodynamics.

**10 Marks**

1. Discuss the Maxwell’s law of distribution of molecular velocities.
2. Explain the change of entropy in a reversible process.
3. Obtain the expression for the change of entropy when ice is converted into steam.
4. Explain the experimental verification of kinetic theory of gases
5. Describe carnots cycle and obtain an expression for efficiency of ideal heat engine in terms of temperature.
6. Explain fully what you understand by entropy. Show that the change in entropy of a substance in a cyclic process is zero.
7. Calculate the change in entropy when 5 kg of water at 100˚C is converted into steam at the same temperature.
8. State and prove carnots theorem.

**UNIT – II**

**2 Marks**

1. Mention any two practical applications of low temperature.
2. If the critical temperature of air is -140˚C, calculate its temperature of inversion.
3. Define Joule – Kelvin co-efficient.
4. Define Joule – Kelvin effect.
5. What is adiabatic expansion process?
6. Mention the results of porous plug experiment.
7. What is meant by adiabatic demagnetization?
8. What do you mean by isenthalpic curve?
9. Give the principles of liquefaction of gases.
10. Define critical temperature of a gas.
11. What do you know about the limit for low temperature?
12. What is refrigeration?
13. Write any two accessories employed in dealing with liquefaction of gases.
14. Give the conditions of air conditioning machines.
15. Define Principles of regenerative cooling
16. What are the uses of Lindes process?
17. Define intensity of magnetization.
18. Define curie law.
19. Define Curie temperature.
20. Define superconductivity
21. Define meissner effect.

**5 Marks**

1. Give a brief account on liquefaction of gases.
2. Write a note an air – conditioning machines.
3. Explain the method of liquefaction of hydrogen.
4. With a neat diagram explain the function of electro flux refrigerator.
5. Detail about the accessories employed in dealing with liquefied gases.
6. Write a note on porous – plug experiment.
7. Show that Joule – Thomson effect is zero for a perfect gas.
8. Explain Principles of regenerative cooling
9. Explain liquefaction of air – lindes process.
10. Explain liquefaction of Helium ( K. Ones method)
11. Discuss about liquefaction of Helium I and Helium II.
12. Discuss about adiabatic demagnetization.
13. Explain helium vapour pressure thermometer.
14. Write note superconductivity.

**10 Marks**

1. Principle and working of refrigerating mechanism.
2. Describe the Joule – Thomson porous plug experiment with necessary theory. Discuss the results of the experiment.
3. With a neat diagram, explain the construction and working of Electro flux refrigerator
4. Explain the phenomenon of adiabatic demagnetization and how you will produce and measure very low temperature
5. Describe the liquefaction of Helium using K – Ones method and explain Helium I andf Helium II.
6. Briefly discuss about superconductor.

**UNIT – III**

**2 Marks**

1. Define Solar constant
2. What are pyrometers?
3. What do you mean by black body radiation?
4. State Kirchhoff’s law of heat radiation
5. What is pyroheliometers? Mention the different types of pyroheliometer?
6. State Planck’s law.
7. What is black body?
8. What is mean by pyrometry?
9. Mention some every day applications of thermal radiations.
10. Point out any four properties of thermal radiations.
11. Give some applications of solar energy?
12. Define solar constant.
13. Define thermal radiation.
14. Define Stefan law
15. Define Boltzmann law.
16. Define wiens law of energy distribution
17. Define ultraviolet catastrophe.
18. What are the postulates of Planck’s law?
19. Write the temperature of the sun.
20. Define green house effect.

**5 Marks**

1. Draw and explain the working of Angstroms Pyroheliometer.
2. Briefly discuss about Planck’s radiation law.
3. State and explain Stefan’s law of radiation.
4. Derive the Newton’s law of cooling from Stefan’s law.
5. What is source of solar energy? Explain
6. Write a note on energy distribution in a black body spectrum.
7. Explain about pyrometry.
8. What do you mean by radiation? Explain Rayleigh radiation.
9. Write a note on the sources of solar energy.
10. Briefly explain about Prevost theory of heat exchange. Determine the surface temperature of the sun.
11. Explain Boltzmann law of radiation.
12. Explain weins displacement law.
13. Explain Rayleigh’s jeans law.
14. Write a note on ultraviolet catastrophe.
15. What is derivation of Stefan’s law?
16. Explain solar constant.
17. Write a note on Stefan’s constant.
18. Explain the Weins black body.

