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AUTONOMOUS, CPE PHASE -III
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VIDYANAGAR, HUBBALLI-580031

# Department of Physics

**B.Sc – I Semester question Bank**

## Mechanics and properties of matter-115DSC1T

### UNIT- 1

### Chapter-1-Units and Measurements

### Chapter-2-Momentum and Energy

### Chapter-3-Special theory of relativity

### 2 Marks

1. Define physical quantity,.
2. Define measurement.
3. Define the unit of physical quantity.
4. Mention the name of a physical quantity.
5. What are fundamental units?
6. Name the different methods of measurement of units.
7. Define errors.
8. What is systematic measurement of mass?
9. Define random errors.
10. Define significance figures.
11. Define work done in mechanics.
12. State work energy theorem.
13. State law of conservation of energy.
14. Define frame of reference.
15. Give the postulates of special theory of relativity.

### 5 Marks

1. Explain the measurement of length
2. Define accuracy, precision and errors in measurement.
3. Name the different types of errors.
4. What are significant figures?
5. State and prove work energy theorem.
6. Deduce the work energy theorem.

### 10 Marks

1. State and prove work energy theorem.
2. Deduce the expression for the work done by a constant and variable.

3. State and prove conservation of energy and angular momentum.
4. Deduce the contraction of time dilation relation
5. State and prove law of conservation of energy for the
   (i) Illustration of freely falling body.
   (ii) Deduce time dilation relation.

**UNIT- 2**

**Chapter-4-Laws of motion**

**Chapter-5-Dynamics of rigid bodies**

**Chapter-6- Gravitation**

**2 Marks**

1. What is rigid body?
2. Define moment of inertia.
3. What is rotational motion?
4. Explain moment of inertia.
5. What is radius of gyration?
6. What is angular momentum?
7. State parallel axes theorem.
8. State perpendicular axes theorem.
9. What is centre of mass?
10. State Newton's first law of motion.
11. State Newton's second law of motion.
12. State Newton's third law of motion.
13. State Kepler's law of motion
14. Mention the S.I unit of moment of inertia.
15. Write the difference between Newton's and Kepler's law of motion.

**5 Marks**

1. State and prove parallel axes theorem
2. State and prove perpendicular axes theorem
3. State and explain Kepler's law of motion
4. Calculate the moment of inertia of a solid cylinder.
5. Explain gravitation and mention its constants.

**10 Marks**

1. Derive the moment of inertia of a uniform bar.
2. Derive the moment of inertia of a cylinder.
3. Derive the moment of inertia of a thin uniform bar.
4. Derive the moment of inertia of a rectangular lamina.
5. Explain the theory of compound pendulum.
6. Explain the theory of fly wheel.
7. Derive the law of gravitation.
8. Derive the moment of inertia of a solid cylinder.

**UNIT- 3**

**Chapter-7-Elasticity**

**Chapter-8-Bending of beam**

**2 Marks**

1. State Hook's law and elastic limit.
2. What is the dimension of modulus of elasticity?
3. Define Poise's ratio and its limiting value.
4. Define Young's modulus and modulus of rigidity.
5. Define Young's modulus, modulus of rigidity and bulk modulus.
6. What is Maxwell's needle?
7. What is period and torsional pendulum?
8. State the postulates of special theory of relativity.
9. What is time dilation?
10. Mention Lorent'z transformations.

**5 Marks**

1. Explain behaviour of the wire under gradually increasing load.
2. Illustrate the Young's modulus, modulus of rigidity and bulk modulus.
3. Define different types of elastic moduli.
4. Compute the expression for the twisting couple on a cylinder fixed at one end and twisted at the free end.
5. Explain torsional pendulum.
6. Discuss Lorentz transformations by using postulates of special theory of relativity.
7. Explain length contradiction.
8. Explain time dilation.

**10 Marks**

1. Derive the relation between Young's modulus, modulus of rigidity and bulk modulus.
2. Derive the expression for modulus of rigidity.
3. Derive the relation for depression at the loaded end of the cantilever.
4. Explain rigidity of modulus and Poise's ratio.
5. Define Poise's ratio and derive the relation between bulk modulus and Poise's ratio.

**UNIT- 4**

**Chapter-9-Surface tension**

**Chapter-10-Viscosity**

**2 Marks**

1. Define surface tension.
2. Define viscosity.
3. Mention the S.I unit of surface tension and viscosity.
4. Define pressure.
5. Give the example for surface tension and viscosity
6. Define angle of contact.
7. What is streamlining flow and turbulent flow?
8. Define equation of continuity.
9. State Stoke's law.
10. Mention the applications of surface tension and viscosity.

**5 Marks**

1. Define surface tension and angle of contact.
2. Explain surface tension and surface energy.

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## Department of Physics

## I SEM

## ENERGY SOURCES (15OEC01T) – 2021-22

### Unit I: Non- Renewable Energy Sources and Conventional energy sources

**2 Marks**

1 Define energy and mention the units of energy.
2 Mention the units of energy and S.I unit of energy.
3 Mention the classification of energy sources.
4 Mention the concept of energy.
5 Mention renewable energy sources.
6 Define renewable energy sources
7 Mention non renewable energy sources.
8 Define non renewable energy sources
9 Mention primary energy sources
10 Mention secondary energy sources
11 Mention conventional energy sources.
12 Define conventional energy sources
13 Mention non conventional energy sources.
14 Define non conventional energy sources
15 Mention commercial energy sources.
16 Define commercial energy sources.
17 Mention non commercial energy sources.
18 Define non commercial energy sources
19 Mention conventional energy sources.
20 Define conventional energy sources
21 Mention non conventional energy sources.
22 Define non conventional energy sources.
23 What are fossil fuels? Give examples.
24 What are nuclear energy sources? Give examples
25 Define energy sources. Give examples
26 Define renewable energy sources. Give examples
27 Define non renewable energy sources. Give examples
28 What is green energy?

29 What do you meant by eco-friendly?

30 What is nuclear energy? Give examples

**5 Marks**

31 Explain the classification of energy sources.

32 Explain renewable and non renewable energy sources.

33 Explain conventional and non conventional energy sources.

34 Explain commercial and non commercial energy sources

35 Explain the concept of energy.

36 Explain the significance of energy

37 Explain the limitations and importance of energy sources.

38 Explain fossil fuels with their extraction, usage rate and limitations

39 Explain nuclear energy with their extraction, usage rate and limitations.

40 Explain fossil fuels impact on environment and their issues.

41 Explain the classification of energy sources.

**8 Marks**

42 Explain renewable and non renewable energy sources and conventional and non conventional energy sources.

43 Explain the concept of energy commercial and non commercial energy sources.

44 Explain the significance of energy

45 Explain the limitations and importance of energy sources.

46 Explain fossil fuels with their extraction, usage rate and limitations

47 Explain nuclear energy with their extraction, usage rate and limitations.

48 Explain fossil fuels impact on environment and their issues

49 Explain nuclear energy impact on environment and their issues.

50 Explain nuclear energy and fossil fuels energy scenario in India and world energy scenario with latest statistics

51 Explain consumption and necessary of fossil fuels and nuclear energy.

52 Explain need of eco-friendly and green energy and their related technology

## Unit II: Renewable Energy Sources and Solar energy

**2 Marks**

1. What is tidal energy?
2. What is wave energy system?
3. What is solar energy?
4. What is biomass?
5. What is biochemical conversion?
6. What is geothermal energy?
7. What is tidal energy?
8. What is hydroelectricity?

9. What is the principle of solar water?
10. Mention the renewable and non-renewable energy sources.

**5 Marks**

1. Write any five applications of solar energy.
2. Write a note on wind energy.
3. Write merits and demerits of wind energy.
4. Explain solar cooker.
5. Write a need and characteristics of photovoltaic (PV ) systems.

**8 Marks**

1. What is the need of renewable and non-renewable energy sources?
2. Explain solar energy features and its importance.
3. Explain PV- models and equipment models.
4. Discuss in brief about greenhouses.
5. Explain working and principle of solar water.

## Unit III: Wind and Tidal Energy harvesting and Geothermal and hydro energy

**2 Marks**

1 What is wind energy?
2 What is wind energy used for?
3 What are advantages of wind energy?
4 What are disadvantages of wind energy?
5 What are examples of wind energy?
6 What is wind Turbine?
7 What are two basic types of wind turbines?
8 What are the main parts of wind turbine?
9 What are the types of wind Turbine Generator?
10 What is a power electronic interface?
11 What are power electronics examples?
12 What is the use of power electronics?
13 What is Grid topology?
14 What is grid interconnection topology?
15 What are geothermal resources?
16 What is the disadvantages geothermal energy?
17 What are the types of geothermal power plants?
18 What is ocean energy?
19 What are the two types of ocean energy?
20 What is ocean wave energy?

21 What are the characteristics of wave?
22 Write different technologies used for wave energy
23 What is a wave device?
24 What technology is used in tidal energy?
25 What are the sources of tide energy?
26 What is ocean thermal energy conversion?
27 What is the basic principle of ocean thermal energy conversion?
28 What are the types of geothermal resources?
29 What are the technologies for direct use of geothermal energy?
30 What is hydropower technology?
31 Which carbon capture technology is best?
32 What are cells in a battery?
33 What are the characteristics of wave

## 5 Marks

34 How does wind turbine work?

35 Write advantages and disadvantages of wind energy

36 What is grid topology? Explain

37 Explain wave profile devices

38 Explain wave attenuators

39 Explain oscillating water column (OWC)

40 What are the advantages of wave energy?

41 Which green energy source is better explain

42 How is solar energy affect the ocean

43 Why is geothermal a good resource explain?

44 How does Carbon Capture technology work?

45 Which carbon Capture technology is best?

46 How does hydro power technology work?

### 8 Marks

47 What are the types of wind turbine generator? Explain each one

48 What are the technologies used for wave energy? Explain the Oscillating water column (OWC)

49 What are the technologies used for wave energy? Explain the wave profile devices

50 What are the technologies used for wave energy? Explain the wave attenuators

51 Explain types of ocean Tides.

52 How does Carbon Capture technology work? Which carbon Capture technology is best?

53 What are new technologies in the hydropower field? How does hydro power technology work?

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## Department of Physics

### B.Sc – II Semester question Bank-2021-22

### Electricity and magnetism-115DSC2T

**UNIT- 1**

**Chapter-1-Electrostatics**

**Chapter-2-Laws of electrostatics**

**Chapter-3-Electric potential**

**2 Marks**

1. What is dielectric constant?
2. Define polarisation and dielectric material.
3. Name the four polarisation mechanism.
4. What is electric polarisation?
5. What is orientation polarisation?
6. What is space charge polarisation?
7. Define dielectric loss and loss tangent.
8. Compare active and passive dielectrics.
9. Mention polar molecules.
10. Mention non polar molecules.

**5 Marks**

1. Compare active and passive dielectrics with examples.
2. Write difference between polar and non-polar molecules.
3. Explain dielectric materials.
4. Derive the relation between P, E and D.
5. Explain electric polarisation and displacement.

**8 Marks**

1. Derive Classiest – Menotti equation.
2. Derive Gauss law in dielectrics.
6. Define electric polarisation, susceptibility and polarisation.
7. Derive the relation between P, E and D.
8. Explain mechanism of polarisation.
9. Derive Langevin's –Debye theory of polarisation in solids by Hopkinson's method.

**UNIT- 2**

**Chapter-4-Basics of dielectrics**

**Chapter-5- Theory of dielectrics**

**2 Marks**

8 What is dielectric polarisation?
9 What is the relation between P, E and D?
10 What is negative charge?
11 What is dielectric?
12 Write the expression for force between charges in dielectric medium.
13 What is polarisation?
14 What is susceptibility?
15 What is electric displacement?
16 What are electric images?
17 Write the expression fordielectric polarisation?

**5 Marks**

1. What are polar and non-polar molecules?
2. Explain relation between P, E and D.
3. Derive the expression for mechanical force on the charged conductor.
4. Explain capacitance of an isolated spherical conductor.
5. Explain calculation of electric field from potential.
6. Explain parallel plate spherical condenser.
7. Explain Gauss's theorem in electrostatics.
8. Explain boundary conditions of P, E and D.
9. Explain energy per unit volume.
10. Explain parallel plate cylindrical condenser.

**8 Marks**

1. Give the expression for mechanical force on the charged conductor and hence derive the expression for the energy density of the electrostatic field.
2. Give the expression for electric intensity at a point on the infinite plane conducing surface.
3. Explain the dipole and explain it for charged spherical shell and solidsphere. Of electric field.
4. Explain potential, as the line integral of electric field.
5. Explain parallel plate capacitor completely filled with dielectrics.

**UNIT- 3**

**Chapter-6-Magnetism**

**Chapter-7-Electric incumbents and measurements**

**Chapter-8- Alternating current circuits**

**2Marks**

1. Define magnetic field and magnetic force.
2. Define magnetic flux and density.
3. State Biot- Savart law
4. State Ampere's circuital law.
5. What is solenoid?
6. Define quality factor of series LCR circuit.
7. Define quality factor of parallel LCR circuit.
8. Define fig of merit of BG.
9. Define resonant frequency inseries LCR circuit
10. Define resonant frequency in parallel LCR circuit

**5 Marks**

1. State and explain Biot- Savart law.
2. State and prove Ampere's circuital law.
3. Give the theory of B G.
4. Derive the relation of current in series LCR circuit.
5. Derive the relation of current in parallel LCR circuit.
6. Deduce the condition of resonance inseries LCR circuit.
7. Deduce the condition of resonance inparallel LCR circuit.
8. Define charge sensitivity, volt sensitivity and current sensitivity of B G.
9. Define quality factor, impedance, power and energy in series LCR circuit.
10. Define quality factor, impedance, power and energy in parallel LCR circuit.

**8 Marks**

1. Using B G, explain the measurement of high resistance by leakage method.

2. Explain the measurement of capacity by absolute method.
3. Explain impedance in series LCR circuit.
4. Explain impedance in parallel LCR circuit.
5. Apply j-operator method deduce the relation for current of series LCR circuit. Arrive at resonance condition of the circuit.

**Chapter-9- Electromagneticwaves**

**Chapter-10- Magnetic materials**

**2 Marks**

1. State Gauss's divergence theorem.
2. State Stroke's theorem.
3. Define scalar product and vector product.
4. Define gradient of a scalar field.
5. Explain curl of vectors.
6. State the pointing theorem.
7. State significance of a divergence of a vector field.
8. Explain the significance of divergence of vector field.
9. Write differential form of vector equation.
10. Define polarisation and give examples.

