DEPARTMENT OF PHYSICS
QUESTION BANK
+3 3rd year Science
Semester-V

Quantum mechanics and Applications (Core 11)

Short Answer Questions

1. Why should the wave function f(x) be a single valued every where?
2. Explain the meaning of well behaved wave function.
3. What is a wave function associated with a free particle?
4. What is a free particle?
5. Explain Born's interpretation of wave function.
6. What are the conditions that a wave function must obey?
7. What do you mean by normalization of a wave function.
8. Write down time dependent Schrodinger wave function.
9. What are the properties of the wave function.
10. What do you mean by expectation value of an observable.
11. What is probability current density.
12. What do you mean by linearity.
13. State superposition principle.
14. Show that probability density is always.
15. What is the wave function for a free particle.
16. Write down the relation between linear momentum and propagation constant.
17. Discuss limitation of free particle wave function.
18. What is the de-Broglie's wave length of an electron travelling with a speed of 3×10^6 m/sec.
19. What is the relation between linear momentum and propagation constant.
20. Define wave packet.
21. Why material particle can not be represented by a single wave?
22. What is an operator.
23. What is eigen value and eigen function of an operator.

24. What are the conditions for a linear operator.

25. What is momentum operator.

26. What is energy operator.

27. What is Hamiltonian operator.

28. Define commutator.

29. What do you mean by Hermitian operator.

30. Write down the properties of Hermitian operator.

31. Show that the momentum operator is hermitian.

32. What do you mean by adjoint of an operator.

33. Explain eigen value spectrum.

34. Explain simultaneous eigen functions.

35. What do you mean by degeneracy.

36. Is sinx a linear operator?

37. Prove that the operator $\frac{d}{d\,x}$ is non-Hermitia...

38. What are conjugate variables?

39. Find an expression for x-component of angular momentum operator in spherical polar co-ordinate.

40. Energy, time commutator is non-zero. Can they be determined simultaneously.

41. What is the significance of commutator in uncertainty principle?

42. Calculate the ground state energy of an electron in a one dimensional box of length $1A^o$.

43. A particle is in the ground state of an infinite square well of size 'a' what is the probability of finding the particle in a distance Δx=0.01a at

   (a) X=a/2   (b) x=a/4

44. In what factors allowed values of energy of a particle in rectangular well depends?

45. Show that sum of reflection and transmission co-efficient for a potential barrier is 1.

46. What is the condition for perfect transmission through a rectangular potential barrier.

47. How many minima and maxima are there in the 2nd excited state wave function of the particle in infinite well.
48. What is stationary state.
49. What is ground state energy or zero energy.
50. What is reflection co-efficent.
51. What is transmission co-efficient.
52. The probability of occupation of a stationary state is _____.
53. The minimum energy of a particle in a box is not zero but if finite is called _____.
54. Write the energy eigen values of a particle in a box.
55. Show that the wave function of two lowest states of a particle in an infinite well are orthogonal.
56. What does quantum no. for a particle 'n' in a box determines.
57. Define Gyromagnetic ratio.
58. What is Bohr magneton?
59. Define Larmor frequency.
60. What is the significance of Stern-Gerlach experimental result?
61. The vector atom model is based on which principle?
62. What are the limitations of Bohr's atom model?
63. What are the short comings of Bohr-Sommerfield theory.
64. What do you mean by parity of eigen functions.
65. Wilson-Sommerfild theory explain the origin of fine structure of spectral lines by assuming _____.
66. What is Zeeman effect.
67. What is longitudinal Zeeman effect.
68. What is transverse Zeeman effect?
69. What do you mean by anomalous Zeeman effect?
70. Anomalous Zeeman effect is observed if the source is placed in _____ magnetic field.
71. Define Lorentz unit.
72. Define the Lande g-factor.
73. What is paschen-Back effect?
74. What is stark effect?

75. How many components are observed in Stark effect?
76. Does weak field Stark effect can be observed.

Long Answer Questions

1. Derive time dependent Schrodinger wave equation in one dimension and three dimension.
2. What are matter waves? What is their phase and group velocity?
3. Derive the expression of probability current density in three dimensions.
4. Discuss about the spread of Gaussian wave packet.
5. Explain time, position and momentum uncertainty of wave packet.
6. State and prove Ehrenfest theorem.
7. Discuss about commutation relation between Hamiltonian 'H' and components of orbital angular momentum.
8. Discuss about orthonormality of eigen function.
9. Discuss about commutation relations of angular momentum with linear momentum.
10. Discuss commutation relation between position and momentum.
11. Derive time independent Schrondinger wave equation and predict its solution.
12. What are stationary state solutions? Find them for time independent Schrodinger wave equation.
13. Write Schrodinger equation for a particle in a box and determine expression for energy eigen values and eigen functions?
14. Obtain the normalized wave function for a particle in a box. Represent them graphically.
15. Consider a particle incident on a potential step of high V_o. calculate the co-efficient of reflection and transmission.
16. What is quantum mechanical tunneling? Under what condition the transmission co-efficient is equal to one.
17. Describe an experimental set-up to study Zeeman effect.
18. What anamolous Zeeman effect? Discuss the Zeeman pattern of the resonance lines of sodium.

