SIDDARTHA INSTITUTE OF SCIENCE AND TECHNOLOGY::PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: APPLIED PHYICS (19HS0849) **Course & Branch**: I-B.Tech – II Sem - EEE. **Regulation:** R19

UNIT – I

Harmonic Oscillators

1. a) Define simple harmonic motion. Give three examples. (4M)
   b) Derive the equation of motion of simple harmonic oscillator and find its solution. (8M)
2. a) What is a simple harmonic oscillator? Derive the equation of motion of simple harmonic oscillator. (8M)
   b) A particle executes SHM with a period of 0.002 sec and amplitude of 10 cm. Find its acceleration when it is 4 cm away from its mean position and also obtain its maximum velocity. (4M)
3. a) Define simple harmonic motion and simple harmonic oscillator. Give examples. (4M)
   b) Write the properties of simple harmonic motion. (4M)
   c) A particle executing S.H.M is represented by $x=10\sin(4\pi t+\pi/3)$ m. Find the frequency and the displacement after a time of 1 second. (4M)
4. a) Define damped harmonic motion. Give examples. (4M)
   b) Derive and solve differential equation of damped harmonic oscillator. (8M)
5. a) Distinguish between damped and forced oscillations. (4M)
   b) Solve the differential equation of damped harmonic oscillator. (8M)
6. a) Explain logarithmic decrement, relaxation time and quality factor of an oscillator. (9M)
   b) The amplitude of a second pendulum falls to one half of its initial value in 150 seconds. Calculate the Q factor. (3M)
7. a) Explain different types of damped oscillations with suitable examples. (8M)
   b) A point performs damped oscillations according to the law $x=a_o e^{-bt} \sin \omega t$. Find the amplitude of oscillation and velocity of the particle at the moment t=0. (4M)

6. a) What are damped oscillations? Solve the differential equation of a damped harmonic oscillator. (8M)
   b) Discuss the case of under damped motion. (4M)

9. a) What are forced oscillations? Give examples. (4M)
   b) Distinguish between damped and forced oscillations. (4M)
   c) Explain the phenomenon of resonance with suitable examples. (4M)
10. a) Distinguish between damped and forced oscillations with suitable examples. (4M)

b) Explain the phenomenon of resonance and write the applications of resonance in various fields. (4M)

c) The frequency of a tuning fork is 300Hz. If its quality factor Q is 5×10^4, find the time After which its energy becomes (1/10) of its initial value. (4M)

UNIT – II

Principles of Quantum Mechanics

1. a) What are matter waves? Write their properties. (4M)

   b) Derive the expression for de Broglie wavelength. (4M)

   c) Calculate the velocity and kinetic energy of an electron of wavelength 1.66×10^{-10}m. (4M)

2. a) Explain de Broglie hypothesis. (4M)

   b) Calculate the de Broglie wavelength associated with a proton moving with a velocity of 1/10 th of velocity of light. (4M)

   c) Illustrate Heisenberg uncertainty principle and write its significance. (4M)

3. a) Explain the concept of matter waves. (2M)

   b) Prove that the product of uncertainty of pair of variables describing the motion of particles is always not less than $h/4\pi$. (4M)

   c) Deduce Schrodinger time independent wave equation. (6M)

4. a) Derive the expression for de Broglie wavelength of matter waves. (4M)

   b) Obtain an expression for wavelength of electron accelerated in a potential V. (4M)

   c) Calculate the wavelength associated with an electron raised to a potential of 1600 V. (4M)

5. a) Derive Schrodinger time independent and time dependent wave equations. (12M)

6. a) Deduce Schrodinger time independent wave equation. (8M)

   b) Write the physical significance of wave function ψ. (4M)

7. a) Deduce Schrodinger time dependent wave equation. (8M)

   b) Write the physical significance of wave function ψ. (4M)

8. a) Write the Schrodinger time independent wave equation. (2M)

   b) Discuss the solution of stationary state Schrodinger equation for particle in a box. (10M)

9. a) Outline the behavior of particle in a one dimensional potential box in terms of eigen values and eigen functions. (8M)

   b) An electron is confined to a one dimensional box of width 2 A, then calculate the energies corresponding to the second and fourth quantum states. (4M)

10. a) Deduce the solution of Schrodinger wave equation for particle confined in a box. (8M)

    b) An electron is confined in a one dimensional potential box having width of 3×10^{-10} m. Estimate the kinetic energy of electron when it is in the ground state. (4M)

Unit – III

Electron Theory of Metals & Semiconductors

1. a) What are the salient features of classical free electron theory? Derive an expression for electrical conductivity in a metal. Mention its drawbacks. (8M)

   b) Find relaxation time of conduction electron in metal if its resistivity is 1.54x10-8Ω-m and it has 5.8×10^{28} conduction electron/m^3. Given m= 9.1×10^{-31} kg, e= 1.6×10^{-19} C. (4M)

2. a) Describe the quantum free electron theory of metals. (8M)

   b) Write the advantages of quantum free electron theory over classical free electron theory. (4M)

3. a) Write the Fermi-Dirac distribution function. (4M)

   b) Explain the effect of temperature on Fermi-Dirac distribution. (4M)

   c) Evaluate the Fermi function for an energy KT above Fermions. (4M)

4. a) Write a note on sources of electrical resistance. (6M)

   b) Describe the origin of energy bands in solids. (6M)

5. a) Explain the formation of energy bands in solids with neat diagram. (6M)

   b) Classify the materials into conductors, semiconductors and insulators based on band theory. (6M)

6. a) What are intrinsic semiconductors? Deduce an expression for the carrier concentration and conductivity of intrinsic semiconductors. (8M)

   b) The following data are given for an intrinsic Ge at 300K. Calculate the conductivity and resistivity of the sample?