**5 Marks**

1. Explain displacement of current.
2. State and prove Gauss's divergence theorem
3. Explain displacement of current.
4. Explain equation of continuity of current.
5. Mention differential form of Maxwell's equation and explain symbols.
6. State and explain Ampere's circuital law.
7. Derive $\nabla.E = \rho / \varepsilon_0$
8. Derive $\nabla.E = 0$
9. Derive $\nabla \times E = -(\partial\varepsilon / \partial T)$
10. Derive $\nabla.B = \mu_0 \varepsilon_0 . \partial\varepsilon / \partial T$

**8 Marks**

1. Explain hysteresis loop of B-H curve.
2. Write a note on Maxwell's Equations.
3. Define Maxwell's Equations for electromagnetic in space.
4. Deduce electromagnetic wave equation in dielectric medium.

5. Deduce electromagnetic wave equation in conducting medium.
6. Write a note on E and B.
7. Derive $\nabla \times E = -\left(\partial B / \partial t\right)$
8. Derive $\nabla \times H = 1/\sigma^2 \left(\partial \varepsilon / \partial T\right)$
9. Write a note on diamagnetic, paramagnetic and ferromagnetic materials.
10. Write a note on applications of diamagnetic, paramagnetic and ferromagnetic materials.

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# DEPARTMENT OF PHYSICS

## II semester- 115OEC02T

### Unit I: Climate science

**2 Marks questions**

1. What is wind energy?
2. What is wind energy used for?
3. What are advantages of wind energy?
4. What are disadvantages of wind energy?
5. What are examples of wind energy?
6. What is wind Turbine?
7. What are two basic types of wind turbines?
8. What are the main parts of wind turbine?
9. What are the types of wind Turbine Generator?
10. What is a power electronic interface?
11. What are power electronics examples?
12. What is the use of power electronics?
13. What is Grid topology?
14. What is grid interconnection topology?
15. What are geothermal resources?
16. What is the disadvantages geothermal energy?
17. What are the types of geothermal power plants?
18. What is ocean energy?
19. What are the two types of ocean energy?
20. What is ocean wave energy?
21. What are the characteristics of wave?
22 Write different technologies used for wave energy
23. What is a wave device?
24. What technology is used in tidal energy?
25. What are the sources of tide energy?
26. What is ocean thermal energy conversion?
27. What is the basic principle of ocean thermal energy conversion?
28. What are the types of geothermal resources?
29. What are the technologies for direct use of geothermal energy?
30. What is hydropower technology?
31. Which carbon capture technology is best?

32. What are cells in a battery?
33. What are the different types of cells &batterie? 34. What are lithium batteries?

**5 Marks questions**

1. How does wind turbine work?
2. Write advantages and disadvantages of wind energy
3. What is grid topology? Explain
4. Explain wave profile devices
5. Explain wave attenuators
6. Explain oscillating water column (OWC)
7. What are the advantages of wave energy?
8. Which green energy source is better explain
9. How is solar energy affect the ocean
10. Why is geothermal a good resource explain?

**8 Marks questions**

1. What are the types of wind turbine generator? Explain each one
2. What are the technologies used for wave energy? Explain the Oscillating water column (OWC)
3. What are the technologies used for wave energy? Explain the wave profile devices
4. What are the technologies used for wave energy? Explain the wave attenuators
5. Explain types of ocean Tides.
6. How does Carbon Capture technology work? Which carbon Capture technology is best?
7. What are new technologies in the hydropower field? How does hydro power technology work?

## Unit II: Climate science

### 2 Marks

1. What is airosole?
2. What is radar ?
3. What is Geostationary satellite?
4. What is cloud?
5. What is nucleation ?
6. What is Cloud seeding ?
7. What is active sensor ?
8. What is passive sensor ?
9. Write a note on Climate Science Overview of meteorological observations.
10. What is humidity ?

### 5 Marks

11. Explain wind speed and direction and pressure.
12. Write a note on Surface weather stations
13. Write a note on geostationary satellite?
14. Discus clouds and precipitation, aerosol size and concentration

### 8 Marks

15. Explain upper air observational network, satellite observation.
16. What is cloud ? Discus the Mechanisms of Cloud Formation ?
17. What are the types of clouds ? Discuss in brief about cloud seeding?
18. Discuss the working of Sling psychrometer for humidity measurement.
19. *Discus the wind vane for wind direction.*
20. Explain the measurement of wind speed using Cup anemometer

## Unit III: Climate science: Global Climate Change

### 2 Marks

1. What is climate?

2. What is global warming?
3. What is green house effect?
4. What are conventional energy sources?
5. What are non conventional energy sources?
6. What is deforestation?
7. What is fossil fuel?
8. What is sea level?
9. What are monsoon patterns?
10. What is melting of glaciers?
11. What do you meant by cyclone?
12. What do you meant by hurricanes?
13. What do you meant by tornadoes?
14. What do you meant by geo -engineering?

**5 Marks**

15. Mention the schemes of geo-engineering.
16. Explain Global climate change.
17. Explain green house effect.
18. Explain enhancement of gases in the atmosphere.
19. Explain conventional energy sources.
20. Explain non conventional energy sources.
21. Explain the causes for global warming.
22. Explain EL Nino southern oscillations
23. Explain LA Nino southern oscillations
24. Explain causes for global warming.
25. Explain fossil fuel burning.

**8 Marks**

26. Explain climate change and green house effect.
27. Explain the enhancement of $CO_2$ and other green house gases in the atmosphere.
28. Explain conventional energy sources, non conventional energy sources and their usage.
29. Explain EL Nino/ LA Nino southern oscillations
30. Explain causes for global warming, deforestation, fossil fuel burning and industrialization.
31. Explain manifestations of global warming, sea level rise, melting of glaciers.
32. Explain variation of monsoon patterns, increase in frequency and intensity of cyclones.
33. Explain hurricanes and tornadoes
34. Explain Geo- engineering as tool to mitigate global warming
35. Explain the schemes of Geo- engineering

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# Department of Physics- CBCS -2020-21

## B.Sc III Sem.DSC-PHY-303

## Thermal physics and Stastical physics

### Model questions

## UNIT-I Thermodynamics

## 2 Marks

1. What do you meant by thermodynamics?
2. Define thermodynamic system in closed system,open system and isolated system.
3. State first law of thermodynamics.
4. State second law of thermodynamics.
5. State third law of thermodynamics.
6. Give the Clausisus statement of second law of thermodynamics.
7. Give the Kelvin's- Plank's statement of second law of thermodynamics.
8. What is the internal energy of thermodynamic system?
9. Define the term isothermal, isobaric, isochoric cycle process.
10. What is an inductor diagram?
11. What is PV diagram?
12. Define efficiency of heat engine?
13. Explain reversible and irreversible process
14. What are the types of heat engines?
15. Define entropy.

### 5Mark

1. Prove $C_P$-$C_V$ = R
2. Deduce an expression for the work done during isothermal process.
3. Deduce an expression for the work done during adiabatic process.
4. What is an heat engine? Explain Carnot's heat engine.
5. State and prove Carnot's heat engine.
6. Explain four –cycle petrol engine.
7. Explain four stroke petrol engine.
8. Explain efficiency of petrol engine.
9. State and explain third law of thermodynamics.
10. Explain diesel engine.

## 10 Marks

1. Describe the theory and working of an Otto and petrol engine.
2. What is heat engine? Explain isothermal process.

3. State and prove Carnot's theorem.
4. Prove $C_P$-$C_V$ = R using first law of thermodynamics.
5. Explain T-S diagram.
6.

**UNIT-II Heat Engines**

**2 Marks**

**Heat engines:**

1. Distinguish between Otto engine & Diesel engine.
2. What is the heat engine? Mention the types of it.
3. Why the Diesel engines are not used in light vehicles.
4. What is the efficiency of Otto engine & Diesel engine?
5. State Carnot's theorem.
6. Draw the P-V diagrams that represent (i) Otto cycle and (ii) Diesel cycle.
7. Draw the entropy temperature diagram for Carnot's reversible engine.
8. State second law of thermodynamics?
9. What is temperature entropy (T-S) diagram? Write the expression for efficiency of a reversible Carnot's engine in terms of temperature.
10. Write the Clausius-Clapeyron's (Latent heat) equation and explain the terms.
11. State Clausius statement of second law of thermodynamics.
12. Explain the term entropy.
13. Is entropy scalar or vector? Write its S.I. unit.
14. What is T-S diagram?
15. What is the significance of T-S diagram?
16. What is the change in entropy in reversible and irreversible processes?
17. Write a short note on entropy as a measure of disorder.
18. What is effect of increase of pressure on the melting point of solid which contracts on melting?
19. What is effect of pressure on the boiling point of liquid?
20. Calculate the change in entropy when 1kg of water at 100$^o$C is converted into steam at the same temperature.(Given: Latent heat of steam = 540 cal/gram)
21. Calculate the change in entropy when 10gram of ice at 0$^o$C is converted into water at the same temperature.(Given: Latent heat of ice = 80 cal/gram)

**5 Marks**

**Heat engines:**

1. Explain the working of Otto engine with neat labeled diagram.
2. Derive an expression for efficiency of Otto engine.
3. Explain the working of Diesel engine with neat labeled diagram.
4. Derive an expression for efficiency of Diesel engine.
5. Prove that efficiency of reversible engine is always greater than any other engine.
6. Prove that entropy always increases in irreversible processes.
7. Write a note on T-S diagram.
8. What do mean by entropy? Show that entropy remains constant in reversible process.
9. Calculate the change in entropy when 10gram of water at 60$^o$ C is mixed with 30gram of water at 20$^o$C.
10. Calculate the change in entropy when 10grams of ice at 0$^o$C is converted into steam at 100$^o$C. (Given: Latent heat of steam = 540 cal/gram) .
11. Calculate the change in entropy when 0.1kg of water at 15$^o$C is mixed with 0.16kg of water at 40$^o$C. (Given: specific heat of water = 4200 J/Kg/K).
12. Find the efficiency of a Carnot's engine working between 400 K and 300 K. It absorbs 80 calories of heat. How much heat is rejected?

13. Calculate the change in entropy when 5 kg of water at 100 $^{o}$C is converted into steam at the same temperature.(Given; Latent heat of steam=540calories/g)
14. Calculate the change in entropy, when 50 g of ice at 0$^{o}$C is converted into water at the same temperature. (Given; Latent heat of steam=80calories/g)

**Heat engines:**

1. Explain the working of Otto engine hence derive an expression for its efficiency.
2. Explain the working of Diesel engine hence derive an expression for its efficiency

**3.** What do mean by entropy? Show that (i) entropy remains constant in reversible process and (ii) entropy increases in irreversible process.

**4.** Write a note (i) entropy (ii) T-S diagram

## UNIT-III Thermodymic potential

### 2 Marks

**Thermodynamic potentials:**

1. Mention different types of thermodynamic potentials.
2. Write an expression for Enthalpy & Gibb's free energy.]
3. Write an expression for internal energy & Helmoltz free energy.
4. Write the significance of thermodynamic potentials.

**Low temperature:**

1. Mention different methods of production of low temperature.
2. What is Refrigerator?
3. What is Joule-Thomson effect?
4. What do you mean by enthalpy?

### 5 Marks

**Thermodynamic potentials:**

1. Write a short note on thermodynamic potentials.
2. Using Maxwell's thermo dynamical relations deduce the Clausius-Clapeyron's equation. Hence explain the effect of pressure on boiling point of liquid.

3.Using Maxwell's thermo dynamical relations deduce the equation $\mathbf{C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P}$ where symbols have their usual meaning.

3. Using Maxwell's thermodynamical relation, show that for a Vander Waal's gas

$$Cp - Cv = R\left(1 + \frac{2a}{VRT}\right)$$

4. Use Maxwell's relation to obtain Cp-Cv=R for an ideal gas. Where Cp and Cv are molar specific heat at constant pressure and constant volume respectively.
5. Write down Maxwell's four thermodynamical relations and explain the terms.
6. Calculate under what pressure ice freezes at272 K if the change in specific volume when 2kg of water freezes is 90x $10^{-6}$ $m^3$ given Latent heat of ice =3.36x$10^5$ j/kg.
7. Calculate the pressure required to made ice freezes at -1 $^{0}$C L=79.6 Calories/g, Specific volume of water at 0 $^{0}$C=1000cc, specific volume of ice at 0$^{o}$C=1.091 cc and one atmosphere = 1.0313x$10^6$ dynes/$cm^2$.
8. Calculate the change in Boiling point of water when the pressure is increased. By 1 atmosphere, B.P.of water 100$^{o}$C. specific volume of steam =1.671 $m^3$ and Latent heat of steam 2.268x$10^6$J/kg.

9. Calculate the change in the boiling point of water when the pressure of steam on its surface is increased from 1atmospheres to 1.10 atmospheres. Given: Latent heat of water at 100°C = 537 cal/gram; volume of 1gram of steam at 100°C = 1676 $cm^3$.

**Low temperature:**

1.What is refrigerator? Explain the working of vapour compression machine.
2.Give the theory of porous plug experiment. Obtain conditions for heating and cooling of gas.
3.Explain vapour-compression machine with neat diagram.
What is Joule-Thomson's effect? Describe the Joule –Thomson's porous plug experiment

**10 Marks**

**Thermodynamic potentials:**

5. Derive Maxwell's thermo dynamical relations.
6. Using Maxwell's thermodynamical relation, derive the following equations
(i)Cp-Cv=R
(ii) $Cp - Cv = R\left(1 + \frac{2a}{VRT}\right)$ for a Vander Waal's gas

**Low temperature:**

7. Describe porous plug experiment. What conclusions have been drawn from it? What is inversion temperature?
8. a) What do you mean by Joule-Thomson effect? Explain.
b) What is refrigerator? Explain the working of vapour compression machine.

## UNIT-IV Theory of radiation

**2 Marks**

1. What is a black body?
2. What is Stefan's –Boltzmann law
3. What is Wien's law?
4. What is Rayleigh's law?
5. What is Plank's law?

**5 marks**

1. Calculate the elevation of the boiling point of water due to change of pressure of 1 cm of mercury. Assume L= 2.25 x10 $^6$ $jkg^{-1}$. Specific value of steam= 1.671$m^3$
2. Calculate the depression in the melting point of ice,when the pressure changes by one atmosphere. Specific value of ice at O°C is $10^{-3}m^3$ $kg^{-1}$ and L= = 3.36 x10 $^5$ $jkg^{-1.}$
3. Explain black body radiation.
4. Explain black body spectrum.
5. Explain the properties of blackbody radiations with examples.

