SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code : ENGINEERING PHYSICS(18HS849)

Course & Branch: B.Tech – EEE **Year & Sem:** I-B.Tech & I-Sem

Regulation: R18

UNIT –I

WAVES & OSCILLATIONS

I. Two marks questions

1 What are damped oscillations? (2M)
2 Define Q-factor? (2M)
3 Derive the differential equation for damped oscillator? (2M)
4 Define Mechanical Oscillator? (2M)
5 Define Electrical Oscillator? (2M)

II. Essay questions

1 a) What are damped oscillations?Derive the equation of motion of damped oscillator? (7M)
b) An under damped oscillator has its amplitude reduced to $(1/10)^{th}$ of its initial value after 100 oscillations.If time period is 2 seconds,calculate (1) the damping constant and (2) the decay modulus. (3M)
2 a) Derive and solve differential equation of damped harmonic oscillator?. (6M)
b) The oscillation of a tuning fork of frequency 200 c p s die away to i/e times their amplitude in one second.Show that the reduction in frequency due to air damping is exceedingly small.. (4M)
3 a) What are forced oscillations? Obtain an expression for the amplitude of forced oscillator and give the condition for amplitude resonance? (6M)
b) The amplitude of an oscillator of frequency 200 Hz falls to 1/10 of its initial value after 2000 cycles.Calculate (i) its relaxation time (ii) damping constant (4M)
4 a) What are the characterstics of Simple Harmonic Oscillator? (2M).
b) Explain Different types of vibrations? (8M)
5 a) Draw the Mechanical Anology of S.H.M? (4M)
b) Derive the equation & solution of S.H.M? (6M)
6 a) Define Q-factor? (2M)
b) What is Power dissipation? (4M)
c) The frequency of a tuning fork is 300 Hz.If its quality factor Q is 5×10^4,find time after which its energy becomes (1/10) of its initial value. (4M)

5 a) Explain detailed mechanism & solution of equation in electrical oscillator? (8M)
b) A capacitor of 3 μF is discharged through 1 ohm resistance and 3 henry inductance. Calculate the frequency of oscillation?. (2M)
6 a) Describe Energy damped harmonic oscillator? (6M).
b) The amplitude of a second pendulum falls to half initial value in 150 sec Calculate the Q- facor? (4M)
7 a) Describe equation of forced vibrations? (4M)
b) Describe the amplitude & phase of forced vibrations? (6M)
10 a) Determine the electrical analogy for a simple oscillator? (4M)
b)Describe the equation of electrical oscillator interms of inductance & capacitance? (6M)

UNIT –II

LASERS

I. Two marks questions

1 What are the characteristics lasers? (2M)
2 Define Meta stable state? (2M)
3 Abbreviate LASER and MASER? (2M)
4 How laser radiation is utilized in medical field? (2M)
5 Write two differences between stimulated and spontaneous emission of radiations? (2M)

II. Essay questions

1 a) Describe the important characteristic of laser beam? (6M)
b) Explain the difference between spontaneous and stimulated emission of radiation? (4M)
2 a) Derive the relation between the various Einstein's coefficients of absorption and emission of radiation. (6M)
b) the wavelength of emission is $6000\,\overset{0}{A}$ and the coefficient of spontaneous emission is 10^6/s. Determine the coefficient for stimulated emission? (Dr. SLR) (4M)
3 a) Explain population inversion? (5M)
b) Explain the various pumping mechanisms? (5M)
4 a) Write brief note on basic components of laser with the help of neat diagram? (5M)
b) Define Meta stable state and write its significance? (5M)
5 a) Explain the construction and working principle of He-Ne laser with suitable energy level diagram. (8M)
b) Write few advantages of He-Ne laser. (2M)
6 a) State population inversion and give its importance in the production of laser? (6M)
b) Calculate the population of the two states in He:Ne laser that produces light of wavelength $6328\,\overset{0}{A}$ at $27^0\,C$? (Dr. SLR) (4M)
7 a) Explain the construction and working of Nd:YAG laser with suitable energy level diagram? (8M)
b) What are the advantages of Nd:YAG laser? (2M)

8 a) Distinguish between He:Ne laser and Nd:YAG laser? (5M)
b) Explain the mono chromaticity and coherence of characteristics of laser? (5M)
9 a) Write short note on applications of lasers in scientific field? (5M)
b) What is lasing action? (5M)
10 a) State and explain the absorption process? (5M)
b) Write short note on applications of lasers in medical field? (5M)