   (n_i= $2.4 \times 10^{-19} m^{-3}$, $\mu_e = 0.39\ m^{2-}V^{-1}S^{-1}$, $\mu_p = 0.19\ m^{2-}V^{-1}S^{-1}$). (4M)

7. a) What are extrinsic semiconductors? Explain. (6M)

   b) Deduce an expression for the carrier concentration of extrinsic semiconductors. (6M)

8. a) What are direct and indirect band gap semiconductors? Give examples. (6M)

   b) Obtain an expression for life time of charge carriers in excited states. (6M)

9. a) Explain the diffusion and drift processes in a semiconductor. (8M)

   b) Obtain the Einstein's relations. (4M)

10. a) What is Hall Effect? Obtain an expression for Hall coefficient. Write the applications of Hall Effect. (8M)

    b) The R_H of a specimen is $3.66 \times 10^{-4}\ m^3c^{-1}$. Its resistivity is 8.93×10^{-3} ohm-m. Find 'μ' and 'n'. (4M)

Unit – IV

Lasers and Fiber Optics

1. a) Write the characteristics of Lasers. (6M)

   b) Distinguish the spontaneous and stimulated emission of radiation. (6M)

2. a) Obtain the relationship between various Einstein coefficients of absorption and emission of radiation. (6M)

   b) Explain the condition for population inversion. (6M)

3. a) Explain the pumping mechanisms to achieve population inversion. (4M)

   b) Explain the construction and working of He-Ne laser with a neat diagram. (8M)

4. a) Explain the construction and working of Nd:YAG laser with a neat diagram. (8M)

   b) Write any four applications of lasers. (4M)

5. a) Explain the construction and working of He-Ne laser with a neat diagram. (8M)

   b) Explain in detail the applications of lasers in industry and medicine. (4M)

6. a) Describe the construction of optical fiber. (4M)

   b) Explain critical angle of incidence and total internal reflection with neat diagrams. (4M)

   c) Draw the block diagram of optical fiber communication system. (4M)

7. a) Deduce expressions for acceptance angle and numerical aperture of an optical fiber. (8M)

   b) An optical fiber has a core material of refractive index 1.55 and cladding with refractive index 1.50. Calculate its numerical aperture. (4M)

8. a) Differentiate step index and graded index fibers. (8M)

   b) An optical fibre has a core refractive index of 1.44 and cladding refractive index of 1.40. Find its θ_a. (4M)

9. a) Classify the optical fibers based on their refractive index profile. (6M)

   b) Explain the propagation of electromagnetic wave through optical fibers. (6M)

10. a) Outline the optical fiber communication system. (6M)

    b) Write any four applications of optical fibers. (6M)

Unit-V

(Physics of Nanomaterials)

1. a) Define Nano science and nanotechnology. (2M)
   b) Explain the basic principles of nanomaterials. (10M)
2. a) Describe the classification of nanomaterials with suitable examples. (4M)
   b) Nanomaterials behave differently in their properties than the bulk materials. Justify. (8M)
3. a) What are nanomaterials? Explain their classification. (3M)
   b) Explain in detail the quantum confinement effect and how it affects the optical and magnetic properties of nanomaterials. (5M)
   c) Write any two applications of nanomaterials in detail. (4M)
4. a) What are nanomaterials? Explain the basic principles of nanomaterials. (8M)
   b) Outline the properties of nanomaterials that are affected due to increased surface area to volume ratio. (4M)
5. a) Explain the synthesis of nanomaterials by ball milling method. (8M)
   b) Discuss the advantages of nanomaterials. (4M)
6. a) Describe the sol-gel method of synthesis of nanomaterials. (8M)
   b) Explain how the physical and optical properties changes when a material is brought down to Nano scale. (4M)
7. a) Describe any one method of fabrication of nanomaterials. (8M)
   b) Write any four applications of nanomaterials. (4M)
8. a) Discuss the advantages of nanomaterials in science and technology. (2M)
   b) Write a note on the properties of nanomaterials. (6M)
   c) Explain how nanomaterials are used in the field of medicine and sensor technology. (4M)
9. a) Explain the principle of Scanning Electron Microscopy (SEM). (8M)
   b) Write any two applications of SEM. (4M)
10. a) What is Scanning Electron Microscope? Discuss in detail the construction and working of SEM. (8M)
    b) Explain the strengths and limitations of SEM. (4M)

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QUESTION BANK (OBJECTIVE)

Subject with Code: APPLIED PHYSICS(19HS0848) **Course & Branch**: I - B.Tech - EEE, **Year & Sem:** I - B.Tech – II - Sem-reg:R19