19. What is stark effect. Discuss about the weak field and strong field stark effect.
20. Describe Stern-Gerlach experiment.
21. Describe an expression for the Larmor precesional frequency. What is its importance.
22. Discuss Sommerfeld's extension of Bohr's model.
23. Discuss the quantum mechanical treatment of one electron atom.

Solid state physics(core 12)

Short questions

1. What is a crystal?
2. What do you mean by amorphous and crystalline solids?
3. What do you mean by a lattice
4. Define crystal structure
5. What are translation vectors.
6. Define a unit of cell and primitive unit cell
7. Explain a lattice with a base related to crystal structure
8. Name the four types of crystalline solids
9. Explain miller indices
10. What are miller indices? Give their importance
11. Discuss the different types of lattices
12. What do you mean by X-ray diffraction of crystals
13. State Bragg's law
14. Define reciprocal lattice
15. What is the atomic diameter of BBC lattice
16. Define atomic form factor
17. Define geometric structure factor
18. Discuss Brillouin zones
19. Give the significance of packing fraction
20. Calculate number of atoms per unit cell in different lattices.
21. What are lattice vibrations and phonons?
22. Which crystals exhibit optical phonon modes?
23. What do you mean by linear monoatomic and diatomic chains?
24. What are acoustical and optical branches in lattice vibrations?

25. State Dulons and Petit's law
26. Explain the basic ideas behind Einstein model for specific heat of solids
27. State Debye T^3 law
28. What is common between phonon and photon?
29. At what temp. the result of Dulons-petit's law is in agreement with the experimental values
30. Define photon
31. What are non-magnetic substances?
32. What do you mean by atomic dipole?
33. What is Bohr magneton?
34. How do you classify magnetic substances?
35. What do you mean by magnetization?
36. Why soft iron preferred in electromagnets?
37. How can a magnet be demagnetized completely
38. What do mean by domains?
39. State curie's law
40. What do you mean by hysteresis?
41. What is a dielectric?
42. Define dielectric constant
43. What is dielectric polarization
44. Define polarization vector
45. Is polarization possible in air or vacuum?
46. On what factors polarization of a dielectric depends?
47. What is atomic polarisability?
48. What do you mean by local field?
49. What do you mean by anomalous dispersion?
50. What is ionic polarization?
51. Name different types of polarization
52. Write the relation between dielectric constant and electric susceptibility
53. Explain dielectric less
54. What do you mean by LASER?
55. What is basic principle of LASER?
56. What is stimulated emission of light?
57. What do you mean by population in version?
58. What do you mean by pumping?
59. Why is the Ruby laser not very efficient?

60. Given an example of a four level laser
61. Explain the concept of band theory.
62. What is Fermi surface?
63. When does the velocity of electron become maximum?
64. Define forbidden energy gap as per Kronig-Penny model of atom
65. What is hole? What is hole current in semiconductor?
66. What is the value of energy gap in a semiconductor?
67. What is the charge on P and N- type semiconductors?
68. What is Hall effect?
69. What is the cause of Hall-potential?
70. Which type of charge has greater mobility?
71. Give the concept of effective mass.
72. Explain Hall co-efficient
73. Discuss P and N-type semiconductors
74. Give the cause of failure of free electron theory?
75. What is critical temperature of a super conductor?
76. What is the effect of magnetic field on super conductivity?
77. What is isotope effect on super conductivity?
78. What are type- I superconductors?
79. What are type-II superconductors?
80. Give the main characteristics of a cooper pair.