**10 Marks**

1. Explain the dynamic system. What are thermodynamic variables? Define intensive and emissive variables.
2. Explain enthalpy, Helmholtz and Gibbs functions in thermodynamics. Derive Gibbs Helmholtz equations.
3. Derive Maxwell's thermodynamical general equations connecting the thermodynamic quantities.
4. Explain Maxwells four thermo dynamical equations and hence find two thermodynamic quantities.

**NIT-V Kinetic theory of gases**

**2 Marks**

**Kinetic model of a gas:**

1. At what temperature, pressure remaining constant will the R.M.S. velocity of hydrogen be double?
2. Write an expression for R.M.S. velocity of a gas and explain the terms.
3. At what temperature, pressure, remaining unchanged will the R.M.S. velocity of the gas be half its value at $0^oC$.

**Brownian motion:**

4. What is Brownian motion?
5. Write expression for mean square displacement of Brownian particles from Einstein's theory.

**5 Marks**

**Kinetic model of a gas:**

1. Write assumptions of Kinetic theory of gases.
2. Explain kinetic concept of temperature.
3. Write a note on kinetic model of a gas.
4. Calculate the RMS velocity of molecules of oxygen at 30°C, if R= 8.314 $Jmole^{-l}K^{-1}$ and molecular weight of oxygen =32.
5. Calculate the K.E. of 10-3 kg of the molecules of helium at 300K. R= 8.314 $Jmole^{-1}K^{-1}$. Molecular weight of helium = 4. Given that R= 8.314 Jmole-lK-1 & atomic weight of chlorine is 35.5, find the R.M.S. velocity of chlorine molecule at $O^{\circ}C$

**10Marks**

1. **Kinetic model of a gas:** Derive the expression for pressure exerted by gas molecules in an enclosed vessel.

**Brownian motion:**

2. Give Einstein's theory of Brownian motion.
3. Explain Brownian motion. Discuss Langevin's theory of Brownian motion.
4. Explain Brownian motion. Discuss Einstein's theory of Brownian motion.

**UNIT-VI Transport phenamena**

**2 Marks**

**Transport phenomena:**

6. What are transport phenomena in a gas?
7. Mention how coefficient of viscosity of gas varies with temperature & pressure.
8. What is the relation between viscosity (n) and thermal conductivity (k)?
9. Define the term free path.

or

What is 'mean free path'?

**5 Marks**

**Transport phenomena:**

5. Define mean free path. Derive the expression $\lambda = 1/\pi\sigma^2 n$
6. Write a note on viscosity of gas.
7. Derive the expression for coefficient of diffusion of gas.
8. Derive an expression for the coefficient of thermal conductivity of gas.
9. Derive Poisson's equation for perfect gas.
10. If the coefficient of viscosity of a gas is 1.66 x 10-5 N.sec.m-2 , density = 1.25 $kgm^{-3}$ and average velocity = 4.5 x $10^2 ms^{-1}$ find **a)** mean free path **b)** collision frequency **c)**molecular diameter.
11. Calculate the mean free path for benzene, if the no. of molecules per cubic meter is 2.79 x $10^{25}$ and diameter of benzene molecule is 7.2AU.
12. Calculate the diameter of a gas molecule, if the no. of molecules per cubic meter is 2.79 x $10^{25}$ and the mean free path of the gas is 2.2 x $10^{-6}$cm.
13. If the coefficient of viscosity of nitrogen is 1.66 x $10^{-5}$ SI units and coefficient of conductivity is 14.88 x $10^{-3}$ SI units, find the specific heat of nitrogen at constant volume.
14. The collision frequency of a gas molecule is $10^6$ collision/ sec. If the velocity of the molecule is 2 x $10^5$ $ms^{-1}$, find out the mean free path.
15. Creation gas has a density of 1.2.kg $m^3$ at a pressure $10^5$ N $m^2$ and at temperature $O^0$C Find R.M.S. velocity.
16. If the molecular velocity of a gas at NTP is 4.659 x $10^2$ $m^{-1}$ calculate the density of the gas.
17. Calculate the diameter of a gas molecule, if the number of molecules per $cm^3$ is 2.8 x $10^{19}$ and the mean free path of the gas is 2.2 x $10^{-6}$cm.

**10 Marks**

**Transport phenomena:**

18. What is mean free path? Write the approximate expression for mean free path. Derive Clausius expression for it.
19. Obtain the expression for coefficient of viscosity form Kinetic theory of gases.
20. Obtain the expression for coefficient of thermal conductivity from Kinetic theory of gases.
21. What are transport phenomena? Derive an expression for the coefficient of thermal conductivity.
22. Derive an expression for the diffusion of gas.

## UNIT-VII Statistical mechanics

**2 Marks**

1. Define probability.
2. State postulate of equal a priori probability.
3. Define thermodynamic probability.
4. Give the additive law of probability.
5. What is joint probability rule?
6. Explain the conditional probability rule.
7. What do you meant by macrostate and microstates?
8. Define accessible and inaccessible states.
9. What do you mean by most probable distribution?

10. Mention any two limitations of Maxwell-Boltzmann method.

**5 Marks**

1. Explain the concept of probability with examples.
2. State and explain the concept of equal a priori probability with example.
3. Define and explain the terms macrostate and microstate with the help of an example.
4. What do you mean by thermodynamic probability of macrostate? How is related to probability of occurrence of that state.
5. Define thermodynamic probability. For n distinguishable particles to be distributed in two compartments, prove that the thermodynamic probability is,

$$W_{(n1,n2)} = n! / n_1!\, n_2! \text{ , where } n_1+n_2=n$$

6. Distinguish between probability and frequency.
7. A card is drawn from a well shuffled pack of 52 cards. Calculate the probability for this card to be either a king or a queen.
8. What is the probability of drawing two queens in succession form a pack of 52 cards?
9. If a pair of 6 faced dice with faces marked 1 to 6 are thrown. What is the probability that the sum of the numbers which shows up is 8?
10. Two six faced dice, each marked 1 to 6 are thrown. Calculate the probability that one of the dice shows 6 and the other shows 5.

**10 Marks**

1. Find the expression for the probability of a macrostate corresponding to the distribution of n particles in k compartments of unequal sizes.
2. Treating ideal gas as a system governed by classical statistics, derive the Maxwell's distribution law for molecular speeds. Discuss special cases.
3. Using Maxwell's law for distribution of speeds of molecules in a gas, obtain expression for average speed and root-mean square speed.
4. Using Maxwell's law for distribution of speeds of molecules in a gas, obtain expression for most probable speed and average speed.
5. Using Maxwell's law for distribution of speeds of molecules in a gas, obtain expression for most probable speed and root-mean square speed.

**UNIT-VIII Statistical distribution law**

**2 Marks**

1. What are three kinds of particles in statistical physics?
2. What do you mean by distinguishable and indistinguishable particles?
3. What is difference between classical statistics and Quantum statistics?
4. What are Bosons? Which statistics is used to study them?
5. What are Fermions? Which statistics is used to study them?
6. A card is drawn from a well shuffled pack of 52 cards. Calculate the probability for this card to be a king.
7. We throw a dice and obtain two numbers. What is the probability that these numbers are 6 and 4 precisely in that order?

**5 Marks**

1. We throw a dice and obtain three numbers. What is the probability that these numbers are 6, 5 and 4 precisely in that order?
2. Calculate the probability that in tossing a coin 8 times, we get 5 heads and 3 tails.

3. Ten distinguishable particles are distributed among three, equal size partitions. Find the probability of the macrostates (i) (4,4,2) (ii) (5,3,2)

4. Distinguish between three kinds of particles.

5. From Maxwell-Boltzmann distribution law show that

$$n(E)dE = 2\pi N/(nkT)^{3/2}.E^{1/2}.\exp(-E/kT)dE$$

5. Treating ideal gas as a system governed by classical statistics, derive the Maxwell's distribution law for molecular speeds.

6. Define root mean square speed of the gas molecules. Using Maxwell's law for distribution of molecular speeds, derive expression for root-mean square speed.

7. What is most probable speed of the gas molecules? Using Maxwell's law for distribution of speeds of molecules, derive expression for most probable speed.

8. Using Maxwell's law for distribution of speeds of molecules, derive expression for the average speed of gas molecules.

**10 Marks**

1. Treating ideal gas as a system governed by classical statistics, derive the Maxwell's distribution law for molecular velocities. Discuss special cases.

2. Derive the Maxwell's distribution law for molecular velocities. Discuss special cases

3. Describe experimental verification of the Maxwell-Boltzmann distribution law for molecular speeds.

4. Distinguish between (or compare) Maxwell-Boltzmann statistics, Fermi-Dirac statistics and Bose –Einstein statistics.

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# PHYSICS QUESTION BANK CBCS-2020-21

## B.Sc IV Sem.DSC-PHY-404

## UNIT-I Wave motion

## UNIT-II Superposition of two collinear harmonic oscillations

## 2 Marks

1. What is wave motion?
2. Write the difference between harmonic wave and longitudinal wave.
3. Define progressive wave and stationary wave.
4. Write the expression for progressive wave and explain the terms.
5. Define principle of superposition of wave.
6. Write two differences between standing wave and progressive wave.
7. What do you meant by node and antinodes?
8. What is wave intensity?
9. Write two properties of stationary wave.
10. What are Lissojous figures?

## 5 marks

1. Define beats.
2. Define group velocity and phase velocity.
3. Define plane waves, spherical waves, wave intensity with equal frequencies.
4. Define plane waves, spherical waves, wave intensity with unequal frequencies.
5. Explain the types of wave motion like transverse wave and standing wave.
6. Write two differences between standing wave and progressive wave.
7. Write two properties of stationary wave and progressive wave.
8. What are Lissojous figures? And write the applications of Lissojous
9. Calculate the velocity of sound in a gas in which the wave of wavelength 500cm
10. Explain the superposition of two perpendicular harmonic oscillations.

## 10 Marks

1. Explain the types of wave motion like transverse wave and standing wave.
2. Explain the normal modes of a string, group velocity, and phase velocity.
3. Explain the superposition of two harmonic oscillations.
4. Explain oscillations having equal frequency and oscillations.
5. Explain oscillations having different frequency and oscillations.
6. What are Lissojous figures with equal frequency and unequal frequencies?
7. Explain the properties of stationary wave and progressive wave.
8. What are the characteristics of wave motion? Define linearity and superposition principle.

## UNIT-III Vacuum techniques

## 2 Marks

1. What is vacuum?
2. Write the ranges of vacuum.
3. Mention the vacuum measuring units.
4. What is pumping speed?
5. What is pump down time?
6. Mention the types of vacuum pumps.
7. Mention the different units to measure the vacuum.
8. Write the applications of vacuum pumps.

## 5 marks

1. Explain the production of vacuum.
2. Explain diffusion pump.
3. Explain molecular pump.
4. Explain penning and pirani of vacuum pumps.
5. Explain the leakages in vacuum pumps.

## 10 Marks

1. Explain the production of vacuum, measuring of vacuum, measuring units, vacuum ranges, pumping speed and pump down time?
2. Explain the types of vacuum pumps. a) Rotary pump b) Diffusion pump
3. Explain Knudsen absolute guage.
4. Explain Penning and Pirani in vacuum pumps
5. Explain the leakages in vacuum pumps with neat leveled diagram.

## UNIT-IV Sound

## 2 Marks

1. Define SHM.
2. What are forced vibrations? Give examples.
3. What are free vibrations? Give examples.
4. What is resonance?
5. What is intensity of sound?
6. What is loudness of sound?
7. What is decibel?
8. What is intensity level?
9. What are musical notes ?
10. What is acoustics ?

## 5 marks

1. Calculate the intensity level when the intensity of sound increases $10^6$ times its original intensity.

2. Calculate the change in intensity level when the intensity of sound increase 100 times its original intensity.
3. Explain amplitude, energy and displacement of SHM.
4. For a particle vibrating horizontally to a displacement of 8 cm at the and velocity is 8 cm/s instant velocity is 6cm calculate (i) amplitude (ii) frequency (iii) time period
5. Explain absorption coefficient.

## 10 Marks

1. Explain Fourier theorem.
2. Explain Fourier theorem for saw tooth wave.
3. Explain Fourier theorem for square wave.
6. Explain acoustics of building with reverberation time and absorption coefficient.
4. Derive Sabine's formula for measurement of reverberation time.

## UNIT-V Theories of light

## 2 Marks

1. What were the merits of wave theory of light?
2. What were the contributions of Fresnel to Huygens wave theory?
3. What is nature of light?
4. What is interference of light?
5. What are coherent sources?
6. Define fringe width?
7. What are newton's rings?
8. What is minimum condition to get interference pattern

## 5 marks

1. Discuss the interference phenomena for wedge shaped film.
2. Derive the expression for fringe width for wedge shaped film.
3. How do you determine the wavelength of light using Fresnel's biprism.
4. Explain Stoke's theorem of phase change in reflection and refraction.
5. Explain Newtons rings using reflection.

## 10 Marks

1. Describe Fresnel's biprism experiment to determine the wave length of monochromatic light.
2. Derive the condition for constructive and destructive interference in case of a thin film for reflected light.
3. Derive the condition for constructive and destructive interference in case of a thin film for transmitted light.
4. Explain the formation of Newton's rings to obtain an expression for wave length of light.
5. Describe the construction and working of Michelson –Morley experiment.

## UNIT-VI Interference

## 2 Marks

## Interference:

1. In moving the mirror $M_1$ of Michleson's interferometer through a distance of 0.4220mm, 1500 fringes are counted calculate the wave length of the light.
2. The diameter of $4^{th}$ ring in Newton's ring experiment is 0.18mm, Calculate diameter of $16^{th}$ dark ring?

## 5 marks

1. Discuss the interferences phenomenon for wedge-shaped film.
2. Derive the expression for fringe width in the wedge shaped film.
3. How do you determine the wavelength of light using Fresnel's Biprism?
4. Explain stoke's treatment of phase change to reflection and refraction.
5. Explain Newton's ring's produced due to reflection.
6. Describe Michelson's interferometer with a neat diagram.
7. Determine the wavelength of light by Newton's rings.
8. In Newton's rings experiment, obtain the conditions for bright and dark rings.
9. Describe the construction of fabry perot interferometer with labeled diagram.
10. Describe the principle and working of fabry perot interferometer.
11. Describe the construction of Michelson's interferometer with neat labeled diagram.
12. Explain Michelson's interferometer is used for determination for wavelength of monochromatic source of light.
13. Explain how Michelson's interferometer is used to determine the difference in wavelength of two close lines.