UNIT-III

INTRODUCTION TO QUANTUM MECHANICS AND SOLUTION OF WAVE EQUATION

I.Two marks questions

1.What are matter waves?. (2M)

2,Mention any two properties of matter waves?. (2M)

3.What is Heisenberg's uncertainty principle?. (2M)

4.What is the significance of wave function?. (2M)

5.What are eigen functions?. (2M)

II. Essay questions

1 a) Derive the expression for de Broglie wavelength for an electron?. (6M)
b) Calculate the de Broglie wavelength of a neutron whose kinetic energy is two times the rest mass of the electron.given $m_n = 1.67 \times 10^{-27}$ kg, $m_e = 9.1 \times 10^{-31}$ kg and $h = 6.63 \times 10^{-34}$ kg. (4M)
2 a) Explain the properties of matter waves. (5M)
b) The position of electron in an atom is located within a distance of $0.1A^0$ using a microscope. What is the uncertainty in the momentum of the electron located in this way? (5M)
3 a) Derive Schrödinger's time independent wave equation. (7M)
b) Explain the physical significance of wave function. (3M)
4 a) Derive Schrödinger's time dependent wave equation. (7M)
b) An electron is moving under a potential field of 15kv. Calculate the wavelength of electron wave. (3M)
5 a) Describe the behavior of particle in a one dimensional infinite potential well in terms of Eigen values and function. (7M)
b) An electron is confined to a one dimensional potential box of 2 A^o length. Calculate the energies corresponding to the second and forth quantum states(in eV). (3M)
6 a) Explain Heisenberg uncertainty principle?. (6M)
b) The position of an electron in an atom is located within a distance of 0.1 A^o using a microscope.What is the uncertainty in the momentum of the electron located in this way?. (4M)
7 a) Draw normalized wave functions for ground and first excited states. (6M)
b) An electron is bound in a one dimensional infinite well having a width of 1×10^{-10} m. Find the energy values in the ground state and the first two excited states. (4M)
8 a) How are eigen energy values of a particle in one dimensional potential box quantized?. (6M)

b) An electron is bound in a one-dimensional box having size of 4 X 10^{-10} m.What will be its minimum energy?. (4M)

9 a) Determine the relation between Wavelength & Potential field of a particle by using de Broglie's hyphothesis?. (6M)

b) Calculate the velocity and kinetic energy of an electron of wavelength of 1.66 x 10^{-10} m. (2M)

10 a) Describe Wave & Particle Nature of Matter Waves? (6M)

b) A quantum Particle confined to one dimensional box of width 'a' is known to be in its first excited state.Determine the probability of the particle in the central half. (4M)

UNIT-IV

INTRODUCTION TO SOLIDS AND SEMICONDUCTORS

I.Two marks questions

1.Define Drift Velocity?. (2M)

2.What is relaxation time?. (2M)

3.What is Mean free path?. (2M)

4.What are allowed and forbidden energy bands?. (2M)

5.What is doping?. (2M)

II. Essay questions

1. a) What are the salient features of classical free electron theory? (6M)

b) Find the relaxation time of conduction electrons in a metal of resistivity is 1.54 X 10^{-8} Ω-m, if the metal has 5.8 X 10^{28} conduction electrons per m^3.Given m= 9.1x 10^{-31} kg. e =1.6x 10^{-19} C. (4M)

2 a) Explain quantum free electron theory. (6M)

b) Write its advantages over classical free electron theory. (4M)

3 a) Explain the origin of energy bands in solids ?. (6M)

b) Using free electron model derive an expression for electrical conductivity in metal. (4M)

4 a) Classify the solids into conductor, semiconductor and insulators based on band theory. (6M)

b) Calculate the mean free path of electron in copper of density 8.5 X 10^{28} m^{-3} . and resistivity of 1.69 X 10^{-19} Ω-m. Given m= 9.1x 10^{-31} kg,T = 300 K, e =1.6x 10^{-19} J. K_B =1.38 X 10^{-23} JK^{-1} ?. (4M)

5 a) Explain intrinsic semiconductor? (6M)

b) What is Fermi level? Locate its position for intrinsic semiconductor. (4M)

6 a) Explain extrinsic semiconductor. (4M)

b) Distinguish between n-type and p-type semiconductors? (6M)

7 a) Derive the expressions for intrinsic carrier concentration and Fermi level for intrinsic semiconductor?. (6M)

b) The following data are given for intrinsic Ge at 300K,n_i =2.4 X 10^{-19} m^{-3},μ_e = 0.39 m^2 v^{-1} s^{-1}, μ_h = 0.19 m^2 v^{-1} s^{-1} .Calculate the resistivity of the sample. (4M)