Unit –I
Harmonic Oscillators

1. The time period of seconds pendulum is [ ]
   a) 1 Second b) 2 Seconds c) 3 Seconds d) None
2. The number of oscillations per second is called as [ ]
   a) Frequency b) time period c) Phase d) None
3. The time taken per one complete oscillation is called as [ ]
   a) Time period b) Frequency c) Phase d) None
4. The maximum displacement of the particle from mean position is called as [ ]
   a) Time period b) wave number c) Phase d) amplitude
5. Units for frequency is [ ]
   a) Hertz b) Weber's c) Newton d) None
6. If a body moves front and back repeatedly about the mean position, it is called [ ]
   a) simple harmonic oscillation b) Damped harmonic oscillation c) Both
   d) none
7. The particle or body executing simple harmonic motion is called [ ]
   a) Simple harmonic oscillator b) Damped harmonic oscillatorc) Both d) none
8. The value of phase when t= 0 is called as ---- [ ]
   a) Phase difference b) Frequency c) Epoch d) None
9. The displacement of particle at any instant executing SHM is given by [ ]
   a) x= a sin (wt+ϕ) b) x= a cos (wt+ϕ) c) x= a tan (wt+ϕ) d) None
10. The velocity of particle at any instant executing SHM is given by [ ]
    a) v= a w sin (wt+ϕ) b) v= a w cos (wt+ϕ) c) v= a tan (wt+ϕ) d) None
11. Force applied per unit length is called as ______________ [ ]
    a) Force constant b) velocity constant c) Momentum d) none
12. A particle moving in x-y plane according to the equation of motion of the particle is [ ]
    a) on a straight line b) on an ellipse c) periodic d) simple harmonic
13. Differential equation for simple harmonic oscillator is [ ]
    a) $\frac{d^2x}{dt^2} + w^3x = 0$ b) $\frac{d^2x}{dt^2} + w^2x = 0$ c) $\frac{d^2x}{dt^2} + w^4x = 0$ d) $\frac{d^2x}{dt^2} + w^5x = 0$
14. The angular frequency of simple harmonic oscillator is [ ]
    a) $w = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ b) $w = \sqrt{\frac{2}{m}}$ c)$w = \sqrt{\frac{m}{k}}$ d) $w = \sqrt{\frac{i}{m}}$
15. The time period of simple harmonic oscillator is [ ]
    a) $T = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ b) $T = 2\pi\sqrt{\frac{k}{m}}$ c)$w = \sqrt{\frac{m}{k}}$ d) $w = \sqrt{\frac{i}{m}}$
16. If the frequency of the oscillator is decreases with respect to the time, such an oscillator is called [ ]
    a) Simple harmonic oscillator b) Damped harmonic oscillator c)Bothd) none
17. The particle or body executing damped harmonic motion is called a [ ]
    a) Simple harmonic oscillator b) Damped harmonic oscillator c) Both
    d) none

18. Differential equation for simple harmonic oscillator is [ ]
a) $\frac{d^2x}{dt^2} + 2b\frac{dx}{dt} + w^2x = 0$ b) $\frac{d^2x}{dt^2} + 3b\frac{dx}{dt} + w^3x = 0$
c) $\frac{d^2x}{dt^2} + w^2x = 0$ d) $\frac{d^2x}{dt^2} + w^4x = 0$
19. If the oscillator returns to equilibrium without oscillating is called as _____ [ ]
a) Critical damped b) under damped c) Over damped d) None
20. If the oscillator returns to equilibrium as quickly as possible without oscillations is called as _______________ [ ]
a) Critical damped b) under damped c) Over damped d) None
21. The system oscillating with the decreasing amplitude is [ ]
a) Critical damped b) under damped c) Over damped d) None
22. In cars, springs are damped by [ ]
a) Engine b) Tyres c) Shock absorbers d) None
23. Oscillations become damped due to [ ]
a) Normal force b) Friction c) Parallel force d) Tangential force
24. The vibrations in which the body vibrates with a frequency other than its natural frequency under the action of external force is called – [ ]
a) Simple harmonic vibrations b) Forced vibrations c) Damped vibrations d) None
25. In damped free vibrations which parameters indicates vibrations [ ]
a) Natural frequency b) Tate of decay of amplitude c) Both a and b d) None
26. What is meant by critical damping coefficient? [ ]
a) Frequency of damped free vibrations is less than zero
b) The motion is periodic in nature
c) Both a and b
d) None
27. When there is reduction in amplitude over every cycle of vibration, then the body is said to have [ ]
a) Free vibrations b) Forced vibrations c) Damped vibrations d) None
28. Longitudinal vibrations are said to occur when the particles of body moves [ ]
a) Perpendicular to its axis b) Parallel to its axis c) In a circle about the axis d) None
29. When a body is subjected to transverse vibrations, the stress induced in a body will be [ ]
a) Shear stress b) Tensile stress c) Compressive stress d) None
30. The angular frequency of SHM is equals to [ ]
a) 2π b) 2π c) 2πf d) None
31. As amplitude of resonant vibrations decreases, degree of damping is _____ [ ]
a) Increases b) Decreases c) Same d) None
32. In SHM, object acceleration depends upon [ ]
a) Displacement from equilibrium b) magnitude of restoring force c) Both a and b
d) None
33. The phenomenon of making a body vibrate with its natural frequency under the influence ofanother vibrating body with the same frequency is called [ ]
a) Forced vibrations b) Natural vibrations c) Resonance d) None
34. Collapse of bridge at the time of soldier marching is an example of [ ]
a) Forced vibrations b) Natural vibrations c) Resonance d) None
35. Optical resonance is an example of [ ]
a) Forced vibrations b) Natural vibrations c) Resonance d) None
36. Tuning of radio or transistor is an example of [ ]
a) Forced vibrations b) Natural vibrations c) Resonance d) None
37. Creation of coherent light in LASER system is an example of [ ]
a) Forced vibrations b) Natural vibrations c) Resonance d) None
38. Guitar string is an example for [ ]
a) Damped oscillator b) Natural vibrations c) Resonance d) None