## 10 Marks

1. In a biprism experiments with sodium light of wave length 5893 Å. The micrometer reading is 2.32 mm. When the eyepiece is placed at a distance of 100 cm from the source. If the distance between two virtual sources is 2 cm. Find the new reading of the micrometer if the eye piece

is moved such that 20 fringes cross the field of view.

2. In a biprism experiment, a biprism of angle 10 and refractive index 1.5 is placed at a distance of 0.4 m from the slit and 0.6 m from the screen. Calculate the fringe width if light of 599.6 nm is used.

3. In a biprism experiment with sodium light bands of width 0.0195 cm are observed at 100 cm from the slit. On introducing a convex lens 30 cm away from the slit, two images of the slit are seen 0.7 cms. apart at 100 cms distance from slit. Calculate the wavelength of sodium light.

4. In Newton's ring experiment, find the radius of curvature of the lens in contact with the glass plate, for the light of wave length 6000 Å. The diameter of 5th dark ring in the reflected pattern is 5.2 mm.
5. In a Newton's rings experiments the diameters of $5^{th}$ &$15^{th}$ rings are $0.336x10^{-2}$m and $0.590x10^{-2}$ resp find the radius of curvature of plano convex lens, if wave length of light used is 5890 Å. A transparent plate of thickness $10^{-3}$ cm is placed in the path of one of the interfering beams of a biprism experiment using light of wave length 5000 Å if the central fringe shifts by a distance equal to width of 10 fringes. Calculate R.I of the plate.
6. In an experiment with michelson's Interfereometer to distance traveled by movable mirror for two successive positions of maximum intensities was 0.2845mm if the mean wave length of two components of sodium D line is 5893 Å .Calculate to difference between wave length

## UNIT-VII Diffraction

## 2 Marks

3. What is diffraction of light? And who discovered it?
4. What is Fresnel diffraction?
5. What is Fraunhoffer diffraction?
6. What do you understand by zone plate?
7. Compare zone plate with convex lens.
8. What are half period zones?
9. What is diffraction grating?
10. Define Resolving power of grating.
11. State Rayleigh's criterion for limit of resolution.
12. Define resolving power and limit of resolution of an optical instrument.
13. Distinguish between prism and grating spectra.

14. Distinguish between interference fringes and diffraction fringes.
15. Define R.P of prism & write the expression for it.

**Problems:**

16. Find the resolving power of a prism having base of 5 cm and $d\mu/d\lambda$. = 1200.
17. Calculate the resolving power of a diffraction grating in the second order having 10000 lines.
18. What is the radius of first zone in a zone plate of focal length 0.40m for the light of 400 nm?
19. Calculate the thickness of a half wave plate of quartz for which $\mu_0 = 1.544$ & $\mu_e = 1.553$, for a light of wave length 5893Å
20. In the first order diffraction with a light of wave length 6000Å the diffraction angle for a grating is $30^0$ find the number of lines per cm of the grating
21. Calculate the thickness of the half wave plate. Given $\lambda$=5000 Å $\eta_0$=1.544 & $\eta_e$=1.553

## 5 Marks

7. Discuss Fresnel's theory of half period zone in relation to plane wave front.
8. Discuss Fraunhaffer diffraction due to double slit.
9. Show that the amplitude due to a complete wave front of a point is half the what would be caused by the first zone.
10. Distinguish between Fresnel and Fraunhoffer diffraction.
11. What is diffraction of light? How Fresnel did explained diffraction based on his assumption.
12. Give the comparison of a Zone plate & a convex lens.
13. Discuss analytically the distribution of intensity in the diffraction pattern due to a single slit.
14. What is dispersive power of a grating and deduce an expression for it?
15. Compare between prism spectra & grating spectra.
16. Derive an expression for the angular dispersion of a plane diffraction grating.

## 10 Marks

1. What is Zone plate? Explain the theory of zone plate (obtain the expression for focal length of zone plate).
2. Describe the construction of zone plate. Show that the zone plate has different foci for different wavelengths.
3. Give Fresnel's theory of half period zones. How it is used to explain rectilinear propagation of light?
4. What is plane transmission grating? Discuss its theory and derive the condition for secondary maxima & minima.
5. Define resolving power and dispersive power of plane diffraction grating. Obtain expression for these in case of plane diffraction grating.
6. a) Define resolving power of an optical instrument.
   b) Derive an expression for resolving power of a prism.
7. Discuss the Fraunhofer type of diffraction produced by a narrow single slit of width 'a' and illuminated by a monochromatic light of wavelength $\lambda$.

8. Discuss Fraunhoffer diffraction pattern due to a single slit. Find the exp for the width of the central maxima.
9. Give the complete account of the phenomenon & relevant theory of diffraction at 'n' parallel slits.
10. Mention the difference between Fresnel and Fraunhoffer diffraction. Explain the diffraction pattern at single slit.
11. Explain the terms half period zones in relation to plane wave font show that the amplitude due to a complete wave font at a pt is half of what would because by the first half period eliminate zone.

## UNIT-VIII Polarisation

### 2 Marks

1. State and explain malu's law.
2. Discuss the difference between positive and negative crystal.
3. Describe Huygen's explanation of double refraction in uniaxial crystal.
4. Explain Huygen's theory of light in negative crystal when optic crystal is in the plane of incidence and inclined at an angle to the refracting surface.
5. Explain Huygen's wave theory of light when optic axis is in the plane of incidence and perpendicular to the refracting surface.
6. Describe Huygen's wave theory in negative crystal when optic axis is in the plane of incidence and parallel to the refracting surface.
7. What is quarter wave plate? Arrive at an expression for its thickness.
8. What is half wave plate? Arrive at an expression for its thickness.
9. What is circularly polarized light? How is it produced?

### 5 Marks

1. How can elliptically polarized light be produced? Explain.
2. Give the analytical treatment of circularly polarized light.
3. Give the analytical treatment of elliptically polarized light.
4. Explain Fresnel's theory of optical rotation.
5. Distinguish between circularly polarized light and unpolarized light.
6. What is double refraction? Describe how Huygen explained it.
7. Write a note on optical activity.
8. Write the assumption made by Fresnel to explain the phenomenon of optical rotation.

### 10 Marks

1. a. State and explain malu's law
   b. Distinguish between positive and negative crystal.

2. a. Give the Huygen's theory of double refrection

b. Distinguish between positive crystals & negative crystals .

3. Discuss the phenomenon of double refraction based on Huygen's principle of double refraction in (i). optic axis parallel (ii). Perpendicular to the refracting surface.

4. What is optical activity give Fresnels theory of rotational polarization ?

5. Explain the Fresnel's theory of rotatory polarization.

6. Distinguish between positive and negative crystals.

7. What are retarders? Obtain the expression for thickness of (i) half wave plate. (ii) Quarter wave plate.

8. Give the detail analysis of unpolarized, plane, circularly and elliptically polarized light

9. What are quarter wave plate & half wave plate? Write the expression for thickness of the quarter wave plate & half plate for negative & positive crystal.

10. Give the analytical treatment for production of Circularly and Elliptically polarized light.

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# Department of Physics-2020-21

B.Sc III Sem. SEC Model questions

Electrical and Network skills

2 Mmarks

1. What is Ohm's law?
2. Electricity Principles.
3. mention different types of signal generator?
4. What are vacuum measuring units?
5. Define Distortion factor meter.
6. Define pump down time.
7. Types of vacuum pumps.
8. Define Rotary pump.
9. Define Diffusion pump.
10. Define Molecular pump.
11. Penning and pirani gauge.
12. What do you mean by forced vibrations?
13. What do you mean by resonance?
14. Define intensity of sound.
15. Define loudness of sound.

5 Marks

1. What do you mean by Distortion factor meter, explain briefly.
2. State and explain about vacuum.
3. Explain about pumping speed and pump down time.
4. State and explain Rotary pump
5. State and explain Diffusion pump
6. State and explain Molecular pump
7. Explain briefly about detection leakage.
8. Derive equation for Simple harmonic motion
9. Discuss about Intensity and loudness of sound, Decibel, Intensity levels.
10. Discuss briefly about Acoustics of buildings

10 Marks

1. How Series, parallel, and series-parallel combinations. Explain with AC Electricity
2. Explain working principle of Relays. Fuses and disconnect switches

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# Department of Physics-2020-21

B.Sc IV Sem. SEC Model questions

## Signal Generators and Analysis Instruments
## Digital Instruments

### 2 Marks

1. What you mean by signal generator?
2. Define generators.
3. mention different types of signal generator?
4. What are vacuum measuring units?
5. Define Distortion factor meter.
6. Define pump down time.
7. Types of vacuum pumps.
8. Define Rotary pump.
9. Define Diffusion pump.
10. Define Molecular pump.
11. Penning and pirani gauge.
12. What do you mean by forced vibrations?
13. What do you mean by resonance?
14. Define intensity of sound.
15. Define loudness of sound.

### 5 Marks

1. What do you mean by Distortion factor meter, explain briefly.
2. State and explain about vacuum.
3. Explain about pumping speed and pump down time.
4. State and explain Rotary pump
5. State and explain Diffusion pump
6. State and explain Molecular pump
7. Explain briefly about detection leakage.
8. Derive equation for Simple harmonic motion
9. Discuss about Intensity and loudness of sound, Decibel, Intensity levels.
10. Discuss briefly about Acoustics of buildings

### 10 Marks

1. How production of signal has done? explain briefly about generators.
2. Explain working principle of digital multimeter with block diagram

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## Department of Physics

**B.Sc. – V SEMESTER-CBCS**

## 2021-22

## MODENR PHYSICS-DSE-PHY-505A

**UNIT- I-Fundamentals of quantum mechanics**

**UNIT- II-Wave mechanics**

**2 Marks**

1. What is Compton Effect?
2. What is the importance of Compton Effect?
3. Why is Compton Effect observed for X-rays and not observed for visible rays?
4. Calculate Compton shift for a photon scattered through an angle of 90˚.
5. Why the wave nature of matter is not apparent in our daily life?
6. Why the wave nature of matter is not apparent in our daily life?
7. An electron and proton have same de Broglie wavelength. Which one will move faster? Why?
8. Why the concept of trajectory in phase space has no meaning in quantum mechanics?
9. The period of harmonic oscillator in its ground state is 2.2 ms. Find the zero point energy. (Given $h$ = 6.625 x $10^{-34}$ JS)
10. Calculate change in wavelength when the recoil electron has maximum kinetic energy. (Given $h$ = 6.625 x $10^{-34}$ JS, electron mass = 9.1 x $10^{-19}$Kg)
11. Photon recoils back after striking an electron at rest. What is the change in the wavelength of the photon?
12. A microscope using photons is employed to locate an electron in an atom to within a distance of 0.1 Å. What is the uncertainty in the momentum of electron located in this way?
13. State Heisenberg's Uncertainty principle.
14. Write orthonormality condition of wave function.
15. State de Broglie hypothesis.

**5 Marks**

1. Illustrate Uncertainty principle using Gamma ray microscope.
2. Describe diffraction of electrons at a single slit.
3. Write the properties of wave function.

4. Give physical significance of wave function.
5. State de Broglie hypothesis and derive an expression for de Broglie wavelength.
6. Derive an expression for the energy of a particle in one dimensional box.
7. Describe Davisson and Germer experiment to study matter waves.
8. Discuss Compton scattering qualitatively and write the expression for Compton shift.
9. Give the physical significance of wave function and zero point energy.
10. X-rays of wavelength 0.5Å incident on few stationary electrons are scattered at 90˚. Calculate the Compton shift and the direction of the recoil electron.
11. An electron in ground state is moving in an infinitely deep potential well of width 20Å. Find the probability of finding electron at the center around 2Å distance.
12. The photon is confined to a nucleus of radius $5x10^{-15}$m. Calculate the minimum uncertainty in (i) momentum; (ii) K.E. of the photon.
13. A beam of mono-energic neutrons corresponding to 27˚C is allowed to fall on a crystal. A first order reflection is observed at a glancing angle 30˚. Calculate the inter planar spacing of the crystal. Given that $h$ = 6.625 x $10^{-34}$ JS, mass of neutron $m_n$= $1.67x10^{-27}$Kg and Boltzmann constant k=$1.38x10^{-23}$ J/K.
14. An electron is bound by a potential which closely approaches in infinite squre well of width $2.5x10^{-10}$m. Calculate the lowest three permissible quantum energies the electron can have.
15. The energy of a linear harmonic oscillator in its third excited state is 0.1eV. Calculate its frequency.
16. In Davison and Germer experiment, electrons are accelerated to a pd of 55V and get reflected at 50° in the 1st order. Calculate the wavelength of these electrons. What would be the pd if electrons are reflected at 48° in the second order (Given d= 2.2Å)

**10 Marks**

1. State and explain uncertainty principle. Illustrate the principle with Gamma ray microscope.
2. Derive an expression for energy of a particle in one dimensional box.
3. Deduce the time independent Schrödinger's wave equation.
4. Write Schrödinger's time independent wave equation for a particle. Explain the physical significance of wave function, Eigen function and Eigen values. What is the concept of zero point energy?
5. Write Schrödinger's wave equation for a linear harmonic oscillator and hence show that its energy is quantized. Explain the concept of zero point energy.
6. What is Compton Effect? Derive an expression for Compton Shift.
7. (a) Write a note on Eigen functions and Eigen values.
   (b) Discuss the permitted energy levels of a linear harmonic oscillator.
8. Develop the time independent Schrödinger's wave equation. What are the conditions that must be satisfied by the solution of the above wave equation?