Long questions

1. Describe a unit cell. Discuss lattice parameters of a unit cell
2. Explain fourteen lattices with neat diagrams
3. What are miller indices? How are they calculated? What are (100),(110)and(111) planes of cubic crystal.
4. Derive an expression separation between inter planer planes
5. Explain atomic scattering factor with mathematical expression
6. Explain geometric structure factor with mathematical expression. How is it related to the atomic scattering factor?
7. (a) Derive Bragg's law of crystal diffraction
   (b) Discuss briefly the methods of crystal structure determination
8. What are Laue's equations for diffraction of X-rays by a crystalline solid? Show that these equations lead to Bragg's law for X-ray diffraction
9. Define reciprocal lattice? Derive the expression for the primitive translation vectors of the reciprocal lattice

10. Find the Brillouin zones in case of SC,BCC and FCC lattices.
11. Discuss Langevin's theory of diamagnetism
12. Discuss Langevin's theory of paramagnetism
13. Discuss the Weiss theory of ferromagnetism
14. Explain ferromagnetism on the basis of Domain theory
15. Explain hysteresis, Retentivity and coercivity. How will you determine the value of Retentivity and coercivity from a loop
16. Describe the lattice vibrations of monoatomic linear lattice and obtain for the dispersion relation for lattice vibration of monoatomic linear chain
17. Obtain the various vibrational modes of a linear monoatomic lattice
18. Discuss Dulons-petit's law of specific heat of solid
19. Discuss Debey's theory of specific heat of solid
20. Discuss Einstein's theory of specific heat of solid
21. What is meant by a local field in a solid dielectric? Obtain Clausius-Mossotti relation in dielectrics subject to static fields
22. Explain classical theory of electronic polarizability
23. Discuss different types of polarization. Discuss the frequency dependence of these polarization
24. Define polar and non-polar molecules. Deduce Clausius-Mossotti relation for polar dielectrics
25. Define local field at an atom. Derive the relation between local field and polarization of a dielectric.
26. What are Einstein co-efficient A and B? Derive Einstein's relation between them.
27. Discuss three and four levels laser.
28. Explain working principle and construction of Ruby laser
29. Explain the principle, construction and working He-Ne laser.
30. Explain the following terms: (a)Spontaneous emission   (b) Stimulated emission(c) Population inversion   (d)metastable state
31. Discuss Kronig-Penny model. Using this model show that the energy spectrum of electron consists of a number of allowed energy bonds separated by forbidden regions
32. What is Hall effect? Give an elementary theory of Hall effect.
33. Show that Hall co-efficient is independent of the applied magnetic field and is inversely proportional to current density and electronic charge

34. What do you mean by mobility of semiconductor? Derive an expression for the mobility.
35. Describe the four-probe method for measurement of conductivity.
36. Explain Meissner effect. Give the experimental demonstration of Meissner effect.
37. Describe Type-I and Type-II superconductors.
38. What is meant by superconductivity? Describe the effect of magnetic field on superconductor.
39. Explain BCS Theory of superconductors.
40. Define Londin penetration depth. Discuss the effect of temperature on penetration depth.

CLASSICAL DYNAMICS (DSE-1)

Short Answer Questions

1. Give example of types of constraints.
2. What are generalized co-ordinates.
3. Write the advantage of using generalized co-ordinates.
4. Write an expression for generalized acceleration.
5. Write an expression for generalized velocity.
6. Write an expression for generalized momentum.
7. What are forces of constraints.
8. If generalized co-ordinate is θ , what is the dimensions of corresponding generalized force.
9. If generalized co-ordinates has the dimension of velocity, generalized velocity has the dimensions of _____.
10. What are Euler-Lagranges differential equations.
11. What is Hamilton's variational principle?
12. What is D' Alembert's principle?
13. What is ignorable co-ordinate?
14. What is generalized momentum?
15. Show that generalized momentum conjugate to a cyclic co-ordinate is conserved.

16. What is Hamiltonian? Explain its physical significance.
17. What are Hamiltonian's equations of motion.
18. Write an expression for a charged particle in an electromagnetic field.
19. Under what conditions, Hamiltonian represents the constant of motion but not the total energy.
20. What is an inertial frame.
21. What are postulates of special theory of relativity.
22. Write down the Lorentz transformation equations.
23. What are inverse Lorentz transformations.
24. What is length contraction.
25. What is time dilation.
26. What is twin paradox.
27. Define world point and world line.
28. What is space like interval.
29. What is time-like interval.
30. What is proper time interval.
31. What is like interval.
32. What is Minkoski space.
33. What is world region.
34. What is light cone.
35. What are four vectors.
36. What is relativistic Doppler's effect.
37. What is four force.
38. What is mass-kinetic energy relation.
39. What is mass variation formula.
40. What are constraints?

Long Answer Questions

1. Derive Lorentz transformation equations.
2. What are four vectors. Find the components of the momentum four vectors.
3. Define a four vector. What are velocity, momentum and force four vectors.
4. Discuss relativistic Doppler's effect.