39. Simple pendulum is an example of [ ]
    a) Simple harmonic oscillator b) Damped harmonic oscillator c) Forced vibrations
    d) None
40. A steel ball rolling on curved disc is an example of [ ]
    a) Simple harmonic oscillator b) Damped harmonic oscillator c) Both a and b d) None

Unit - II
Principles of Quantum Mechanics

1. When an electron is accelerated by a potential of V volts. Then the de Broglie wavelength is given by [ ]
   A) $\frac{12.26}{\sqrt{V}}\ nm$ B) $\frac{26.12}{\sqrt{V}} A^0$ C) $\frac{12.26}{\sqrt{V}}\ \mu m$ D) $\frac{12.26}{\sqrt{V}} A^0$
2. An electron, neutron and proton have the same wavelength. Which particle has greater velocity? [ ]
   A) Neutron B) Proton C) Electron D) All
3. Probability density of wave function is [ ]
   A) Ψ B) $|\Psi|^2$ C) $\Psi\Psi^*\Psi$ D) none
4. When an electron is accelerated through a potential field of 100 V then it is associated with a wave of wavelength equal to [ ]
   A) 0.1226 nm B) 1.226 nm C) 12.26 nm D) 122.6 nm
5. The wavelength of de Broglie wave associated with a moving particle is independent of its [ ]
   A) Mass B) Charge C) Velocity D) Momentum
6. If E is the kinetic energy of the material particle of mass m then the de Broglie wavelength is [ ]
   A) $\frac{h}{\sqrt{2mE}}$ B) $\frac{\sqrt{2mE}}{h}$ C) $h\sqrt{2mE}$ D) $\frac{h}{2mE}$
7. The characteristic of particles is [ ]
   A) Wavelength B) Frequency C) Amplitude D) Momentum
8. The dual nature is exhibited by [ ]
   A) Particle only B) Wave only C) Photon only D) By both A and B
9. The wave function Ψ associated with a moving particle [ ]
   A) Is not an observable quantity B) does not have direct physical meaning
   C) is a complex quantity D) all of the above
10. The most probable position of a particle in a one dimensional potential well of width 'a' in the first quantum state is [ ]
    A) a/4 B) a/3 C) a/2 D) 2a/3
11. Einstein mass –energy relation is [ ]
    A) $\nu = \frac{mc^2}{h}$ B) $\nu = \frac{mc}{h}$ C) $\nu = \frac{hc}{\lambda}$ D) $\lambda = \frac{mc}{h}$
12. The uncertainty principle is applicable to [ ]
    A) Only small particles B) Microscopic particles
    C) All material particles D) Only tiny particles
13. The wavelength of electron moving with a velocity of 500 m/s is [ ]
    A) 1.45 μm B) 0.50 nm C) 2.90 nm D) 3.00 nm
14. Dual nature of matter wave proposed by [ ]
    A) de Broglie B) Planck C) Einstein D) Newton
15. Which of the following equation is the normalized wave equation [ ]
    A) $\iiint |\Psi|^2\, dx\, dy\, dz = 0$ B) $\iiint |\Psi|^2\, dx\, dy\, dz = 1$
    C) $\iiint |\Psi|\, dx\, dy\, dz = 0$ D) $\iiint |\Psi|\, dx\, dy\, dz = 1$

16. In a one dimensional potential box, particle energy [ ]

A) $\frac{n^2\pi^2\hbar^2}{2ma^2}$ B) $\frac{n^2\pi^2h^2}{2ma^2}$ C) $\frac{n^2h^2}{8ma^2}$ D) $\frac{n^2\pi^2\hbar^2}{8ma^2}$

17. The characteristic of particles are [ ]

A) Mass B) Velocity C) Energy D) All the above

18. Velocity of matter wave is always [ ]

A) Lesser than velocity of light B) Equal to velocity of light
C) Greater than velocity of light D) None of these

19. If an electron is moving under a potential field of 15 kV. Calculate the wavelength of electron waves [ ]

A) 1 Å B) 0.1 Å C) 10 Å D) 0.01Å

20. According to de Broglie hypothesis, electron exhibits __________ nature? [ ]

A) Wave B) Particle C) Wave and Particle D) Energy

21. The equation $\iiint |\Psi|^2\, dx\, dy\, dz = 1$ represents [ ]

A) Orthogonal wave function B) Normalized wave function
C) Orthogonal and Normalized wave function D) none