8 (a) Explain Drift and diffusion processes in semiconductors? (6M)

b) Find the diffusion coefficient of electron in silicon at 300K if $\mu_e = 0.19\ m^2\ v^{-1}\ s^{-1}$?. (4M)

9 a) Derive Einstein's relation in semiconductors? (6M)

b) The resistivity of an intrinsic semiconductor is 4.5 Ω-m at 20°C and 2.0 Ω-m at 32°C. What is the energy band gap?. (4M)

10 a) Describe the Hall effect in a semiconductor.

b) Write the applications of Hall effect.

c) The R_H of a specimen is $3.66 \times 10^{-4} m^3 c^{-1}$. Its resistivity is 8.93×10^{-3} Ωm. Find mobility and charge carrier concentration.

UNIT-V

PHYSICS OF NANOMATERIALS

I. Two marks questions

1 Define top down and bottom up process? (2M)

2 What is the principle in the Ball milling synthesis process of nanomaterial? (2M)

3 Write allotropes of Carbon? (2M)

4 What are the various structures of carbon nanotubes? (2M)

5 What are the advantages of sol-gel process? (2M)

II. Essay questions

1. a) What is nanomaterial? Write the classification of nanomaterials (4M)
   b) Explain the basic principle of nanomaterials. (6M)
2. a) What is Quantum Confinement? (4M)
   b) Write the applications of nanomaterial? (6M)
3. a) Explain why surface to volume ratio very large for nano materials? (6M)
   b) Find the surface area to volume ratio of Sphere using surface area and volume calculation for the given radius is 5 meter? (4M)
4. a) What are the techniques available for synthesizing nanomaterials? (3M)
   b) Explain ball milling technique for synthesis of nanomaterial? (7M)
5. a) Explain Sol-Gel technique for synthesis of nanomaterial? (7M)
   b) Write advantages of sol-gel process? (3M)
6. a) What are the differences between nanotechnology and NanoScience? (5M)
   b) Write short note on physical properties of carbon nanotubes? (5M)
7. a) What are carbon nanotubes? Mention its structures? (5M)
   b) Write brief note on applications of Carbon nanotubes? (5M)
8. a) What is nanotechnology? And give applications of carbn nanotubes (CNT'S) in biomedical field? (6M)
   b) What are allotropes? Write allotropes of Carbon? (4M)
9. a) Define Condensation, Crystal growth and Nucleation? (6M)
   b) Write brief note on working and characteristics of carbon nanotubes based field effect transistor (FET)? (4M)

10. a) Mention the important applications of carbon nanotubes in information technology? (5M)
    b) Explain the sensor and catalyst applications of carbon nanotubes? (5M)

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UNIT –I

WAVES & OSCILLATIONS

1. Oscillations are damped due to presence of [ ]
   A) linear motions B) restoring force C) frictional force D) mechanical force
2. When friction reduces the mechanical energy of the system as time passes,the motion is said to be [ ]
   A) simple B) damped C) random D)linear
3. The oscillations of a system in the presence of som resistive force are [ ]
   A)Linear motion B)simple harmonic motion C)damped motion D)random motion
3. Shock absorbers in automobiles are one particle application of [ ]
   A)Linear motion B)simple harmonic motion C)damped motion D)random motion
4. Maximum displacement from equilibrium position is [ ]
   A) freauency B) amplitude C)wavelength D) peroid
5. Displacement time graph depicting as oscillatory motion is [ ]
   A)Cos curve B)Sin curve C) Tangent curve D) Straight line
6. In S.H.M.,Velocity at equilibrium position is [ ]
   A) Minimum B) Constant C)Maximum D) Zero
7. Natural frequency of a guitar string can be changed by changing of [ ]
   A) Area B)Diameter C)Length D) Stiffness
8. Over-damping results in [ ]
   A) Slower return to equilibrium B)Faster return to equilibrium
   C) Equilibrium is never achieved D)Arrhythmi return to equilibrium
9. As amplitude of resonant vibrations decreases,degree of damping [ ]

A) increases B) *remains same* C) *decreases* D) varies

10 Oscillations becomes damped due to [ ]
A) normal force B) friction C)tangential force D) parallel force

11 In S.H.M objects acceleration depends upon [ ]
A) displacement from equilibrium position B) magnitude of restoring force
C) both A & B D) force exerted on it