**UNIT- III-Atomic spectra**

**UNIT- IV-Magnetic field effect on light**

**2 Marks**

1 Write the two drawbacks of Thomson's Atom model.
2. Write the postulates of Rutherford nuclear atom model.

3. What are the limitations of Rutherford nuclear atom model?
4. What are the postulates of Bohr's atom model?
5. Discuss the limitations of Bohr's theory.
6. Name the spectral series of hydrogen atom.
7. Name the line and region when an electron jumps from n=4 to n=2 of hydrogen atom.
8. Name the line and region when an electron jumps from n=3 to n=2 of hydrogen atom.
9. Write the postulates of the Summerfield's atom model.
10. What is relativistic atom model?
11. What are the drawbacks of the quantization?
12. Mention the new concepts introduced in the vector atom model.
13. What do you mean by space quantization?
14. What is spin quantization?
15. In what way the Summerfield's atom model differs from Bohr's theory.
16. Draw the vector diagram of space quantization for 'p' electrons.
17. Draw the vector diagram of space quantization for's' electrons.
18. Draw the vector diagram of space quantization.
19. Mention the four quantum numbers of atom model.
20. What is the limit of number of subshells in a shell?
21. What is the limit of number of electrons in a shell?
22. State Pauli's exclusion principle.
23. Name any two elements which have single valence electrons.
24. What are alkali metals? Give examples.
25. Write any two characteristics of spectra of alkaline earth metals.
26. Define critical potentials?
27. What is excitation potential?
28. What is ionization potential?
29. Write the principle of Frank –Hertz experiment.
30. Calculate the ionization potential of the hydrogen atom taking h=6.625 x $10^{-34}$ Js.
31. Calculate the excitation potential of the mercury atom given the wavelength of the emitted radiation when the excited atom return to its normal state is 2531$A^0$.
32. Draw the vector diagram of LS coupling for two electrons.
33. Draw the vector diagram of jj coupling for two electrons.
34. Mention the expression for magnetic moment of the electron due to orbital and spin motion.
35. Mention any two differences between LS coupling and jj coupling.
36. What is Larmor's precession?
37. Why Zeeman Effect is called magneto optical phenomenon?
38. What is normal Zeeman Effect?
39. Mention the expression for the magnetic interaction energy.
40. What is anomalous Zeeman Effect?
41. Write the expression for normal Zeeman shift in terms of frequency and wavelength.
42. Write the expression for angular frequency of Larmor's precession and describe the symbols.
43. Draw the energy level diagram for sodium D lines with necessary spectral terms.
44. Write the differences between excitation potential and ionization potential.

**5 Marks**

1 Write a note of Rutherford atom model.
2. Write a note of Bohr's atom model.
3. Write a note of Summerfield's atom model.
4. What is space quantization? Explain.

5. Explain the need for introducing the concept of electron spin.
6. Write a note vector atom model.
7. Explain with suitable example how Pauli's exclusion principle gives the logical reasoning of grouping of electron in shells and subshells.
8. What are alkali spectra? Explain the characteristics of spectra.
9. The wavelength of first line in Balmer series is $6563A^0$.Calculate the wavelength of the second line in Lyman series.
10. Given that the spectral term corresponding to the ionization potential of energy atom is 84178.5/cm.Calculate the ionization potential of mercury.
11. Calculate (i) Ionization potential (ii) First excitation potential of the hydrogen atom taking $h=6.625 \times 10^{-34}$ Js , $e=1.6 \times 10^{-19}$C and $m=9.1 \times 10^{-31}$kg.
12. In Stern - Gerlach experiment silver atoms traverse a distance of 0.1m in a non-homogenous of magnetic field of field gradient $55Tm^{-1}$.If the velocity of silver atom is 450m $s^{-1}$.Calculate the separation between the traces on the photographic plate. $\mu_B = 9.2 \times 10^{-24}$ $JT^{-1.}$
13. Write a note on of LS coupling.
14. Write a note on of jj coupling.
15. Write a note on of jj coupling schemes with vector diagram.
16. Derive an expression for magnetic moment due to orbital motion of the electron.
17. What is Zeeman Effect? Explain with experimental set up.
18. Derive an expression for the normal Zeeman shift.
19. Explain anomalous Zeeman Effect of sodium D line with the help of Lande's splitting factor.
20. Calculate the Zeeman shift in normal Zeeman Effect, given magnetic field 0.5T and $e/m=1.7 \times 10^{11}$ c/kg and wavelength 5500 $A^0$.
21. Normal Zeeman shift is $13.35 \times 10^{-12}$ m when spectral line of wavelength 6000 $A^0$ is subjected to magnetic field of 0.4T. Find the value of e/m.
22. What magnetic flux density required to observe the normal Zeeman Effect if a spectrometer can resolve spectral lines separated by 1 $A^0$ in the wavelength region 8000 $A^0$

**10 Marks**

1. Give an account of different quantum numbers required to specify the state of an electron in the atom.
2. Mention the salient features of vector atom model and explain the different quantum numbers associated with it.
3. Explain seven quantum numbers.
4. Describe Stern - Gerlach experiment and discuss its results.
5. Explains Frank –Hertz experiment with neat diagram and mention its drawbacks.
6. What is normal Zeeman Effect? Explain classical theory of normal Zeeman Effect.
7. Derive an expression for Lande's splitting factor and explain anomalous Zeeman Effect.
8. Explain how $D_1$ and $D_2$ line of sodium splits into four and six lines in magnetic field.

**UNIT- V-Molecular spectra**

**UNIT- VI-Raman effect (Lasers)**

**2 Marks**

1. Write any two uses of pure rotational spectra.
2. Write the selection rules for the rotational spectra of diatomic spectra.

3. Write any two differences between atomic spectra and molecular spectra.
4. Write any two general features of line spectra.
5. Mention the different types of spectra.
6. What is Raman scattering?
7. What is the difference between Rayleigh's and Raman scattering?
8. Mention any two characteristics of Raman lines.
9. Write any two applications of Raman Effect.
10. What are Stokes a line and anti-Stokes lines?
11. Define population inversion.
12. Write the characteristics of Laser.

**5 Marks**

1. What is Raman Effect? What are the characters of Raman Effect?
2. With exciting line 4348 $A^0$ a sample gives strokes line 4445 $A^0$ deduce the wavelength of anti-stokes lines.
3. The excited line in an Raman experiment is 5460 $A^0$ and strokes line 5520 $A^0$ deduce the wavelength of anti-stokes lines.
4. Describe the experiment set up to study the Raman Effect?
5. Explain Einstein's A and B coefficients.
6. Explain the working of He-Ne laser.
7. Define the term population inversion, How is it achieved for laser action.
8. Write note laser applications.
9. Explain the term spontaneous emission, stimulated emission and absorption.
10. Explain working and applications of hologram.
11. What is optical pumping? Explain different types of pumping used in lasers.
12. Explain the construction of Ga-As laser with neat diagram.
13. Explain the working of Ga-As laser with neat diagram.
14. Explain the applications of Raman Effect.
15. Explain the applications of lasers.

**10 Marks**

1. What is Raman Effect? What are the characters of Raman Effect? And write applications of Raman Effect
2. Explain the term spontaneous emission, stimulated emission and absorption with neat diagram.
3. Describe the experiment set up to study the Raman Effect? And write the applications of Raman Effect.
4. Explain different types of pumping used in lasers and how it is used to achieve the laser action
5. Explain the construction and working of He-Ne laser with neat diagram.
6. Explain the construction and working of Ga-As laser with neat diagram.

**UNIT- VII-Nuclear models ( $\alpha, \beta, \gamma$)**

**UNIT- VIII-Detectors**

**2 Marks**

1. Write an expression of semi empirical formula for the BE.
2. What are magic numbers?

3. Mention two examples of doubly magic elements.
4. Who proposed the liquid drop model of a nucleus?
5. Mention the merits of liquid drop model.
6. Mention the demerits of liquid drop model.

**Nuclear Reactions and alpha decay**

7. What is the nuclear reaction? Give an example.
8. Mention types of nuclear reactions.
9. What is Q-value of nuclear reaction?
10. What are pickup reactions? Give an example.
11. All types of nuclear reactions ? Give an example.
12. Complete the following reaction

    ${}_4Be^9 + ? = {}_6C^{12} + {}_1n^0$

    $n + \pi^+ \rightarrow ?$
13. What is the particle 'X' in the following nuclear reactions?

    (i) ${}_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + X$

    (ii) ${}_1H^2 + \gamma \rightarrow {}_1H^2 + X.$

14. Write the steps involved in the formation of compound.
15. What do you mean by range of alpha particles?
16. Write any two factors in which range of alpha particles depended.
17. Why does the distance $R_o$ i.e. the range of alpha particle?
18. Write the significance of Gieger Nuttal Law?
19. State Geiger Nuttal Law and explain its terms.

**Beta Decay and Gamma Decay**

1. Mention any two types of beta decay
2. What is electron emission of beta decay or β-decay?
3. What is electron capture or K-capture?
4. What is positron emission of beta decay or β+decay?
5. Draw decay schemes for Talium 204, Cs 137,Na 22, Mn 54 and Co 57 and identify the daughter element. (each 2mk).
6. Mention any two properties of gamma rays.

**Nuclear detectors**

7. What is the aim and principle of gas filled detectors
8. Write the construction of gas filled detectors
9. What is the principle of proportional counter?
10. What is the principle of ionization counter?
11. What is the principle of GM counter?

12. Write the construction of gas filled detectors
13. What is dead time and recovery time with respect to GM counter?

**Nuclear Models**

1. Explain liquid drop model.
   Or Discuss the assumptions of liquid drop model.
2. Deduce semi empirical mass formula.
3. Write a note on semi empirical mass formula.
4. Explain shell model.
   Or Write a note on shell model of nucleus.
5. Compare shell model & liquid drop model.
6. Explain nuclear fission on the basis of the liquid drop model.
7. What are magic number nuclei? How does the shell model explains the existence of magic numbers 2, 8 and 20.

## Nuclear Reactions and alpha decay

| | |
|---|---|
| 8. | Mention types of Nuclear reactions with examples. |
| 9. | Explain briefly the formation of compound nucleus |
| 10. | Explain Gamow's theory in details |
| 11. | Derive the expression for alpha disintegration energy of alpha particle |
| 12. | Experimentally determine the range of alpha particle |
| 13. | Explain alpha particle spectra with any two examples. |

**Beta Decay and Gamma Decay**

| | |
|---|---|
| 14. | Explain briefly the types of beta decay |
| 15. | Explain neutrino hypothesis theory of beta decay or origin of continuous beta spectrum. |
| 16. | Explain how gamma rays are originated |
| 17. | Explain briefly the origin of gamma rays |
| 18. | Mention the properties of Gamma rays |
| 19. | Explain briefly the interaction of gamma rays with matter. |

**Nuclear detectors**

| | |
|---|---|
| 20. | Describe the principle, construction and working of GM counter. |
| 21. | Describe the construction and working of proportional counter. |
| 22. | Describe the principle, construction and working of Gas filled counter |
| 23. | Explain briefly the variation of pulse height with applied voltage in gas filled detectors |

**Q. No II Questions carrying 10 marks**

**Nuclear Models**

24. List the comparative properties of liquid drop and nucleus. Deduce the semi-empirical mass formula.
25. Deduce semi-empirical mass formula of binding energy and explain specific binding energy curve.
26. Explain liquid drop model and obtain semi-empirical mass formula.

## Nuclear Reactions

27. Mention types of Nuclear reactions with examples.
28. What is Q-value of nuclear reaction? Deduce expression of Q- Value of nuclear reaction

**Nuclear detectors**

29. Discuss in detail the construction and working of a GM counter. What do you mean by Quenching of GM counter? What is its necessary?
30. Describe with neat diagram the construction and working of a GM counter. Explain paralyzing Time of GM counter.

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# DEPARTMENT OF PHYSICS

BSc V Semester –CBCS-Question Bank SEC – 2021-22

## Renewable Energy & Energy Harvesting

2 marks

1) What is solar cell? Give an example
2) What is inorganic solar cell? Give an example
3) What is organic solar cell? Give an example
4) What is hybrid solar cell? Give an example
5) What is main working principle of solar cell? Define
6) Why are the antireflective coating used for solar cells and give example?
7) Give alluring reasons to use silicon inorganic solar cell?
8) What are types of inorganic solar cells? Define the types
9) Give main drawbacks of the inorganic solar cells?
10) How does plastic solar cell convert light in to electricity?
11) What is spin coating?
12) Define polymer, additive?
13) What are advantages of nanotechnology solar cells?
14) What are components used in hybrid solar cells?
15) Briefly explain the current status and future aspects of solar capacity installation and price of organic inorganic and hybrid solar cells?

5marks

1) Explain the design and working of silicon inorganic solar cell?
2) Explain the Background benefits and production of CdTe inorganic thin film solar cell?
3) Explain in general the design and working of organic solar cells and mention An example
4) How plastic solar cells are made?
5) Briefly explain working and components of hybrid solar cell?
6) Why silicon is used to prepare inorganic solar cells? Give the alluring reasons?
7) Mention the advantages of nanotechnology solar cells?

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## Department of Physics

**2021-22**

**B.Sc. – VI Semester**

# SOLID STATE PHYSICS-DSE-PHY-606B

**UNIT- I-Crystal structure**

**UNIT- II-Lattice**

**2 Marks**

1. What is crystal?
2. Define space lattice.
3. Define the term basis and crystal structure.
4. Distinguish between space lattice and crystal structure.
5. What is Bravasis lattice?
6. What is unit cell?
7. What are Miller indices?
8. State Brag's law.
9. What is atomic and geometrical factor?
10. What are Brillion zones?

**5 Marks**

1. Explain seven systems of crystals.
2. Explain Bravasis lattice.
3. Explain solids and amorphous crystalline materials.
4. Explain lattice translational vectors.
5. Explain Miller-indices.
6. Explain types of lattice.
7. For a simple cubic lattice parameter $2.04A^0$, calculate the spacing of lattice plane (212).
8. If the interplanar spacing for (321) plane is 1.122 $A^0$ in case of a cubic lattice, calculate the

lattice constant

9. Crystal plane produces intercepts 4a, b,2c on X, Y and Z respectively.Find the miller indices.

**10 Marks**

1. Explain crystal structure.
2. Explain solids and amorphous crystalline materials.
3. Explain lattice translational vectors.
4. Explain lattice with on the basis of central and non-central elements.
5. Explain unit cell and Miller-indices.
6. Explain the types of lattices.
7. Explain reciprocal lattice, Brillion zones.
8. Explain in detail crystal classification.
9. Explain Bragg's law X-ray diffraction by powder method.
10. Explain Atomic and geometrical factor.

**UNIT- III-Lattice dynamic**

**UNIT- IV-Magnetic properties of materials**

**2 Marks**

1. Define paramagnetic materials.
2. Define diamagnetic materials.
3. Define ferromagnetic materials.
4. Write any two general features of ferromagnetic materials.
5. Mention the different types of magnetic materials.
6. Write the expression for susceptibility of paramagnetic materials.
7. Define lattice dynamics.
8. Draw dispersion relation of monoatomic chain.
9. State Dulong-Petit's law.
10. Write the applications of magnetic materials.