22. The uncertainty principle was proposed by [ ]

A) de Broglie B) Heisenberg
C) Schrodinger D) Somerfield

23. The electrons which are in the valence band are called [ ]

A) Valence electrons B) Protons C) Neutrons D) None of these

24. Einstein mass energy relation is [ ]

A) $E = mc^2$ B) $\frac{h}{\lambda} = mc$ C) $\vartheta = \frac{mc^2}{h}$ D) All

25. The characteristics of waves are [ ]

A) Energy B) Phase C) Mass D) Velocity

26. When an electron is accelerated, if de Broglie wavelength is 1 A^{o} then the applied voltage is

A) 12 volts B) 150 volts C) 15 volts D) 500 volts [ ]

27. The Concept of matter of matter waves was suggested by [ ]

A) de Broglie B) Planck C) Einstein D) none

28. Quantum theory of radiation was proposed by [ ]

A) de Broglie B) Planck C) Einstein D) none

29. Mass - Energy relation was proposed by [ ]

A) de Broglie B) Planck C) Einstein D) none

30. The interpretation of wave function is given by [ ]

A) Max Born B) Maxwell C) Einstein D) Planck

31. The Schrodinger time independent wave equation is applicable to the systems having Constant _____________ [ ]

A) Momentum B) energy C) velocity D) force

32. An example of Fermion is [ ]

A) He atom B) nucleus C) α particle D) electron

33. If E_1 is the energy of ground state, then the energy gap between 2nd and 4th the energy levels of a particle confined in a potential box is [ ]

A) 12 E_1 B) 10 E_1 C) 8 E_1 D) 6 E_1

34. The region of space around the nucleus where the probability of finding the electron is maximum is called [ ]

A) Orbit B) Orbital C) Nodal plane D) None

35. The region of space around the nucleus where the probability of finding the electron is zero is called [ ]
A) Orbit B) Orbital C) Nodal plane D) None
36. The probability of finding a particle in the ground state in a potential box of finite width is [ ]
A) Maximum at extreme points B) maximum at Middle of the energy level
C) constant at all places D) Zero everywhere
37. The probability of finding a particle in the top most level in a potential box of finite width is [ ]
A) Maximum at extreme points B) maximum at Middle of the energy level
C) constant at all places D) Zero everywhere
38. If the ground state energy of a particle confined in a box is E_1, What is its energy in the 4^{th} state [ ]
A) 4 E_1 B) 8 E_1 C) 12 E_1 D) 16 E_1
39. The non-existence of electron inside the nucleus can be proved mathematically by [ ]
A) Pauli's principle B) Dirac principle
C) Heisenberg uncertainty principle D) Klein-Gordon principle
40. The product of ______________ cannot be determined simultaneously for a fermion according to Heisenberg's uncertainty principle. [ ]
A) Position and acceleration B) velocity and momentum
C) position and momentum D) mass and energy

Unit –III
Electron Theory of Metals and Semiconductors

1. Classical free electron theory was developed by [ ]
   A) Drude and Lorentz B) Somerfield C) Goldstein D) Rutherford
2. Quantum free electron theory was developed by [ ]
   A) Drude and Lorentz B) Somerfield C) Goldstein D) Rutherford
3. According to quantum free electron theory the electrical conductivity is given by [ ]
   A) $\sigma = n^2e^2\tau_F/m^*$ B) $\sigma = ne^2\tau_F/m^*$ C) $\sigma = n^3e^2\tau_F/m^*$ D) $\sigma = ne^3\tau_F/m^*$
4. The energy band gap between valence band and conduction band in a conductor is [ ]
   A) 1 eV B) 2 eV C) 0 D) 5 eV
5. The energy band gap between valence band and conduction band in a semiconductor is [ ]
   A) Less than 1 eV B) 0.2 - 2 eV C) 0 D) 5 eV
6. The energy band gap between valence band and conduction band in an insulator is [ ]
   A) 0 B) 10 eV C) 6 eV D) 2 eV
7. The classical free electron theory is based on the principles of [ ]
   A) Classical mechanics B) Quantum mechanics C) Thermodynamics D) None
8 The quantum free electron theory is based on the principle of [ ]
   A) Classical mechanics B) Quantum mechanics C) Thermodynamics D) None
9. In classical free electron theory, electrons are moving in _______ potential [ ]
   A) 0 B) Constant C) Periodic D) Parabolic
10. In quantum free electron theory, electrons are moving in [ ]
    A) 0 B) Constant C) Periodic D) exponential
11. In Band theory of solids, electrons are moving in [ ]
    A) 0 B) Constant C) Periodic D) exponential
12. The average distance travelled by an electron between two successive collisions in the presence of applied field is known as [ ]
    A) Mean free path B) relaxation time C) velocity D) acceleration
13. Classical free electron theory failed to explain [ ]
    A) Conductors B) Insulators C) semiconductors D) dielectrics
14. The average velocity obtained by electron by applying electric field is known as [ ]
    A) RMS velocity B) average velocity C) uniform velocity D) drift velocity
15. The time taken by electron to reach original position from the disturbed position is called as [ ]
    A) Relaxation time B) mean time C) periodic time D) None
16. The time taken by electron to make two successive collisions is called as [ ]
    A) Relaxation time B) mean time C) collision time D) none
17. Choose the best conductor [ ]
    A) Cu B) Ag C) Al D) Fe
18. Choose the best insulator [ ]
    A) Plastic B) Ag C) Al D) Fe
19. Energy band gap of diamond (Insulator) is [ ]
    A) 1 eV B) 2 eV C) 0 eV D) 5 eV
20. The cause of electrical resistance in metals is due to [ ]
    A) Lattice vibrations B) Impurities C) scattering D) All