**10 Marks**

1. What is quantum theory of radiation? Derive Planck’s law for black body radiation. Hence deduce Rayleigh Jeans law.
2. Derive Planck’s formula for the distribution of energy in the spectrum of a body. Deduce from its Weins displacement law.
3. Explain Rayleigh Jeans’ law.
4. With a neat graph explain the black body radiation spectrum, discuss the Planck’s law.
5. State the basic concept on which Planck’s law of black body radiation is based.
6. Briefly explain verification of Stefan’s law.
7. Briefly explain the determination of Stefan’s constant.
8. Explain the sources of solar energy
9. Briefly explain the solar constant and the temperature of the sun.

**UNIT – IV**

**2 Marks**

1. Define thermometry
2. What are the types of thermometers?
3. What is relation between Celsius, Kelvin scales of temperature.
4. Define liquid thermometers.
5. What is the gas equation?
6. Define gas thermometer.
7. Define platinum resistance thermometer.
8. Define Thomson effect.
9. Define Thomson coefficient.
10. Define specific heat of solid
11. Define specific heat of gas
12. Define specific heat of liquid
13. Define thermal capacity
14. Define caloric value of fuel.
15. Define Dulong and Pettis law
16. What is the Debye’s function
17. State Debye’s temperature
18. State Einstein temperature
19. Explain diatomic gas molecule
20. Discuss the result of Einstein theory of specific heat capacity.
21. How does the specific heat capacity of a monoatomic gas differ from the specific heat capacity of diatomic gas?
22. Give the assumptions of Einstein specific heat of solids.
23. State Debye’s T3 law.
24. Differentiate specific heat gases and heat capacity.
25. Write the Mayer relation.

**5 Marks**

1. State Dulong and Pettis law
2. Explain the variation of atomic heat of the substance with temperature.
3. Explain the Einstein theory of specific heat.
4. Briefly explain the quantum theory of specific heat of diatomic gases.
5. Discuss the quantization of various contributions to energy of diatomic molecules.
6. Explain specific heat capacities of diatomic molecules.
7. Derive an expression for specific heat of solids on the basis of Debye’s theory.
8. Deduce the relationship between the specific heat of a gas at constant pressure and at constant volume.
9. Discuss high and low temperature behavior.
10. Find the ratios of specific heats of monoatomic and diatomic gases
11. Explain the caloric value of fuels.
12. Explain the Mayer’s relation.
13. Discuss the role of degree of freedom in the internal energy of the diatomic gas molecule.
14. Explain the specific heat capacity of gases using the classical theory.

**10 Marks**

1. Discuss Debyes theory of specific heat capacities of solids at high and low temperatures.
2. Discuss high and low temperature behavior.
3. Discuss quantum theory of specific heat capacity of the gases.
4. Derive an expression for the specific heat capacity of the diatomic gases on the basis of quantum theory.
5. Derive an expression for the Einstein’s theory of specific heat capacity of solids.
6. Discuss the role of degree of freedom in the internal energy of the diatomic gas molecule.
7. Explain the specific heat capacity of gases using the classical theory.

**UNIT – V**

**2 Marks**

1. What is fermi energy?
2. Explain Maxwell’s law of equipartition of energy?
3. Define microstate.
4. What are fermions?
5. Write a note on statistical equilibrium?
6. Define Phase Space.
7. What are Bosons? Give examples.
8. What are the particles which obey F – D statistics?
9. Define degeneracy.
10. What are micro and macrostate?
11. Define an ensemble.
12. Distinguish between macro and micro state.
13. Distinguish between Bosons and Fermions.
14. Define electron gas.
15. Define degrees of freedom.
16. Define position space.
17. Define momentum space.
18. Define mu-space and gamma space.
19. Define partition function
20. Define fermi level

**5 Marks**

1. Obtain energy value of a photon, applying Bose-Einstein distribution law.
2. Write a note on Phase Space.
3. Write down the applications of Bose –Einstein distribution law.
4. Write down the applications of Fermi-Dirac distribution law.
5. Write a note on superconducting transition temperature.
6. Discuss in detail about the distribution law of Maxwell and Boltzmann.
7. Compare Maxwell-Boltzmann, Fermi –Dirac and Bose-Einstein statistics.
8. Explain Statistical equilibrium.
9. Write a note fermi energy.
10. Explain electron gas.
11. Write a note on applications of phase-space .
12. **Marks**
13. Briefly explain the Maxwell and Boltzmann distribution law.
14. Briefly explain the Fermi-Dirac distribution law.
15. Briefly explain the Bose –Einstein distribution law.
16. Compare Maxwell-Boltzmann, Fermi –Dirac and Bose-Einstein statistics.
17. Write a note on
18. Phase Space
19. Statistical equilibrium
20. Discuss about applications of Maxwell and Boltzmann distribution law.
21. Discuss about applications of Fermi-Dirac distribution law.
22. Discuss about applications of Bose –Einstein distribution law.