**5 Marks**

1. Explain paramagnetic materials.
2. Explain diamagnetic materials.
3. Explain ferromagnetic materials.
4. Mention the different types of magnetic materials.
5. Explain lattice dynamics.

6. Explain the dispersion relation of monoatomic chain.
7. Explain Dulong-Petit's law.

**10 Marks**

1. Derive the expression for susceptibility of paramagnetic materials.
2. Derive the expression for susceptibility of diamagnetic materials.
3. Derive the expression for susceptibility of materials with the quantum treatment.
4. Derive the dispersion relation of monoatomic chain.
5. Explain Debye relation for specific heat of solids.

**UNIT- V-Domain**

**UNIT- VI-Dielectrics properties of materials**

**2 Marks**

1. What is polarization?
2. Mention the types of polarization.
3. What is dielectric field?
4. Define normal and anomalous dispersion.
5. What are Plasmon's?

**5 Marks**

1. Explain the types of polarization.
2. Explain the complex dielectric loss and derive its expression.
3. Explain plasma oscillations.

**10 Marks**

1. Derive Clausius- Mossotti equation.
2. Derive Cauchy and Stellmeir relations.

**UNIT- VII-Elementary band theory**

**UNIT- VIII-Superconductivity**

**2 Marks**

1. What is the effective number of free electrons at absolute zero in case of

(i) Semiconductors (ii) insulators.

2. Explain the concept of hole.
3. Explain the terms: (i) intrinsic semiconductor and (ii) extrinsic semiconductor.

   or

   What do you mean by intrinsic and extrinsic semiconductors?
4. What are n-type and p-type semiconductors?
5. Draw the energy band diagram for intrinsic semiconductor.
6. Draw the energy band diagram for n-type semiconductor.
7. Draw the energy band diagram for p-type semiconductor.
8. Define the terms (i) Valence band (ii) Conduction band of semiconductor
9. What do you mean by forbidden energy band gap of semiconductor?
10. How the of mobility of charge carriers depends on temperature in a semiconductor?
11. What is Hall Effect?
12. Define the terms (i) Hall voltage and (ii) Hall coefficient.
13. Write any two applications of Hall Effect.
14. What is significance of Hall Effect?
15. Determine the conductivity of pure silicon at 300K. Given that the concentration of carriers is $1.6 \times 10^{10}$ per $cm^3$ for silicon. The mobility of electrons is 1500 $cm^2$/volt.sec, and that of holes is 500 $cm^2$/volt.sec.
16. Calculate the Hall coefficient of sodium if the number of free electrons per unit volume is $2.55 \times 10^{26}$.

**5 Marks**

1. Based on the energy band diagram distinguish between conductors, insulators and Semiconductors.
2. Derive an expression for electrical conductivity of semiconductor.
3. Outline band theory of solids.
4. Describe Hall Effect in semiconductors.
5. What is Hall Effect? Write the applications of Hall coefficient.
6. Find the concentration of holes and electrons in a p-type Germanium at 300 K, if the Conductivity is 100 per Ω cm. Also find these values for n-type silicon, if the conductivity is 0.1 per Ω cm.

   Given that for Ge, $n_i = 2.5 \times 10^{13}/cm^3$; $\mu_n = 3800\ cm^2 / V.s$; $\mu_p = 1800\ cm^2 / V.s$

   for Si, $n_i = 1.5 \times 10^{13}/cm^3$; $\mu_n = 1300\ cm^2 / V.s$; $\mu_p = 500\ cm^2 / V.s$
7. A semiconductor has the electron concentration $0.45 \times 10^{12}\ m^{-3}$ and hole concentration $5 \times 10^{20}\ m^{-3}$. Find its conductivity.
   Given: hole mobility = 0.048 $m^2$/V.s ; Electron mobility = 0.135 $m^2$/V.s
8. The resistance of a semiconductor is 4.5 Ω at 20° C and 2.0 Ω at 32° C. Calculate the energy gap. Boltzmann constant, $k = 1.37 \times 10^{-23}\ JK^{-1}$.
9. The energy gap in germanium is 0.75ev. Compare the intrinsic conductivities of germanium at 27° C and 57° C. Boltzmann constant $k = 8.6 \times 10^{-6}$ eV.
10. In an intrinsic GaAs, the electron and hole mobilities are 0.85 and 0.04$m^2$/V-s. respectively and

the corresponding effective masses are $0.068m_o$ and $0.5m_o$ respectively, where $m_o$ is rest mass of an electron. Given the energy band gap at 300K as 1.43eV, determine the intrinsic carrier Concentration and mobility.

11. For an intrinsic semiconductor with a gap width of 1eV. Calculate the position of Fermi level at T=0K and at T=300K, if $m^*_h=6m^*_e$, where $m^*_h$ and $m^*_e$ are effective masses of hole and Electron respectively.
12. Calculate the Hall voltage and Hall coefficient in a Ge crystal of thickness 0.6mm, when A magnetic field of 0.8T is applied. The current density is $350Am^{-2}$ and electron density is $3x10^{23}m^{-3}$.
13. A metal strip carrying a current of density 5 $Am^{-2}$ is applied with a magnetic field of 2T Normally. The Hall voltage developed is found to be 6.3V. If the thickness of the strip is $3.5x 10^{-3}$m, calculate electron density and Hall field ($e=1.6x10^{-19}c$).
14. Motilities of electrons and holes in a sample of intrinsic silicon at room temperature are 0.36 $m^2V^{-1}s^{-1}$ and 0.1736 $m^2V^{-1}s^{-1}$ respectively. Calculate electrical conductivity of silicon. (Given: Electron and hole densities are equal to $2.5x10^{16}$ $m^{-3}$.
15. Motilities of electrons and holes in a sample of intrinsic germanium at room temperature are 0.54 $m^2V^{-1}s^{-1}$ and 0.18 $m^2V^{-1}s^{-1}$ respectively. If electron and hole densities are equal to $3.6x10^{19}$ $m^{-3}$. Calculate germanium conductivity and resistivity.

**10 Marks**

**10 marks**

1. a) Describe the formation of energy bands in solids.
   b) Explain how it helps to classify the materials as conductors, insulators and Semiconductors.

   OR

   Explain the formation of energy bands in solids and discuss the classifications.
2. Derive an expression for electrical conductivity of semiconductor.
3. Explain the kronig penny model in detail*.

## Superconductivity

**Questions carrying 2 marks**

1. What is superconductivity?
2. Give two main characteristics of superconductors.
3. What is Meissner effect?
4. What are superconductors?
5. What is critical temperature? Write the relation between critical temperature and critical field.
6. What high Tc superconductors? Give one example.
7. Show that magnetic susceptibility of superconductor is -1.
8. What is the isotope effect in superconductor?
9. What are type-I & type-II superconductors?
10. Distinguish hard and soft superconductors.
11. Mercury isotopic mass is 199.5 at 4.185K. Calculate its critical temperature when its isotopic Mass changes to 203.4 amu.

12. Critical temperature of superconductor is 10 K at a pressure of 1mm of Hg. Calculate critical Temperature of the material at a pressure of 5 mm of Hg.

**5 marks**

1. What is superconductivity? Enlist the characteristics of superconductivity
2. Write a note on Meissner effect.
3. Write a note on type –I and type-II superconductors.

   or

   Explain type – I and type – II superconductors.
4. Distinguish between type – I and type – II superconductors. Write any two applications of Superconductors.
5. Write on high temperature superconductors.

   or

   Briefly account for high temperature superconductors.
6. Enlist applications of superconductors.

## Crystal structure

**Questions carrying 2 marks**

1. What is a crystal?
2. Define space lattice.
3. Define the terms basis and crystal structure.
4. Distinguish between space lattice and crystal structure.
5. What is bravais lattice?
6. What is meant by basis vectors and lattice translational vectors?
7. What are primitive & non-primitive cells?

   or

   Distinguish between primitive cell and non- primitive cell.
8. Define unit cell.

   Or

   What do you mean by a unit cell of the crystal?
9. Write down the number of molecules/atoms present in the unit cell of NaCl crystal.
10. What is the number of molecules/atoms present in the unit cell of simple cubic (SC) lattice?
11. What is the number of molecules/atoms present in the unit cell of BCC lattice?
12. What is the number of molecules/atoms present in the unit cell of FCC lattice?
13. Write down the number of molecules/atoms present in the unit cell of CsCl crystal.
14. What is the basic structure of NaCl lattice?
15. What is the basic structure of CsCl lattice?
16. What is meant by crystal symmetry?
17. Mention point symmetry operations.
18. Explain the meaning of n-fold rotation axis. What is the value of angle of rotation for 3-fold rotation axis?
19. Write down the coordination number of simple cubic (SC) lattice.
20. Deduce the coordination number of BCC lattice?
21. Deduce the coordination number of FCC lattice?
22. What is the value of atomic radius of simple cubic (SC) lattice?
23. What is the value of atomic radius of BCC lattice?
24. What is the value of atomic radius of FCC lattice?
25. Define lattice planes.
26. What are miller indices?

    or

What do you mean by Miller indices of a crystal plane?

27. What are Miller indices? What do they signify?
28. Explain the method to determine the miller indices of a crystal plane
29. Deduce the Miller indices of a plane which intercepts at $a$, $b/2$, $3c$ in a simple cubic unit cell.
30. The Miller indices of a plane in a simple cubic crystal are [123]. Find the coordinates of the plane.
31. A crystal plane produces intercepts $4a$, $b$, $2c$ on X, Y and Z axes respectively. Find the Miller indices.
32. Write down the Miller indices for planes in the given set of intercepts ($a$, $b/2$, $c$).
33. Find the miller indices of the crystal plane having intercepts of 1, 2 and 3 on the x, y and z axis respectively.
34. Find the miller indices if the plane in a crystal has intercepts in the ratio of' $4a$, $5b$ and 0 on the X, Y and Z axis respectively.
35. For a simple cubic lattice of lattice parameter 2.04Å, calculate the spacing of lattice plane (212).
36. If the interplanar spacing for (321) plane is 1.122Å in the case of a cubic lattice. Calculate the lattice constant.

## Crystal X-ray diffraction

**Questions carrying 2 marks**

1. Explain origin of characteristic X-ray spectrum.
2. Write any two properties of continuous X- ray spectrum.
3. State Bragg's law of diffraction.
4. Write Bragg's equation for X- ray diffraction. Explain the terms.
5. Why for $\lambda > 2d$, Bragg's equation has no solution?
6. Mention X-ray diffraction methods.
7. Calculate the longest wavelength that can be analyzed by a rock-salt crystal of spacing
8. d=2.8Å in the first order.
9. The spacing between the principle planes of NaCl crystal is 2Å, The first order Bragg's
10. Reflection occurs at an angle of 10°. What is the wavelength of X-ray?

## Free Electron Theory of Metals

**Questions carrying 2 marks**

1. Mention two basic assumptions made by Drude and Lorentz in case of free electron theory of metals.
2. What do you mean by free electron gas?
3. Define drift velocity and is mobility of electron.
4. Write down the expression for thermal conductivity of metal. Explain the terms.
5. Write down the expression for electrical conductivity of metal. Explain the terms.
6. State Wiedemann-Franz law in case of metals.
7. Mention any two failures of classical free electron theory.

8. What are the assumptions made by Sommerfeld to explain the free electrons of metal?
9. What s Fermi level?
10. What is Fermi energy?
11. What do you mean by Fermi energy and Fermi level?
12. Mention any two advantages of Sommerfeld model of free electrons of metals.
13. Mention any two limitations of Sommerfeld model of free electrons of metals.
14. For copper at 20°c, electrical conductivity is $5.81 \times 10^7$SIU and thermal conductivity is 386 SIU. Calculate Lorentz number.
15. Calculate the Quantum mechanical value of Lorentz number. Given: $k_B=1.38 \times 10^{-23}$ J/K, $e=1.6 \times 10^{-19}$C.
16. Fermi energy for gold is 5.54eV. Calculate its Fermi temperature.

## Semiconductors

**Questions carrying 2 marks**

17. Mention one difference between Sommerfeld model and Kronig-Penney model for free electron in solids.
18. What is the effective number of free electrons at absolute zero in case of (i) semiconductors and (ii) insulators.
19. Explain the concept of hole.
20. Explain the terms: (i) intrinsic semiconductor and (ii) extrinsic semiconductor.

    or

    What do you mean by intrinsic and extrinsic semiconductors?
21. What are n-type and p-type semiconductors?
22. Draw the energy band diagram for intrinsic semiconductor.
23. Draw the energy band diagram for n-type semiconductor.
24. Draw the energy band diagram for p-type semiconductor.
25. Define the terms (i) Valence band (ii) Conduction band of semiconductor
26. What do you mean by forbidden energy band gap of semiconductor?
27. How the of mobility of charge carriers depends on temperature in a semiconductor?
28. What is Hall effect?
29. Define the terms (i) Hall voltage and (ii) Hall coefficient.
30. Write any two applications of Hall effect.
31. What is significance of Hall effect?
32. Determine the conductivity of pure silicon at 300K. Given that the concentration of carriers is $1.6 \times 10^{10}$ per $cm^3$ for silicon. The mobility of electrons is 1500 $cm^2$/volt.sec, and that of holes is 500 $cm^2$/volt.sec.
33. Calculate the Hall coefficient of sodium if the number of free electrons per unit volume is $2.55 \times 10^{26}$.

## Magnetic Materials

**Question carrying 2 marks**

1. What are diamagnetics? Name few diamagnetic substances.
2. What are Paramagnetics? Name few Paramagnetic substances.
3. What are Ferromagnetics? Name few ferromagnetic substances.
4. Why do magnetic lines of force prefer to pass through ferromagnetic substances than through air?
5. What do you infer from the large value of the susceptibility of the material?
6. What happen, if an iron bar magnet is melted? Does it retain its magnetism? Justify.
7. Why does a Paramagnetic sample display greater magnetization when cooled?
8. Why do we use steel or alnico for making Permanent Magnets?
9. Mention two important applications of magnetic materials.
10. Define magnetic induction.
11. Define intensity of magnetization.
12. Define magnetic permeability.
13. Define magnetic susceptibility.
14. Show that $\mu_r = (1+\chi)$, where $\mu_r$ =relative permeability and $\chi$ is magnetic susceptibility.
15. What is magnetostriction?
16. Define coercivity and retentivity.
17. Find the relative permeability of a ferromagnetic material if field of strength $200 Am^{-1}$ produces a magnetization of $3300 Am^{-1}$ in it.
18. The magnetic susceptibility of silicon is $-0.5x10^{-5}$. What is the intensity of magnetization in a magnetic field of intensity $9.9x1^{-4}$ $Am^{-1}$?
19. An iron bar is subjected to a magnetizing field 1200 $Am^{-1}$. If susceptibility of iron is 599. Calculate (i) $\mu$ and (ii) B.