21. In E-K diagram [ ]
    A) Each portion of the curve represents allowed and forbidden bands
    B) The curves are horizontal at the top
    C) The curves are parabolic D) All the above
22. The highest filled energy level occupied by electrons is called as [ ]
    A) Fermi level B) atomic level C) molecular level D) Dirac level
23. At T= 0 K in metal below the Fermi level, all energy levels are [ ]
    A) Empty B) Completely Filled C) Half-filled D) partially filled
24. At T= 0 K in metal above the Fermi level, all energy levels are [ ]
    A) Empty B) Completely Filled C) Half-filled D) partially filled
25. The origin of the energy bands was explained by [ ]
    A) Free electron theory B) Classical theory C) Kronig Penny Model D) Bohr's model
26. The mass of the electron in the periodic potential field is known as [ ]
    A) Critical mass B) Effective mass C) constant mass D) relative mass
27. A semiconductor have the band structure similar to an insulator at [ ]
    A) 0 K B) 100 K C) 1000 K D) 10 K
28. An example of direct band gap semiconductor is [ ]
    A) Si B) Ge C) Al D) GaAs
29. An example for indirect band gap semiconductor is [ ]
    A) Si B) Al C) Cu D) GaAs
30. In direct band gap semiconductors energy is released in the form of [ ]
    A) Photons B) Phonons C) Gravitons D) Mesons
31. Energy band gap of Si is [ ]
    A) 1.12 eV B) 0.72 eV C) 0.55 eV D) 0.34 eV
32. Energy band gap of Ge is [ ]
    B) 1.12 eV B) 0.72 eV C) 0.55 eV D) 0.34 eV
33. In conductors, the gap between valance and conduction band is [ ]
    A) 0.5 eV B) 0.1 eV C) 0 eV D) 1 eV
34. If the temperature of a semiconductor increases, the resistance will [ ]
    B) increase B) decrease C) remain constant D) none
35. Electrical resistivity of metals depends on [ ]
    A) Concentration B) temperature C) density D) refractive index
36. In indirect band gap semiconductors energy is released in the form of [ ]
    B) Photons B) gravitons C) phonons D) Mesons
37. The energy of photon and phonon are [ ]
    A) Same B) $E_{photon} > E_{phonon}$ C) $E_{phonon} > E_{photon}$ D) $E_{photon} = E_{phonon}$
38. If a magnetic field is applied perpendicular to a current carrying conductor, a force is developed which is perpendicular to both, current magnetic fields.
    This effect is known as [ ]
    A) Meissner's effect B) Compton effect C) Hall Effect D) Direct effect
39. If the Hall coefficient is positive, the material is [ ]
    A) p-type B) n-type C) intrinsic D) none
40. Hall effect is used to find the ________________ [ ]
    A) concentration of charge carriers B) mobility of charge carriers
    C) type of semiconductor D) all the above

Unit - IV

Lasers & Optical Fibers

1. In He-Ne laser, the ratio of He and Ne in gas mixture is [ ]
   A 1:10 B 10:1 C 1:100 D 100:1
2. He-Ne laser is a good example for a ______ level system. [ ]
   A Two B Three C Four D Nine
3. In excited state, the atoms will remain for a time period of [ ]
   A 10^{-4} sec B 10^{-6} sec C 10^{-8} sec D 10^{-10} sec
4. The lasing action is possible only if there is [ ]
   A A black body B Population inversion C A set of reflecting mirrors D Oscillation of laser
5. The pumping process used in a He-Ne gas Laser is [ ]
   A optical pumping B electric discharge C chemical reaction D passing forward bias
6. Population inversion cannot be achieved by [ ]
7. A optical pumping B chemical reaction
   C electric discharge D thermal process
8. He-Ne gas laser is [ ]
   A solid state laser B semiconductor laser C continuous laser D pulsed laser
9. The ratio of Einstein coefficients $\frac{A_{21}}{B_{21}} =$ [ ]
   A $\frac{8\pi h\vartheta^3}{c^3}$ B $\frac{8\pi h\vartheta^3}{c^2}$ C $\frac{8\pi h\vartheta^3}{c}$ D $\frac{2\pi h\vartheta^3}{c^3}$
10. The wavelength of the laser emitted by the He-Ne laser is [ ]
    A 694.3 nm B 632.8 nm C 652.5 nm D 671.6 nm
11. Laser radiation is [ ]
    A monochromatic B highly directional C Coherent D All
12. Propagation of light through fiber core is due to [ ]
    A diffraction B interference C total internal reflection D refraction
13. In a He-Ne laser, atoms involved in laser emission are [ ]
    A neon B Helium C Hydrogen D Chlorine
14. Nd:YAG laser is [ ]
    A Gas laser B Liquid laser C Solid laser D Semiconducting laser
15. Measurement of variation of divergence of laser beam with distance is used to determine [ ]
    A Coherence B Monochromaticity C Brightness D Directionality
16. Coherence of light is measured from [ ]
    A Variation in spot size with distance B Visibility of interference fringes it produces C Brightness of the beam D Wavelength of the beam
17. Which of the following can be used for generation of laser pulse? [ ]
    A Ruby laser B Carbon dioxide laser C Helium neon laser D Nd- YAG laser
18. In Nd-YAG laser, YAG means [ ]
    A Yttrium Aluminium Garnet B Yellow Aluminium Garnet C $Y3Al5O12$ D Both A and B
19. The active medium in Nd:YAG laser is [ ]
    A Nd B YAG crystal C Y D AG
20. Which scientist first came up with the idea of stimulated emission? [ ]
    A Alexander Graham Bell B Isaac Newton C Arthur Schalow D Albert Einstein
21. In case of an optical fibre the acceptance angle is equal to [ ]
    A $\sin^{-1}\sqrt{{n_1}^2 - {n_2}^2}$ B $\sin^{-1}({n_1}^2 - {n_2}^2)$ C $\sin^{-1}(n_1 - n_2)$ D $\sin^{-1}\sqrt{{n_1}^2 + {n_2}^2}$