5. Derive energy momentum relation.
6. What are constraints? How do they affect motion of a mechanical system. Explain forces of constraints.
7. Define generalized co-ordinates and obtain the expression for generalized acceleration, generalized force.
8. Obtain the Euler-Lagrange differential equation by a variational procedure.
9. Prove Lagrange's equations of motion for a system of interacting particles.
10. State Hamilton's principle and use it to obtain the equation of motion.
11. Derive Hamilton's equation of motion using variational principle and applying it calculate frequency of oscillation of a harmonic oscillator.
12. Obtain Hamilton's equation of motion in spherical co-ordinates.
13. Derive Hamilton's Canonical equations of motion in general co-ordinates.

Nuclear and Particle Physics (DSE-2)

Short Answer Questions

1. Write a short note on size, mass and density of the nucleus.
2. What is nuclear spin.
3. What is magnetic dipole moment of nucleus.
4. What is electric quadrupole moment of nucleus.
5. What is binding energy of nucleus.
6. Define mass defect.
7. What is packing fraction.
8. Explain angular momentum of nucleus.
9. Write a short note on parity of nucleus.
10. Explain magnetic moment of nucleus.
11. Write down the properties of nuclear forces.
12. Calculate binding energy of an α-particle from the following data.

    Mass of helium nucleus=4.001265 a.m.u.

    Mass of proton=1.007277 a.m.u.

    Mass of neutron=1.008666 a.m.u.

13. Describe the liquid drop model.
14. Explain the assumptions of liquid drop model.
15. Explain nuclear stability by liquid drop model.
16. Discuss the different terms used in semi-empirical mass formula for liquid drop model.
17. What is volume energy correction.
18. What is surface energy.
19. What is Coulomb energy.
20. What is asymmetry energy.
21. What is pairing energy.
22. What is binding energy formula.
23. What is semi-empirical formula.
24. What is the condition of nuclear stability.
25. What are the drawbacks of liquid drop model.
26. What do you mean by magic number.
27. What is shell model.
28. What are the assumptions of shell model.
29. What are the merits of shell model.
30. What are the failures of shell model.
31. What is radioactivity.
32. Give the properties of different rays emitted by radio-active substance.
33. State the laws of radio active disintegration.
34. Define half life of a radioactive substance.
35. Define mean life.
36. Define radioactive decay constant.
37. What is α-decay.
38. Discuss the condition for α-decay.
39. Explain the concept of Gammow's teory of α-decay.
40. Explain β-decay.
41. Write a short note on Υ-decay.
42. Explain pair production.
43. What is nuclear reaction.
44. Explain different kinds of nuclear reaction.

45. What do you mean by Q-value for a nuclear reaction.
46. Obtain the expression for threshold energy.
47. Mention the conservation laws in nuclear reaction.
48. What is endoergic reaction.
49. What is exoregic reaction.
50. What is the concept of nuclear reactions channel.
51. Write a short note on nuclear detectors.
52. Explain the working of nuclear detectors.
53. Name the three methods for detection of nuclear radiations.
54. Explain the working of proportional counter.
55. Explain the working of Geiger-Muller counter.
56. Explain the working of Scintillation counter.
57. What are the characteristics required for a good perfect nuclear detector.
58. Distinguish between ionization chamber and G.M counter.
59. Write a short note on solid state detectors.
60. Why germanium detectors are more suitable than silicon detectors.
61. Explain photo multiplier tube.
62. Explain the working of a photo detector.
63. What are the characteristics of good neutron detector?
64. Describe the construction of a linear accelerators.
65. Write the principle of linear accelerator.
66. Give the principle of linear accelerator.
67. Give the principle of Van de Graff accelerator.
68. Write the working of cyclotron
69. What is the principle of synchro-cyclotron.
70. What is the principle of betatron.
71. What are elementary particle.
72. Explain weak and strong interaction.
73. What are bosons.
74. What are fermions.
75. Explain the family members of leptons.
76. Explain the family members of bosons.
77. Explain the family members of hyperons.

78. What are the different types of hyperons.
79. Give the properties of bosons.
80. Compare composite bosons and mesons.
81. What is lepton number?
82. What is Baryon number?
83. What is isospin?
84. Define strangeness.
85. Define hypercharge and strengeness.
86. What are quarks.
87. Give elementary idea about quarks and glun.
88. What are different types of quarks.
89. What is conservation of angular moment of angular moment of elementary particles.
90. Explain conservation of parity.