12 Angular frequency of S.H.M. is equal to [ ]
A) 2π B) $2\pi f$ C) 2f D) 1/T

13 For a resonating system,it should oscillate [ ]
A) bound B) only for some time C) freely D)for infinite time

14 Another term used for vibration called [ ]
A)Association (B) motion (C) Tension (D)Oscillation

15 Waves which require medium for propagation are [ ]
A) electromagnetic B) mechanical C) transverse D)longitudinal

16 X- ray waves,vision waves and radio waves are the examples of [ ]
A) mechanical B) transverse C) longitudinal D)electromagnetic

17 The restoring force in a S.H.M. is _____ in a magnitude when the particle is instantaneously at rest is [ ]
A) Zero B) Minimum C) Maximum D) None

18 Energy is supplied to the damped oscillatory system at the same rate at which it is dissipating energy,then the amplitude of such oscillations should become constant.such oscillations are called [ ]
A) Damped Oscillations B) Undamped Oscillations
C) Coupled Oscillations D) Maintained Oscillations

19 The S.H.M. at resonance _____ in the ideal case of zero damping [ ]
A) Maximum B) Minimum C) Zero D) Infinite

20 A motion which repeats itself after equal intervals of time is called [ ]
A) Harmonic motion B) Wave motion C) Simple motion D) Pulsed motion

21 The Number of oscillations per second is known as [ ]
A) Amplitude B) Frequency C) Time period D) Wavelength

22 The time taken for one oscillation is known as [ ]
A)Amplitude B) Frequency C) Time period D) Wavelength

23 The ratio of the energy of the oscillator to the energy lost per radian of the angular frequency is known as [ ]
A) Quality factor B) Resonance factor C) both A & B D) None

24 The Quality factor is depends on _____ [ ]
A) Inductance 'L' B)Capacitance 'C' C) both A & B D) None

25 The amplitude & total energy remain constant for an infinite time.such vibrations are [ ]
A) Free vibraions B) Forced vibrations C) Damped vibrations D) None

26 The distance travelled by a wave at particular time 't' is known as [ ]
A)Amplitude B) Frequency C) Time period D) Wavelength

27 A particle set into oscillations in a resisting medium like air,oil is example of [ ]

A) Damped vibrations B) Forced vibrations C) free vibrations D) none

28 Radio tunning is an example of _____ vibrations. [ ]
A)Resonant vibrations B) Forced vibrations C) free vibrations D) none

29 Oscillations becomes damped due to [ ]
A) normal force B) friction C)tangential force D) parallel force

30 Power dissipation in damped harmonic oscillator is [ ]
A) P = 2bE B) P = 2b+E C) P = 2b-E D) P = 2b/E

31 The ratio of the energy of the oscillator to the energy lost per radian of the angular Frequency is [ ]
A)Quality factor B) frequency C) amplitude D)none

32 The frequency of free vibrations depends upon _____ of the body [ ]
A) Mass B) Elasticity C) Shape D)All of the above

33 If freely oscillating pendulum,the amplitude decreases continuously with time is [ ]
A) Electrical Oscillator B) Mechanical Oscillator C) both A & B D) None

34 Vibrations are divided into _____ types. [ ]
A) 1 B) 2 C) 3 D) 4

35 Natural frequency is exist in _____ vibrations [ ]
A) Free vibraions B) Forced vibrations C) Damped vibrations D) None

36 The Sum of Potential energy & Kinetic energy is _____ [ ]
A) Total Energy B) Kinetic Energy C) Potential Energy D)None

37 In forced vibrations,the amplitude is always _____ [ ]
A) Large B) Small C) large (or) small D) None

38 In free vibrations,the amplitude is always _____ [ ]
A)Large B) Small C) large (or) small D) None

39 The _____ energy of the oscillator is spent in overcoming air resistance [ ]
A) Mechanical B) Electrical C) Both A & B D) None

40 A resoring force is proportional to displacement in _____ oscillator [ ]
A) Mechanical B) Electrical C) Damped D) None

UNIT –II
(LASERS)