22. The refractive index of core and cladding are 1.563 and 1.498 respectively, then NA is [ ]
A 0.346 B 0.246 C 0.192 D 0.446
23. Attenuation in optical fibres is mainly due to [ ]
A Scattering losses B Absorption losses C Bending losses D All the above
24. The refractive index of core and cladding are 1.50 and 1.44 respectively, and then Δ is [ ]
A 0.4 B 0.004 C 0.04 D 4
25. In fiber optical fibre communication systems, electric signals are converted into optical signals by [ ]
A Photo detectors B LED C Solar cells D All the above
26. Numerical aperture depends on [ ]
A Acceptance angle B Critical angle C Refractive angle D Refraction angle
27. In step index fibers, the signal travel in a [ ]
A Linear manner B Random manner C Zigzag manner D Skew manner
28. In fiber optical fiber communication systems, optical signals are converted into electrical signals by [ ]
A Photo detectors B LED C Solar cells D All the above
29. The refractive index of core and cladding are 1.50 and 1.44 respectively and then acceptance angle is [ ]
A $24^\circ 50'$ B 26° C 23° D $23^\circ 65'$
30. In graded index fibers, the refractive index of the core varies [ ]
A Linearly B Exponentially C Parabolically D None
31. Losses in fiber are expressed i [ ]
A dB/km B Constant C W/m D None
32. The refractive index of core and cladding are 1.50 and 1.44 respectively, and then NA is [ ]
A 0.42 B 0.042 C 4.2 D 0.0042
33. In graded index fibre, signals travels in a [ ]
A Random manner B Skew manner C Zigzag manner D Linear manner
34. Optical fiber carries the signals in the form of [ ]
A Current B Light C X – rays D None
35. In step - index fiber the refractive index of the cladding is [ ]
A Zero B Constant C Irregular D None
36. The refractive index of the core is [ ]
A Greater than the cladding B Less than the cladding C Equal to the cladding D All the above
37. The material used in fiber is [ ]
A Copper B Alluminium C Glass D Ru bber
38. Numerical aperture (NA) = --- [ ]
A $\sin\theta$ B $\cos\theta$ C $\tan\theta$ D $\cot\theta$
39. To amplify the optical signals in their passage through the fibers, the following are used [ ]
A Amplifiers B Repeaters C Either A or B D None
40. Relative refractive index change Δ = [ ]
A $\frac{n_1+n_2}{n_1}$ B $\frac{n_1-n_2}{n_1}$ C $\frac{n_1-n_2}{n_2}$ D $\frac{n_1+n_2}{n_2}$