Long Answer Questions:-

1. What is mean by binding energy and binding energy per nucleon? Explain the variation of average binding energy with mass number.
2. What do you mean by electric quadrupole moment. Derive an expression of it.
3. Give the properties of the nucleus. Explain the terms magnetic dipole moment and electric dipole moment.
4. State the observation of liquid drop model. Obtain semi-empirical formula.
5. What are magic numbers? Explain how shell model accounts for the existence of magic number.
6. What is shell model? Give the various achievements of the shell model.
7. Explain α-decay. Give Gammow's theory of α-decay.
8. Give Fermi's theory of β-decay. Give Gammow's explanation of β-decay.
9. State Geiger-nuttal law and discuss its importance.
10. What are conservation law obeyed by a nuclear reaction? What is Q-value of nuclear reaction. Explain its importance.
11. What do you mean by threshold energy. Derive an expression for it.

12. Explain the principle of detection of particles. Explain the construction, principle and working of ionization chamber.
13. Describe the construction and working of Geiger-Nutter counter. What are its limitatios.
14. What are nuclear detectors. Describe principle, construction and working of Scintillation counter.
15. Describe the principle and working of solid state detectors.
16. Explain the construction and principle of a photomultiplier tube.
17. What is Van de Graaff accelerator? Describe the construction, principle and working of it.
18. Describe a cyclotron and explain how charged particles can be accelerated with it. What is its limitations.
19. What is the difference between a quark and gluon? Discuss the properties of quarks.
20. What are the conservation laws used with elementary particles.
21. What are hyperons and leptons? Give their decay processes.
22. What are the conservation laws used with elementary particles.
23. What are strange particles? Explain the principle of their production.
24. What are leptons. Discuss their properties.
25. What are baryons. Discuss their properties.

Semester-VI

Electromagnetic theory(Core-13)

Short Answer Questions

1. What is equation of continuity.
2. What is equation of continuity for steady current.
3. State Gauss law in electrostatics.
4. What is displacement vector.
5. What is differential form of Maxwell's 1st equation.
6. What is differential form of Maxwell's 2nd equation.
7. What is Ampere's circuital law.

8. What is displacement current density.
9. Explain conduction current and displacement current.
10. What are Maxwell's equations in free space.
11. What are the Maxwell's equations for static field.
12. What is Snell's law in electrostatistics.
13. What is Lorentz force.
14. What is magnetic vector potential.
15. State Poynting theorem.
16. What is Poynting vector.
17. What is Poynting vector in complex form.
18. What is Lorentz gauge.
19. What is Coloumb gauge.
20. Are vector and scalar potentials independent of each other.
21. What is the law of conservation of charge which resembles equation of continuity.
22. What is the nature of electromagnetic wave.
23. What do **E** and **H** represent in an electromagnetic wave.
24. What do you mean by wave impedance.
25. What is the phase difference between field vectors **E** and **H** in a good conductor.
26. What are isotropic and an-isotropic medium.
27. What do you mean by wave impedance?
28. What is penetration depth? Write its expression for a good conductor.
29. Explain skin depth on the basis of electromagnetic theory. What is its value for copper?
30. An electromagnetic wave propagates in a conducting media of conductivity .Write an expression for phase velocity of the wave.
31. Express refractive index of the conductive medium for an electromagnetic wave.
32. What is intrinsic impendance   of a good conductor when an electromagnetic wave travels in conducting media of conductivity
33. What is an optical fibre?
34. What is the phenomenon on which optical fibre works.

35. Define acceptance angle?
36. Define numerical aperature?
37. What is step index fibre?
38. What is graded index fibre.
39. What are Fresnel's equation cases when electric field **E** is perpendicular to the plane of incidence.
40. What are Fresnel's equations when electric vector '**E'** is parallel to the plane of incidence.
41. What are evanescent waves?
42. What is the unit of Poynting vector.
43. What is the electrostatic energy density.
44. What is the expression of speed of electromagnetic waves.
45. What is the direction of flow of energy of an electromagnetic wave.
46. Write down the expression of refractive index of the non-conducting media.
47. what is polarization?
48. What is linear polarization?
49. What is elliptical polarization?
50. What is circular polarization?
51. Define Brewster's angle. Why is a Brewster angle also called a polarizing angle.
52. Define Parallel polarization.
53. Define perpendicular polarization.
54. State Brewster's law.
55. What is a wire grid polarizer.
56. What is absorption axis.
57. What is transmission axis.
58. What is polaroidx.
59. What do you mean by H-polaroids and K- polaroids**.**
60. What are the uses of polaroids.
61. State Malus law.
62. What do you mean by polarization by reflection.
63. What is optic axis.