## Superconductivity

**Questions carrying 2 marks**

13. What is superconductivity?
14. Give two main characteristics of superconductors.
15. What is Meissner effect?
16. What are superconductors?
17. What is the difference between a conductor cooled to $0^\circ$ K and a superconductor?
18. Superconductor cooled below transition temperature in an external magnetic field become perfect diamagnet. Justify.
19. What is critical field and what is its value at the critical temperature?
20. What is critical temperature? Write the relation between critical temperature and critical field.
21. What is vortex state of a superconductor?
22. What high Tc superconductors? Give one example.
23. What is maglev vehicle? Mention its principle.
24. Show that magnetic susceptibility of superconductor is -1.
25. What is the isotope effect in superconductor?

26. What is the pressure effect in superconductor?
27. What is the effect of temperature on entropy of superconductor?
28. What are type-I & type-II superconductors?
29. Distinguish hard and soft superconductors.
30. What are SQUIDS?
31. What is perovskite structure with respect to the high Tc superconductors?
32. What are the hurdles to produce superconductors at room temperature?
33. Mercury isotopic mass is 199.5 at 4.185K. Calculate its critical temperature when its isotopic mass changes to 203.4 amu.
34. Critical temperature of superconductor is 10 K at a pressure of 1mm of Hg. Calculate critical temperature of the material at a pressure of 5 mm of Hg.

**5 mark questions:**

## Crystal structure

1. Describe briefly the seven systems of crystals.
2. What do you mean by Bravais lattices? Describe briefly the seven systems of crystals.
3. Name the seven crystal systems. Mention the number of Bravais lattices in cubic system.
4. Write a note on Bravais lattice.
5. What is a Bravais lattice? What are the different space lattices in the cubic system? How many lattice points per unit cell are there in each of these lattices?
6. Write a note on Bravais lattice.
7. Define crystal systems and give their characters.
8. What are Miller indices of a plane in crystal? How are they determined?
9. What are lattice planes of crystal? How they are represented in terms of Miller indices?
10. What are miller indices? Obtain an expression for the interplanar spacing in terms of miller indices.
11. Describe the crystal structure of NaCl. Explain clearly how this structure differs from that of CsCl. Give the coordinates of the atoms within *fcc* lattice.
12. The density of NaCl is 2.16 x $10^3$ kg/$m^3$. Find the lattice constant, if the NaCl has *fcc* lattice. (Given: Avogadro's No. 6.023 x $10^{26}$ /kg mol, molecular weight of NaCl = 58.5)
13. NaCl crystal has *fcc* structure. The density of NaCl is 2.18 x $10^3$ kg $m^{-3}$ calculate the distance between two adjacent atoms (atomic weight of Na = 23 and that of Cl = 35.5)
14. Calculate the density of copper if its atomic weight is 63.54 and lattice constant is 3.61 Å, it has *fcc* structure.
15. In a tetragonal lattice a=b=2.8Å, c=1.8Å. Calculate the lattice spacing between the planes (222).
16. A substance with face centered cubic lattice has density 6.25 kg $m^{-3}$& molecular weight 60.2. Calculate the lattice constant, Avogadro's number =6.02 x $10^{26}$/kg mol
17. Show that for a simple cubic lattice $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$
18. Calculate the lattice constant of NaCl crystal from the following data.
    Molecular weight of NaCl M=58.5

Avogadro number $N = 6.02 \times 10^{26}$

Density of NaCl $\rho = 2180 kgm^{-3}$

19. Deduce the Miller indices of a plane which cuts off intercepts in the ratio 1a:3b:-2c along the three axes, where a, b and c are primitives.
20. In a crystal primitives are 1.2Å, 1.8Å and 2.0Å, a plane (231) cuts an intercept 1.2Å on the X-axis. Find the corresponding intercepts on Y-axis and Z-axis.
21. Lead is a face centered cube with an atomic radius of 1.746x10-10m. Calculate the spacing between planes(i)200plane(ii) 220plane.

## Crystal X-ray diffraction

1. Explain salient features of X-ray spectra.

   Or

   Give an account of X-Ray Spectra
2. Why X-rays get diffracted by crystals? Derive expression for Bragg's law of X-ray diffraction.
3. State and explain Bragg's law of X-Ray diffraction. Derive expression for it. Why we can not use visible light for diffraction in crystals?
4. Describe Bragg's x-ray spectrometer.
5. A beam of X-rays of $\lambda = 0.842$Å is incident on a crystal at a grazing angle of 8°35' when the first - order Bragg's reflection occurs. Calculate the facing angle for 3rd order reflection.
6. Monochromatic x-rays of $\lambda = 1.5$Å are incident on a crystal face having all interplanar spacing of 1.6Å. Find the various orders in which Bragg's reflections take place.
7. Find the various possible orders of reflection from a crystal whose lattice constant is 1.4Å.
8. The wavelength of X - rays is 1.28Å.
9. What wavelength in a beam containing the range 0.2Å and 1Å will be reflected when incident at 9° upon the cube face of a crystal of a rocksalt crystal? Given d=2.814Å.
10. Monochromatic X-rays incident on a crystal of interplanar spacing 0.28nm produces Bragg's reflection of certain order at glancing angle of 18°. When the same X-rays are incident on another crystal of interplanar spacing 0.34nm, the reflection occurs at 30°. calculate the wavelength of X-rays.
11. An X-ray tube operates at 30kV emits a continuous X-ray spectrum with a short wavelength limit $\lambda = 0.414 \times 10^{-10}$m. Find the Planck's constant. (Given e= $e = 1.6 \times 10^{-19}$c and $C = 3 \times 10^{8}$ m/s).

## Free Electron Theory of Metals

1. Discuss Drude and Lorentz (classical) free electron theory of metals.
2. Discuss the failures of classical free electron theory.
3. State Wiedemann-Franz Law and arrive at the equation for classical Lorentz number. Compare the classical, Quantum mechanical and experimental value of Lorentz number.
4. Using the free electron model derive the expression for the electron conductivity in metals.
5. Using the free electron model derive the expression for the thermal conductivity in metals.
6. Explain the Sommerfeld's Quantum mechanical free electron theory of metals.
7. Explain the merits and limitations of Sommerfeld model of free electrons of metals.
8. Calculate the electrical conductivity of copper assuming that each atom contribute one free

electron.

Given: atomic weight of Cu=63.54
density of copper =$8.93 \times 10^3 kgm^{-3}$
mass of electron =$9.1 \times 10^{-31} kg$
relaxation time of electrons=$2.48 \times 10^{-14} s$

9. Calculate the Fermi energy of copper assuming that each atom contributes one free electron.
   Given: Atomic weight of copper = 63.54
   Density of copper = $8.93 \times 10^3$ $kgm^{-3}$
   Avogadro's number = $6.02 \times 10^{26}$ per kmol
   Mass of electron = $9.1 \times 10^{-31} kg$.
   Planck's constant = $6.63 \times 10^{-34}$ Js
10. Calculate the Fermi energy of sodium assuming that the metal has one free electron per atom.
   Given: h = $6.63 \times 10^{-34}$ Js
   Mass of electron = $9.1 \times 10^{-31}$ kg.
   Density of Sodium = 9.73 $kg/m^3$
   Atomic Weight of Sodium = 22.99 amu.
   Avogadro's number = $6.02 \times 10^{26}$ per kmol
11. The density of zinc of valency 2 is 7130 $kgm^{-3}$ and its atomic weight is 65.4. Calculate its Fermi energy. The effective mass of a free electron in zinc crystal is $7.7 \times 10^{-31}$ kg. Avogadro's number = $6.02 \times 10^{26}$ per kmol

**Semiconductors**

16. Based on the energy band diagram distinguish between conductors, insulators and semiconductors.
17. Derive the expression for electron concentration for an intrinsic semiconductor.
18. Give the theory of experimental determination of energy gap of semiconductor.
19. Derive an expression for Hall coefficient.
20. Derive an expression for electrical conductivity of an intrinsic semiconductor.
21. Outline band theory of solids.
22. Describe Hall effect in semiconductors.
23. What is Hall effect? Write the applications of Hall coefficient.
24. Find the concentration of holes and electrons in a p-type Germanium at 300 K, if the conductivity is 100 per Ω cm. Also find these values for n-type silicon, if the conductivity is 0.1 per Ω cm.
   Given that for Ge, $n_i = 2.5 \times 10^{13}/cm^3$; $\mu_n = 3800\ cm^2/V.s$; $\mu_p = 1800\ cm^2/V.s$
   for Si, $n_i = 1.5 \times 10^{13}/cm^3$; $\mu_n = 1300\ cm^2/V.s$; $\mu_p = 500\ cm^2/V.s$
25. A semiconductor has the electron concentration $0.45 \times 10^{12}\ m^{-3}$ and hole concentration $5 \times 10^{20}\ m^{-3}$. Find its conductivity.
   Given: hole mobility = 0.048 $m^2/V.s$ ; Electron mobility = 0.135 $m^2/V.s$
26. The resistance of a semiconductor is 4.5 Ω at 20° C and 2.0 Ω at 32° C. Calculate the energy gap. Boltzmann constant, $k = 1.37 \times 10^{-23}\ JK^{-1}$.
27. The energy gap in germanium is 0.75ev. Compare the intrinsic conductivities of germanium at

$27^o$ C and $57^o$ C. Boltzmann constant k = 8.6 X $10^{-6}$ eV.

28. In an intrinsic GaAs, the electron and hole mobilities are 0.85 and 0.04$m^2$/V-s. respectively and the corresponding effective masses are 0.068$m_o$ and 0.5$m_o$ respectively, where $m_o$ is rest mass of an electron. Given the energy band gap at 300K as 1.43eV, determine the intrinsic carrier concentration and mobility.
29. For an intrinsic semiconductor with a gap width of 1eV. Calculate the position of Fermi level at T=0K and at T=300K, if $m^*_h=6m^*_e$, where $m^*_h$ and $m^*_e$ are effective masses of hole and electron respectively.
30. Calculate the Hall voltage and Hall coefficient in a Ge crystal of thickness 0.6mm, when A magnetic field of 0.8T is applied. The current density is 350$Am^{-2}$ and electron density is $3x10^{23}m^{-3}$.
31. A metal strip carrying a current of density 5 $Am^{-2}$ is applied with a magnetic field of 2T normally. The Hall voltage developed is found to be 6.3V. If the thickness of the strip is 3.5x $10^{-3}$m, calculate electron density and Hall field (e=$1.6x10^{-19}$c).
32. Mobilities of electrons and holes in a sample of intrinsic silicon at room temperature are 0.36 $m^2V^{-1}s^{-1}$ and 0.1736 $m^2V^{-1}s^{-1}$ respectively. Calculate electrical conductivity of silicon. (Given: electron and hole densities are equal to $2.5x10^{16}$ $m^{-3}$.
33. Mobilities of electrons and holes in a sample of intrinsic germanium at room temperature are 0.54 $m^2V^{-1}s^{-1}$ and 0.18 $m^2V^{-1}s^{-1}$ respectively. If electron and hole densities are equal to $3.6x10^{19}$ $m^{-3}$. Calculate germanium conductivity and resistivity.

## Magnetic Materials

**Q. No II Questions carrying 5 marks**

1. Distinguish between diamagnetic and paramagnetic materials.
2. What are paramagnetic, diamagnetic and ferromagnetic materials? Explain.
3. State Properties of Paramagnetic substances.
4. State Properties of diamagnetic substances.
5. State Properties of ferromagnetic substances.
6. How are materials classified according to their behavior in magnetic field? Why does the magnetization of a paramagnetic substance increase on cooling?
7. Write a note on applications of magnetic materials.
8. A magnetic field of 1800 $Am^{-1}$ produces a magnetic flux of $3x10^{-5}$ Wb in an iron bar of cross sectional area 0.2 $cm^2$. Calculate permeability.
9. The magnetic flux density and intensity of magnetizing field in sample of magnetic material are 1T and $3x10^3Am^{-1}$ respectively. Find permeability and susceptibility of the medium.
10. Describe Gouy's method to determine susceptibility of paramagnetic substance.

## Superconductivity

**Questions carrying 5 marks**

7. Explain the concept of superconductivity on the basis of free election model for metals.
8. Enlist the properties of superconductors.
9. Discuss the effect of critical magnetic field on critical transition temperature using magnetic phase diagram.
10. Write a note on Meissner effect.
11. Explain Meissner effect. How it contradicts classical Maxwell theory?
12. Explain Meissner effect. How it leads to the superconductor as perfect diamagnetic?
13. Describe an experiment to demonstrate Meissner effect.
14. Write a note on type –I and type-II superconductors.

    or

    Explain type – I and type – II superconductors.
15. Distinguish between type – I and type – II superconductors. Write any two applications of superconductors.
16. Write on high temperature superconductors.

    or

    Briefly account for high temperature superconductors.
17. Enlist applications of superconductors.
18. The critical temperature of a superconductor as zero magnetic field is Tc. Determine the temperature at which the critical field becomes half of its value at 0K.
19. The critical fields at 6K and 8K for NbTi alloy are $7.616 \times 10^6$ and $4.284 \times 10^6$ $Am^{-1}$ respectively. Determine the transition temperature and critical field at 0K.
20. At 6K critical field is $5 \times 10^3$ $Am^{-1}$. Calculate the transition temperature, where magnetic field is $2 \times 10^4$ $Am^{-1}$ at 0K.
21. A superconductor with $T_c = 3.5K$ has a critical magnetic field of $3.2 \times 10^3$ $Am^{-1}$. What would be the value of critical field at 2.5K?

**10 mark questions:**

## Crystal structure

1. Describe the seven crystal systems and 14 bravais lattices with suitable diagrams.
2. What are Miller indices? Describe the procedure to determine them. Derive an expression for the spacing between planes having similar Miller indices.

## Crystal X-ray diffraction

1. Describe Bragg's x-ray spectrometer and explain how it is used to determine the structure of the crystal.

## Free Electron Theory of Metals

1. a) Discuss classical free electron model.

b) Obtain an expression for electrical conductivity of metals.

3. a) Derive an expression for electrical conductivity in case of free electrons of metals.
   b) Deduce Wiedemann-Franz Law and compare classical value and experimental value of Lorentz number.
4. Discuss Sommerfeld's quantum mechanical free electron theory of metals.