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. He-Ne gas laser is [ ]
   A) Solid state laser B) Semiconductor laser C) Continuous laser D) Pulsed laser
7. 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) $\frac{2\pi h\vartheta^3}{c^3}$
8. Population inversion cannot be achieved by [ ]
   A) Optical pumping B) Chemical reaction
   C) Electric discharge D) Thermal process
9. Laser radiation is [ ]
   A) Monochromatic B) Highly directional C) Coherent and Stimulated D) All
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. In a He-Ne laser, atoms involved in laser emission are [ ]
    A) Neon B) Helium C) Hydrogen D) Chlorine
12. The source of excitation in He-Ne gas laser is [ ]
    A) Xenon flash lamp B) Optical pumping C) Electric discharge D) Direct conversion
13. Emission of photon when an electron jumps from higher energy state to lower energy state due to interaction with another photon is called [ ]
    A) Spontaneous emission B) Stimulated emission
    C) Induced emission D) Amplified emission
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. Rate of stimulated emission is proportional to [ ]
    A) Population of lower energy state
    B) Population of excited state
    C) Incident radiation density
    D) Population of excited state and incident radiation density
18. What is the need to achieve population inversion? [ ]
    A) To excite most of the atoms
    B) To bring most of the atoms to ground state
    C) To achieve stable condition
    D) To reduce the time of production of laser
19. 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

20. Which of the following can be used in vibrational analysis of structure? [ ]
A) Maser B) Quarts C) Electrical waves D) Laser

21. Directionality property of laser can be used in [ ]
A) Surveying B) Remote sensing C) Lidar D) All Correct

22. In Nd-YAG laser, YAG means [ ]
A) Yttrium Aluminium Garnet B) $Y3Al5O12$
C) Yellow Aluminium Garnet D) Both A and B

23. The active medium in Nd:YAG laser is [ ]
A) Nd B) YAG crystal C) Y D) AG

24. In which region , laser emission occurs in Nd:YAG laser [ ]
A) IR region at $1.06\mu m$ B) visible region C) UV region D) RF region

25. The role of He in He-Ne laser is [ ]
A) He is an active medium B) Population inversion takes place in He
C) Stimulated emission takes place in He D) He atoms help in exciting Ne atoms

26. The reason for narrow tube in He-Ne laser [ ]
A) Atomic collision with tube wall increases
B) Atomic collision with tube wall decreases
C) There is no effect of narrow tube on He-Ne Laser
D) Atomic collision with tube wall constant

27. Population inversion in laser means [ ]
A) Number of atoms in ground state are more than number of atoms in excited state
B) Number of atoms in ground state are less than number of atoms in excited state
C) Number of atoms in ground state is equal to number of atoms in excited state
D) None

28. Metastable state has life time approximately [ ]
A) 10^{-3} s B) 10^{-8} s C) 10^{-10} s D) 10^{-12} s

29. Which of the following statements concerning a laser system is incorrect? [ ]
A) Spontaneous emission occurs in the laser system.
B) The intensity of the laser beam can be varied by changing the reflective coefficient of the partially reflecting mirror.
C) The laser system does not require an external energy source.
D) The laser medium consists of a metastable state.

30. Which one of the following statements best describes stimulated emission in a laser? [ ]
A) Electrons collide with atoms in a metastable state and cause photons to be emitted.
B) Atoms in a metastable state de-excite and cause electrons to be emitted.
C) Photons interact with atoms in a metastable state and cause photons to be emitted.
D) Photons interact with atoms in a metastable state and cause electrons to be emitted.

31. Why is laser light monochromatic? [ ]
A) The excited electrons are in a metastable state.
B) The system is in a state of population inversion.
C) The emitted photon and incident photon are of the same phase.

D) Photons of the same energy as that of the incident photons are emitted when the electrons transit down from a higher energy level.

32. What determines the color of light? [ ]
A) Its intensity B) Its wavelength C) Its source D) None

33. Which scientist first came up with the idea of stimulated emission? [ ]
A) Alexander Graham Bell B) Isaac Newton C) Arthur Schalow D) Albert Einstein

34. The life time of ground state is [ ]
A) Limited B) Unlimited C) Zero D) None

35. Pickout the monochromatic light [ ]
A) Sun light B) Tube light C) Laser D) Sodium light

36. The population of the various energy levels of a system in thermal equilibrium [ ]
A) Boltzmann distributive Law B) Stimulated emission C) Planck's Law D) None

37. Units of Planck's constant is [ ]
A) sec B) Watts C) joule-sec D) m-sec

38. If an electron excites from lower state to higher state then the process is known as [ ]
A) Absorption B) Stimulated emission C) Spontaneous emission D) All of the above

39. Coherence means [ ]
A) Ordering of light field B) Monochromaticity C) Brightness D) Directionality

40. A He-Ne laser emits light of wavelength 632.8 nm and has a output power 2.3 mW then the number of photons emitted per second is [ ]
A) 73.3×10^{14} B) 29.56×10^{14} C) 1173.5×10^{14} D) 23.5×10^{14}