64. What is double refraction.

65. Define O-ray and E-ray.

66. Refractive index of water is 1.33. calculate the angle of polarization for light reflected from the surface of a pond.

67. If the Brewster's angle is so. Find the refractive index of the material.

68. What is optical activity?

69. What do you mean by rotator polarization and rotator dispersion.

70. Define specific rotation.

71. What do you mean by retardation plates.

72. What is a quarter wave plate.

73. What is a half wave plate.

74. What are uniaxial and biaxial crystals.

75. Define plane of vibration and plane of polarization.

76. Write equation of continuity?

77. State equation of continuity?

78. Which conservation law obeyed by equation of continuity?

79. What is displacement current?

80. Write Maxwell's equation for harmonically varying fields?

81. What are electromagnetic vector and scalar potentials?

82. Write Lorentz gauge. What are the advantages of this gauge?

83. Write coulomb's gauge. What are its significances?

84. What do you mean by poynting vector and what does it represent?

85. Write Maxwell equations for linear, isotropic, dielectric media?

Long Answer Questions

1. Derive Maxwell's equations.
2. Write down differential and integral form of Maxwell's equation for free space and for static fields.
3. Discuss the boundary conditions at the interface of two di-electrics.
4. Derive the expression of magnetic vector potential.
5. Derive the wave equations in terms of magnetic intensity 'H'.
6. Derive the wave equation interms of magnetic intensity 'H'.
7. State and prove Poynting theorem.

8. Write down the Maxwell's equation involving the scalar and vector potentials. What are Lorentz and Coulomb gauge

9. Determine the boundary conditions satisfied by B,H and E and D at the interface between two media of different permeabilities and dielectric constants.

10. Derive Fresnel's equations for reflection and refraction of electromagnetic waves at a plane boundary separating two media.

11. Discuss metallic reflection and refraction. Find out an expression for the reflection power of a metallic surface.

12. Obtain the necessary relation between the incident and reflected electromagnetic field amplitudes for reflection at a plane metal surface.

13. Discuss the propagation of plane electromagnetic waves in an isotropic dielectric medium.

14. Obtain an expression for plasma frequency when electrom agnetic wave propagates in an ionized media.

15. Describe and explains the construction of Nicol prism and its action as polarizer and analyser.

16. Explain the construction and use of quarter wave plate and a half wave plate and give their uses in various types of polarized light.

17. Describe construction of a Babinet compensator. How is it used for analyzing elliptically polarized light?

18. Show that circularly polarized light and plane polarized light.

19. What do you understand by optical rotation? Give Fresnel's theory to explain optical rotation.

20. Define specific rotation of an optically active substance and how is it related to molecular rotation?

21. Describe construction and working of Laurents's half shade polarimeter.

22. Write down Maxwell's field equations and prove poynting's theorem relating to the flow of energy at a point in space in an electromagnetic field.

23. Derive Maxwell's equation in different form.

24. What do you mean by displacement current? Show that displacement current is the variation of electric displacement?

25. Obtain poynting theorem for conservation of energy in an electromagnetic field and discuss the physical meaning of each term.
26. Define and discuss poynting vector. Discuss its dimension.
27. What are electromagnetic potentials? Obtain Maxwell's equation in terms of potentials?
28. Show that electromagnetic potentials A and Ø are not unique. Explain Coulomb gauge and Lorentz gauge.
29. Derive boundary conditions at the interface of two media?

30. Determine the boundary condition satisfied by $\bar{B}, \bar{H}$ & $\bar{E}, \bar{D}$ at the interface between two media.
31. Discuss reflection and refraction of plane waves at the plane interface between two dielectric media.
32. Derive Fresnel's equations for reflection and refraction of EM waves at the plane boundary separating two media when incident wave is polarised with $\bar{E}$ normal to the plane of incidence.
33. Derive Fresnel's equation, when $\bar{E}$ parallel to plane of incidence.
34. Define co-efficient of reflection and transmission and derive expressions for them.
35. What is total internal reflection? Why is it produced? What are evanescent waves? Show that the amplitude of reflected wave is the same as that of incident waves?
36. Obtain expression for reflection co-efficient of EM wave incident of a metallic surface with E vector parallel to plane of incidence?
37. Distinguish between single mode and multi mode fibre.
38. Distinguish between step index and graded index fibre.
39. Explain the principle and working of an optical fibre.

Statistical mechanics (core-14)

Short Answer Questions

1. What is the difference between a microstate and a macrostate?
2. What is thermodynamic probability of a given macrostate?
3. What do you mean by entropy.
4. What is physical significance of entropy.
5. What is statistical definition of entropy.
6. What are intensive parameters?
7. What are extensive parameters?