## Semiconductors

4. a) Describe the formation of energy bands in solids.
   b) Explain how it helps to classify the materials as conductors, insulators and semiconductors.

   OR

   Explain the formation of energy bands in solids and discuss the classifications.
5. Derive an expression for electrical conductivity of an intrinsic semiconductor.

## Magnetic Materials

**Questions carrying 10 marks**

1. Discuss the classification of magnetic materials and distinguish between paramagnetic and diamagnetic materials.
2. How do you account for origin of magnetic moment in a magnetic material? Explain the classification of materials based on their behavior in a magnetic field.
3. Discuss Langevin's classical theory of Paramagnetism.

Note: combining 5 marks questions, 10 marks questions may be framed.

## Superconductivity

**Questions carrying 10 marks**

1. Explain Meissner effect. How it contradicts classical Maxwell theory? Describe the experiment to demonstrate Meissner effect.
2. Explain the concept of superconductivity on free electron model. Discuss the effect of critical field on critical temperature using magnetic phase diagram.
3. Write a note on a) High-Tc superconductors (b) Applications of superconductors.

## Nuclear Physics

## 2 mark Questions

### Radioactive radiations and Scattering αof Particles

1. What is the nature of α- & β-particles?
2. With which elements/particles the α rays, β rays and γ rays are identified?
3. Mention common properties of radiations.
4. Define impact parameter & closest distance of approach
5. State postulates of Rutherford's theory of α -ray scattering
6. Mention the factors affecting the probable number of α particles to be scattered?
7. Mention the changes in mass number and atomic number with emission of γ radiation. What will happen to atomic radius?

### Nuclear Models

8. Write an expression of semi empirical formula for the BE.
9. What are magic numbers?
10. Mention two examples of doubly magic elements.
11. Who proposed the liquid drop model of a nucleus?
12. Mention the merits of liquid drop model.
13. Mention the demerits of liquid drop model.

### Nuclear Forces

14. What is the nature of nuclear force?
15. Are the nuclear forces (i) charge independent (ii) exist beyond the radius of the nucleus?
16. What is the mass and charge of pion?
17. Who proposed the meson theory of nuclear forces?

### Nuclear Reactions

18. What is the nuclear reaction? Give an example.
19. Mention types of nuclear reactions.
20. What are endoergic & exoergic reactions?
21. What is Q-value of nuclear reaction?
22. What do you mean by nuclear transmutation?
23. What are pickup reactions? Give an example.
24. Mention knockout reaction with an example.
25. What are thermonuclear reactions?
26. Complete the following reaction
    (i) $_4Be^9 + ? = _6C^{12} + _1n^0$
    (ii) $n + \pi^+ \rightarrow ?$
27. What is the particle 'X' in the following nuclear reactions?
    (i) $_4Be^9 + _2He^4 \rightarrow _6C^{12} + X$
    (ii) $_1H^2 + \gamma \rightarrow _1H^2 + X.$

### Nuclear Fission and Fusion

28. Mention types of nuclear fission.

29. Explain P-P cycle.
30. What is Nuclear Fission?
31. What is Nuclear Fusion?
32. Define critical parameter. Mention its value for nuclear stability against spontaneous emission.
33. Calculate loss of mass into energy in the following reaction $_1H^2+_1H^2=_2He^4$

Given: mass of $_1H^2$=2.01402amu

Mass of $_2He^4$=4.002603amu

**Nuclear Instruments**

**Q. No I Questions carrying 2 marks**

1. What is mass spectrograph?
2. Why the beam of positive ion deflected by electrified are allowed to pass through the magnetic field in Aston's mass spectrograph?
3. What are the advantages of Aston's mass spectrograph?
4. Enlist the limitations of Aston's mass spectrograph.
5. What is the function of velocity selector in Bainbridge's mass spectrograph?
6. What is dead time and recovery time with respect to GM counter?
7. Define efficiency of GM counter.
8. What is quenching? Why it is necessary?
9. What is plateau region?
10. Enlist advantages of GM counter.
11. Mention disadvantages of GM counter.
12. Why GM counter cannot detect neutrons?
13. What is the principle of scintillation counter?
14. What is spinthariscope?
15. What is dynode? What is its function?
16. What is the function of photomultiplier tube?
17. What is nuclear emulsion?
18. Compare nuclear emulsion and optical emulsion.
19. Mention the applications of nuclear emulsion.
20. Enlist advantages of nuclear emulsion.
21. State the betatron condition.
22. Mention the condition of resonance in a cyclotron.

## 5 mark Questions

**Radioactive radiations and Scattering α of Particles**

1. Mention the properties of α-, β- & γ radiations
2. Deduce an expression of impact parameters
3. Obtain Rutherford's scattering formula.
4. Define impact parameter, angle of scattering and closest distance of approach for α-ray scattering. Mention the expression for impact parameter.
5. Find the impact parameter and cross section for an α particle of energy 7.68Mev, scattered by a

thin gold foil (Z=79) of thickness $6x10^{-12}$ m for scattering angle of 90°. Also calculate the ratio of number of α particles scattered at an angle of 90° to the total number of incident α particles.

Given A=197, $\rho=19.3x10^3 kgm^{-3}$, Avagadro's number=$6.02x10^{26}$

6. An α particle of energy 5Mev is scattered through 180° by a fixed $_{92}U$ nucleus.
7. The number of α particles scattered at an angle of 10° is 106. What will be the number of scattered α particles at an angle of 90°and 180°?

**Nuclear Models**

8. Explain liquid drop model.

Or

Discuss the assumptions of liquid drop model.

9. Deduce semi empirical mass formula.
10. Write a note on semi empirical mass formula.
11. Explain shell model.

Or

Write a note on shell model of nucleus.

12. Compare shell model & liquid drop model.
13. Explain nuclear fission on the basis of the liquid drop model.
14. What are magic number nuclei? How does the shell model explains the existence of magic numbers 2, 8 and 20.

**Nuclear Forces**

15. Explain Meson theory of nuclear forces.
16. What are nuclear forces? Write a note on the meson theory of nuclear forces.

**Nuclear Reactions**

17. Mention types of Nuclear reactions with examples.
18. Deduce the condition for endoergic reaction to take place.
19. Derive the relation between Q-value and threshold energy of endoergic reaction.
20. Explain nuclear transmutation with examples.
21. State conservation laws governing nuclear reactions with examples.
22. Find Q-value of the reaction $_3LI^7(P\ \alpha)_2He^4$, if mass of Li, P and α are 7.01822, 1.00814 and 4.00387amu.
23. Compute Q-value and threshold energy of the nuclear reaction $_7N^{14}$ (n, d) $_6C^{13}$.

Given: Mass of $_7N^{14}$ =14.003074amu
Mass of neutron=1.008665amu
Mass of deuterium= 2.014102amu
Mass of $_6C^{13}$=13.003354

24. Calculate the Q-value and threshold energy of α particle in nuclear reaction $_7N^{14}$ (α, P) $_8O^{17}$.

Given: $M_a$=4.00387, $M_X$=14.00753, $M_b$=1.00814 and $M_y$=17.00450amu.

25. Compute mass of oxygen and minimum kinetic energy of α particle for the endoergic reaction

$_7N^{14}$ (α, P) $_8O^{17}$ Given: $M_a$=4.00387, $M_X$=14.00753, $M_b$=1.00814 and Q= -1.154

26. Calculate minimum energy of γ required to disintegrate a deuteron into a proton and neutron. Given: $M_p$=1.00759, $M_n$=1.00898, $M_d$=2.01471amu
27. Find the mass of carbon in a nuclear reaction $_7N^{14} + _0n^1 \rightarrow _6C^{14} + _1H^1$+0.55Mev.
28. Determine the product nuclei and Q-value of the reaction $_{13}Al^{27}$ (d,α ), if mass of $_{13}Al^{27}$ , $_{13}Al^{27}$ , α and d are 26.9901, 24.9936, .0039 and 2.0147

**Nuclear Fission and Fusion**

29. Explain Bohr wheeler theory of nuclear fission.
30. Explain C-N cycle.
31. Write a note on Hydrogen bomb.
32. Calculate the energy released by the fission of 1kg of u-235,if energy released per fission is 200Mev and Avogadro's number=$6.02x10^{26}$
33. A reactor is developing energy at the rate of 32 $x10^{26}$ watts. How many atoms of u-235 undergo
34. fission per second? Assume energy released per fission is 200Mev. Also find the mass of uranium.
35. Find the energy released during the fusion of two deuterons into helium and a neutron, if mass of deuteron, helium and neutron are 2.014102, 3.016049 and 1.008656amu.

**Nuclear Instruments**

**Q. No II Questions carrying 5 marks**

1. Describe the construction and working of Aston's mass spectrograph.
2. Describe the principle, construction and working of Bainbridge mass spectrograph.
3. Describe construction and working of GM counter.
4. Describe the construction and working of scintillation counter.
5. Write a note on nuclear emulsion.
6. With a neat diagram explain the construction and working of cyclotron.
7. Obtain expression for length of $n^{th}$ cylinder in a linear accelerator.
8. Describe the principle, construction and working of Cyclotron.
9. In a betatron, magnetic flux density within the stable orbit changes at the rate of $16WbS^{-1}$. Calculate the energy of electron which undergoes $2x10^6$ revolutions per second.
10. In a linear accelerator, proton accelerated thrice by a potential of 40kV, leaves a tube and enters an accelerating space of length 30 cm before entering the next tube. Calculate the frequency of r.f.voltage and length of the tube entered by the proton.
11. Deuterons in a cyclotron describe a circle of radius 0.28 m just before emerging out the Dee's. The frequency of applied emf is 20 MHz. Find the flux density of the magnetic field and velocity of Deuterons emerging out of cyclotron. Mass of the Deuteron is $3.32x10^{-27}$ kg and charge is $1.6x10^{-19}$c.

**10 mark Questions**

**Radioactive radiations and Scattering αof Particles**

1. What are the assumptions of Rutherford model? Deduce the relation between impact parameter and smallest distance of approach.
2. Deduce an expression for the impact parameter and hence obtain Rutherford's scattering formula.

**Nuclear Models**

3. List the comparative properties of liquid drop and nucleus. Deduce the semi-empirical mass formula.
4. Deduce semi-empirical mass formula of binding energy and explain specific binding energy curve.
5. Explain liquid drop model and obtain semi-empirical mass formula.

**Nuclear Reactions**

6. Mention types of Nuclear reactions with examples.
7. What is Q-value of nuclear reaction? Deduce expression of Q- Value of nuclear reaction.

**Nuclear Instruments**

**Q. No III Questions carrying 10 marks**

1. Describe the construction and working theory of Aston's mass spectrograph. Develop the theory to determine the mass of the particles.
2. Describe the construction and working theory of Aston's mass spectrograph. How it is used in detection of isotopes? What are its advantages?
3. Describe the principle, construction and working of Bainbridge mass spectrograph. How the nuclear mass is determined using this?
4. Discuss in detail the construction and working of a GM counter. What do you mean by quenching of GM counter? What is its necessary?
5. Describe with neat diagram the construction and working of a GM counter. Explain paralyzing time of GM counter.

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AFFILIATED TO KARNATAK UNIVERSITY DHARWAD
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# DEPARTMENT OF PHYSICS

BSc VI Semester-CBCS- Question Bank SEC – 2021-22

## Nano Material for Energy Applications

**Two marks questions**

1. What is top-down and bottom-up approaches for nanoparticle?
2. What are the two approaches of synthesizing nano materials?
3. Which process is the top-down approach to synthesize metal nanoparticles?
4. What is the difference between top-down and bottom-up approach in nanotechnology?
5. How nanomaterial's are synthesized?
6. What is the advantage of top-down approach?
7. What are the key advantages of bottom-up approaches compared to top-down approaches Nano scale fabrication?
8. What factors affect the synthesis of nanoparticles?

   Several factors such as the method used for synthesis, pH, temperature, pressure, time, particle size, pore size, environment, and proximity greatly influence the quality and quantity of the synthesized nanoparticles and their characterization and applications.
9. What is nanotechnology used for?

   Nanotechnology is helping to considerably improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among many others.
10. What is XRD technique?

    X-ray diffraction analysis (XRD) is a technique used in materials science to determine the crystallographic structure of a material. XRD works by irradiating a material with incident X-rays and then measuring the intensities and scattering angles of the X-rays that leave the material.
11. What are the diffraction techniques?

    The diffraction method utilizes the interference of the radiation scattered by atoms in an ordered structure and is therefore limited to studies of materials with long-range order. The incoming X-ray beam can be characterized as a plane wave of radiation interacting with the electrons of the material under study.
12. Why the angle is 2 theta in XRD?

The angle formed between the x-ray source and the detector is 2θ. This configuration is most convenient for loose powders. Thus the 2 θ is the angle between transmitted beam and reflected beam.

13. What is the purpose of X-ray diffraction?

    X-ray diffraction, or XRD, is a technique for analyzing the atomic or molecular structure of materials. It is non-destructive, and works most effectively with materials that are wholly, or part, crystalline.

14. What does XRD intensity depend on?

    The directions of possible diffractions depend on the size and shape of the unit cell of the material. The intensities of the diffracted waves depend on the kind and arrangement of atoms in the crystal structure.

15. Mention the Bragg's equation and explain the terms.
16. Write the Sherr's formula to calculate crystallite size and explain the terms.
17. What is XPS?
18. Mention any two applications of XPS.
19. Mention any two advantages of XPS
20. Mention any two disadvantages of XPS
21. Mention any two advantages of SEM
22. What is Raman Spectroscopy?
23. What is IR Spectroscopy?

**Five marks questions**

1. Explain working and principle of X-Ray powder diffraction or XRD or X-Ray diffraction technique.
2. Explain working and principle of X-Ray Photoelectron spectroscopy or XPS.
3. Mention any five applications of XPS
4. Explain working and principle of SEM
5. Explain working and principle of TEM
6. Write neat labeled diagram of SEM.
7. Write neat labeled diagram of TEM.
8. Explain RAMAN Spectroscopy
9. What is spectroscopy? Explain UV-VIS, IR and Raman Spectroscopy?

**Ten marks questions**

1. Explain working and principle of X-Ray Photoelectron spectroscopy or XPS. Mention any five applications of XPS.
2. What is SEM? How does it work? Explain the construction of SEM with neat labeled diagram.
3. What is TEM? How does it work? Explain the construction of TEM with neat labeled diagram.