Unit-V
Physics of Nanomaterials

1. The average spacing between neighboring atoms in a typical crystal is about [ ]
   a) 50 Pico meters b) 300 Pico meters c) 2 nanometers d) 5 nanometers
2. Who was the first to propose the concept behind nanotechnology [ ]
   a) Galileo Galilei (1600) b) Richard P. Feynman (1959) c)K. Eric Drexler (1977)
   d) Richard Smalley (1985)
3. By reducing the size of a nanomaterial, the change in the interatomic spacing is [ ]
   a) Increased b) Decreased c) First increased and then decreased d) Kept constant
4. 1 nm = [ ]
   a) 10^{-9} mm b) 10^{-9} cm c) 10^{-9} m d) 10^{-9} m^2
5. Nanomaterials are catalysts because of their enhanced ____ [ ]
   a) Chemical activity b) thermal activity c) Mechanical activity d) optical activity
6. In quantum confinement effect, the energy levels of ------- changes. [ ]
   a) Electrons b) Atoms c) Molecules d) Nanoparticles
7. Who first visualised the concept of nanotechnology? [ ]
   a) Eric Drexler b) Richard Feynman c) Norio Taniguchi d) Newton
8. Quantum dot is an example of [ ]
   a) 1D nanomaterial b) 2D nanomaterial c)3D nanomaterial d) all
9. For a cubic nanoparticle of side ‘a’ surface area to volume ratio is given by [ ]
   a) 3/a b) 4/a c) 5/a d) 6/a
10. When the dimension of the nanoparticles is of the order of de Broglie wavelength, or mean free path of electrons, energy levels of electrons change. This effect is called ________ [ ]
    a) Surface area to volume ratio b) Quantum confinement c) CNT d) None
11. For nanomaterials, the surface area to volume ratio is [ ]
    a) Large b) Very large c) Small d) Very small
12. The size range of nanomaterials is [ ]
    a) 1 to 100 cm b) 1 to 100 nm c) 1 to 100 mm d) 1 to 100 µm
13. Clothes made up of nanofibres are [ ]
    a) Water repellent b) Wrinkle free c) Stress resistant d) All of these
14. In the fabrication of nanoparticles, bulk material is crushed into nanoparticles on _______ method. [ ]
    a) CVD b) Ball milling c) Plasma arching d) Sol-gel method
15. For a sphere of nanoparticles of radius r, surface area to volume ratio is given by [ ]
    a) 2/r b) 3/r c) 4/r d) 5/r
16. The technique used for the fabrication of nanomaterials is [ ]
    a) Ball milling b) Sol-gel c) CVD d) All of these
17. Gold nanospheres of 100 nm appear [ ]
    a) Blue in color b) Red in color c) Violet in color d) Orange in color
18. Fullerene is [ ]
    a) Carbon molecule with carbon atoms arranged in a spherical shape
    b) Thin film of polymer
    c)Another form of diamond
    d)Graphite sheets

19. SEM stands for [ ]
    a) Scanning Electron Microscope b) Scanning Echelon Meter
    c) Scanning Electron Meter d) Scanning Electrical Meter
20. Diameter of one carbon atom is [ ]
    a) 0.5 nm b) 0.05 nm c) 0.15 nmd) 5 nm
21. Nanotechnology is the engineering of functional systems at the [ ]
    A) Atomic scale b) Molecular scale c) Structure level d) Conic scale
22. Nanomaterials are [ ]
    a) Small volume materials b) The atoms or molecules
    c) Having grain size of 1 nm d) Having domain sizeabout 100 nm
23. Properties of nanoparticles differ from bulk materials due to presence of [ ]
    a) Less number of atoms b) More number of atoms
    c) Impurities d) More number of atoms and impurities
24. An electrochromic device is [ ]
    a) Used in solar cells
    b) Display device which displays information by changing colour when a voltage is applied
    c) A crystalline mixture
    d) None of the above
25. The prefix “nano” comes from a Greek word meaning ------- [ ]
    A) Billion B) Dwarf c) Invisible D) Infinite
26. Which of the following wave lengths for electromagnetic radiation (light) is within the visible region [ ]
    a)1 nm b) 100 nm c) 500 nm d) 1 μm
27. A quantum dot is [ ]
    a) An object that changes it properties upon addition or removal of a single electron
    b) A mathematical operator used in string theory, and represented by the character
    c) A hole in space time
    d) An electromagnetic vacuum fluctuation
28. In the fabrication of nanoparticles, microcrystalline structures are broken down to nano crystalline structures in [ ]
    a) Chemical vapour deposition b) Ball milling c) Plasma arching d) Sol-gel method
29. The advantages of sol-gel technique in the fabrication of nanomaterial is [ ]
    a) It is a low temperature process b) The product can be obtained from any form
    c) It is polished to optical quality d) All of the above
30. The size of red blood cell is [ ]
    a) 700 nm b) 30 nm c) 100 nm d) 1 nm
31. The size of virus is [ ]
    a) 700 nm b) 30 nm c) 100 nm d) 1 nm
32. Crystal growth is an example of --------- technique [ ]
    a) Bottom up b) Top down c) Both a&b d) None of above
33. Due to quantum confinement in nanoparticles, electronic bands become ------- [ ]
    a) Wider b) Disappear c) Narrower d) None of above
34. Preparation of nanomaterial by slicing or successive cutting of a bulk material to get nano sized particles is
    a) Bottom up b) Top down c) Both a&b d) None of above

35. Quantum well lasers and high quality optical mirrors are fabricated using – technique [ ]
A) Bottom up b) Top down c) Both a&b d) None

36. What is graphene? [ ]
a) Anew material made from carbon nanotubes
b) A one atom thick sheet of carbon
c) Thin film made from fullerenes
d) A software tool to measure and graphically represent nanoparticles

37. What is "self assembled mono layers"? [ ]
(a) Atoms are molecules that spontaneously form uniform single lawyers
(b) A type of clothing that gets thicker in response to colder temperatures
(c) An optical device that puts itself together
(d) A fuzzy logic circuit

38. SEM is used mainly to study the _____________ properties of materials [ ]
(a) Surface b) bulk c) magnetic d) chemical

39. In SEM, the lenses used are of ____________ type [ ]
a) Glass lenses b) electromagnetic lenses c) mirrors d) thin film glass

40. FET stands for [ ]
a) Field effect thermostat b) Field effect transistor
c) Field effect triode d) Function effect table