8. Show that entropy is an extensive parameters.
9. What is the value of thermodynamic probability for a system in perfect order?
10. What is the third law of thermodynamics.
11. What is the change in entropy of a reversible process.
12. If the change in entropy is greater than zero then the process is _____.
13. Define second law of thermodynamics and show that it follows from the law of increase of entropy.
14. Why does entropy increase during expansion if gas.
15. Show that diffusion of gas is an irreversible process.
16. What are thermodynamic functions. Why they are thermodynamic potentials.
17. Enthalpy remains constant in _____ process.
18. Helmholtz free energy remains constant in _____ process.
19. Gibb's function remains constant in _____ process.
20. What is the physical significance of Gibb's function.
21. What is phase space?
22. Define ensemble?
23. Define macrocanonical ensemble.
24. Define canonical ensemble.
25. Define grand canonical ensemble
26. What is the minimum size of a phase space cell in classical and quantum statistics?
27. What do you mean by degree of freedom.
28. What is partition function.
29. What is the significance of partition function.
30. How we can treat the identical gas molecules as distinguishable in classical statistics?
31. What is the purpose of dividing phase space in to cells.
32. Define phase space and momentum space.
33. What is thermal radiation.
34. What is a black body. Give an example.

35. State kirchhoff's law of radiation.
36. State stefan's law.
37. State wien's displacement law.
38. What is Saha's ionization formula.
39. What is ultraviolent catastrophe?
40. State planck's la of black body radiation.
41. What is quantized oscillator.
42. What is the significance of Saha's ionization formula.
43. Write down the properties of thermal radiation.
44. Define spectral energy density.
45. Compare black body radiation with perfect gas.
46. Define radiation pressure.
47. Define emissivity.
48. Define emissive power.
49. Define absorptive power.
50. What is Fery's black body.
51. Define solar constant?
52. Rest mass of photo is zero. Explain its physical significance?
53. What is degenerate gas.
54. What is electron gas.
55. Write down distribution law in **F-D** statistics. What are bosons?
56. What are fermions?
57. What is Fermi-Dirac statistics.
58. What is Bose-Einstein statistics.
59. Mention few phenomena which could not be explained using Maxwell-Boltzmann statistics?
60. Why a blackened platinum wire, when gradually heated appears first dull red then blue end finally white.
61. Explain why black body radiation is white.
62. Name few phenomena which can not be explained with Maxwell-Boltzman's statistics.
63. What is the basic difference between classical and quantum statistics?
64. Define Fermi energy?

65. What is fermi gas?
66. What is a photon gas?
67. What is the difference between photon gas and an ideal gas?
68. What is Fermi energy level?
69. What is Bose-Einstein's condensation
70. What is photon?

Long Answer Questions

1. Define thermodynamic variables and thermodynamic potentials. Derive Maxwell's thermodynamic relations from them.
2. Calculate the average and rms speed of molecules obeying **M-B** statistics.
3. Derive Maxwell-Boltzman law of distribution of molecular speed and obtain an expression of most probable speed of the molecules using it.
4. What do you mean by partition function. Express Helmholtz free energy and enthalpy from it.
5. State and prove law of equipartion of energy.
6. Prove that the entropy thermodynamic system remains constant in any reversible process.
7. Discuss the law of increase of entropy on the basis of statistical physics.
8. Derive Sacker Tetrode equation.
9. Derive partition function for an ideal mono-atomic gas.
10. State Stefan's law and prove it from thermodynamics.
11. State derive wien's distribution law.
12. Derive Saha's ionization formula.
13. State and derive ionization formula.
14. Explain graphically energy distribution of black body radiation with wavelength of different temperature.
15. Derive Planck's law and show that Wien's law and Rayleigh-Jeans la are special case of planck's law.
16. Derive an expression for the most probable distribution of particles for a system obeying Bose-Einstein statistics.
17. Derive an expression for the energy distribution of free electrons in a conduction using Fermi-Dirac distribution law.

18. Define Fermi energy? Derive an expression for it.
19. Using BE distribution law derive Planck's law of black body radiation.
20. What are the assumptions of Bose-Einstein statistics? Derive the Bose-Einstein distribution law of speeds.

Nano Materials and Applications (DSE 3)

SHORT QUESTIONS-

1. What are nanostructures?
2. What do you mean by nanostructure?
3. What do you mean by nanotechnology?
4. Write the name of three categories of solid?
5. What is critical length for the resistance of the material?
6. Which properties of the material are changed at nano-region?
7. What is the cause of the increase of in surface to volume ratio for the nano material?
8. What is critical length?
9. What are size dependent properties of solid?
10. When the nano material is in the quantum confinement regime?
11. What is exciton?
12. What is exciton Bohr radius?
13. What is the degree of freedom of zero dimensional nano-structured material?
14. Write two examples of 0D nano-structured material (NSM)?
15. What is the degree of freedom of 1D NSM?
16. What is the degree of freedom of 2D NSM?
17. What is the degree of freedom of 3D NSM?
18. What are 0D NSM?
19. What are 1D NSM?
20. What are 2D NSM?
21. What are 3D NSM?
22. What are quantum dots?
23. What are thin films?
24. What are nano-rods?
25. What are nano-wires?
26. Write an expression for density of states for 0D nano-crystal?
27. Write an expression for density of states for 1D nano-crystal?

28. Write an expression for density of states for 2D nano-crystal?
29. Write an expression for density of states for 3D nano-crystal?
30. Define density of states.
31. What is quantum confinement?
32. Write the time dependent Schrodinger equation in 1D.
33. Write the time independent Schrodinger equation in 1D.
34. Write an expression for the Eigen energy for infinite potential well.
35. Write an expression for the energy of an electron moving in 1D nano-wire?
36. What is compound microscope?
37. What is transmission electron microscopy?
38. What is scanning probe microscopy?
39. What is scanning tunnelling microscopy?
40. State Bragg's law.
41. Write examples of top-down approach.
42. Write examples of bottom-up approach.
43. What is electrolyte deposition?
44. In which method the heating is done by Joule heating?
45. What do you mean by spray pyrolysis?
46. Explore sol-gel techniques.
47. What do you mean by pulsed laser deposition (PLD)?
48. Which method is used for thin film deposition as well as synthesis of nano-material?
49. What do you mean by E-beam evaporation?
50. What do you mean by sputtering?
51. What are CNT based transistor?
52. Why nano-materials are different from other materials?
53. Why CNT has a very high strength?
54. Write examples of one dimensional application of nano-materials.
55. Write examples of two dimensional applications of nano-material?
56. What are photonic device?
57. What devices are less sensitive to light?
58. What is LED?
59. What is QDLED?
60. What is nano-dot solar cell?
61. What is single electron device?
62. What is single electron transistor?

63.   What is CNT?
64.   What are CNT based transistor?
65.   Write examples of single electron devices?
66.   What is used in fabricating nano-wire solar cell?
67.   What is the function of quantum dot solar cells?
68.   Explain fabrication of nano-wire LED.
69.   How can LED fabricate?
70.   Draw the transfer characteristics of P-channel CNTFET.

LONG QUESTIONS-

1. What do you mean by nano-structured material? Explain 0D, 1D, 2D, 3D nano-material?
2. Describe the density of states of materials at nano-scale?
3. Write notes on,
    a) Nano-dots
    b) Nano-rods
    c) Nano-wire
    d) Thin film
4. Explain the quantum confinement of a particle trapped in an infinite potential well by using time independent Schrodinger equation.
5. Discuss the application of Schrodinger equation to a particle moving along the positive X-axis towards a potential box.
6. Apply Schrodinger equation to explain the quantum confinement of a particle in 3D trapped inside a potential box.
7. Explain the quantum confinement of an electron in one dimensional and it is free to move along two other axes.
8. Explain the quantum confinement of an electron confined in two dimensions and it is free to move?
9. Explain quantum confinement of an effect in nano-structured materials and its consequences?
10.   Write short notes on :
    a) Top-down technique
    b) Bottom top technique
    c) Photo lithography
    d) Ball milling
    e) Sputtering
11.   Explain evaporation technique.
12.   Explain pulsed laser deposition.

13. Explain chemical vapour deposition.
14. Explain electro deposition techniques for synthesis of nano-material.
15. Discuss about the spray pyrolysis method for the synthesis of nano-materials.
16. Describe X-ray diffraction technique for the characterisation of nano-particles.
17. Describe scanning electron microscopy technique for characterisation of nano-particles.
18. Describe the working principle of atomic force microscopy and scanning tunnelling microscopy.
19. Discuss about the principles and working of a quantum dot hetero structure laser diode.
20. Write notes on:
    a. Optical switching
    b. Optical data storage

21. Write notes on:

    a) Magnetic quantum well
    b) Magnetic quantum dots
    c) Magnetic data storage

22. Write short notes on:

    a) Micro electro mechanical systems.
    b) Nano electro mechanical systems.