UNIT-III

INTRODUCTION TO QUANTUM MECHANICS & SOLUTION OF WAVE EQUATION

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) $\boldsymbol{\Psi}$ B) $|\boldsymbol{\Psi}|^2$ C) $\boldsymbol{\Psi\Psi^*\Psi}$ D) none

4. 4) When an electron is accelerated through a potential field of 100 eV 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 it's
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 are [ ]

A) Wavelength B) Frequency C) Amplitude D) Momentum

8. Band theory of solid was developed by [ ]
   A) Sommerfeld B) Drude and Lorentz C) Bloch D) Einstein
9. The dual nature is exhibited by [ ]
   A) Particle only B) Wave only C) Photon only D) By both A and B
10. 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
11. 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
12. Einstein mass –energy relation is [ ]
    A) $\nu = \frac{mc^2}{h}$ B) $\nu = \frac{mc}{h}$ C) $\nu = \frac{hc}{\lambda}$ D) $\lambda = \frac{mc}{h}$
13. The uncertainty principle is applicable to [ ]
    A) Only small particles B) Microscopic particles
    C) All material particles D) Only tiny particles
14. The wavelength of electron moving with a velocity of 500 m/s is [ ]
    A) 1.45 nm B) 0.50 nm C) 2.90 nm D) 3.00 nm
15. Dual nature of matter wave proposed by [ ]
    A) de Broglie B) Planck C) Einstein D) Newton
16. 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) $\iiint |\Psi|\, dx\, dy\, dz = 1$
17. 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) $\frac{n^2h^2}{2ma^2}$ D) $\frac{n^2\pi^2\hbar^2}{8ma^2}$
18. The characteristic of particles are [ ]
    A) Mass B) Velocity C) Energy D) All the above
19. Potential barrier strength depends on [ ]
    A) mass of the particle B) potential of the barrier
    C) widthe of the barrier D) All of the above
20. 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
21. 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
22. According to the de Broglie, electron exhibits which nature? [ ]
    A) Wave B) Particle C) Wave and Particle D) Energy
23. 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

24. The uncertainty principle was proposed by [ ]
A) de Broglie B) Heisenberg
C) Schrodinger D) Sommerfield

25. The electrons which are in valence band are called [ ]
A) Valence electrons B) Protons C)Neutrons D) None of these

26. Einstein mass energy relation is [ ]
A) $E = mc^2$ B) $\frac{h}{\lambda} = mc$ C) $\vartheta = \frac{mc^2}{h}$ D) All

27. The characteristics of waves are [ ]
A) Energy B) Phase C) Mass D) Velocity

28. 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 [ ]

29. The Concept of matter of matter waves was suggested by [ ]
A) de Broglie B) Planck C) Einstein D) none

30. Quantum theory of radiation was proposed by [ ]
A)de Broglie B)Planck C) Einstein D) none

31. Mass- Energy relation was proposed by [ ]
A)de Brogli B) Planck C)Einstein D) none

32. The quantum free electron theory is based on the principle of [ ]
A) classical mechanics B) statistical mechanics C) quantum mechanics D) none

33. The charge of electron is [ ]
A)negative B)positive C)neutral D) none

34 .The charge of proton is [ ]
A)negative B)positive C)neutral D) none

35 The charge of neutron is [ ]
A)negative B)positive C)neutral D) none

36. Time independent wave equation was proposed by [ ]
A)heisenberg B) Schrodinger C) de Broglie D) none

37. An electron,neutron,proton have the same wavelength.Which particle has greater velocity.
A)Neutron B)Proton C) Electron D) none [ ]

38. A moving particle is associated a wave,then the wave is called as [ ]
A) Matter Wave B)Pilot Wave
C) de Broglie Wave D) All of the above

39. Characterstics of waves are [ ]
A) Wavelength B) Velocity C) Momentum D) Mass

40. Characterstics of Particles are [ ]
A) Wavelength B) Time peroid C)Frequency D) Mass

UNIT-IV

INTRODUCTION TO SOLIDS & SEMICONDUCTORS

1.Classical free electron theory was developed by [ ]
A) Sommerfeld B) Drude and Lorentz C) Bloch D) Einstein

2.Quantum free electron theory was developed by [ ]
A) Sommerfeld B) Drude and Lorentz C) Bloch D) Einstein

3.According to quantum free electron theory the expression for electrical conductivity is [ ]
A) $\frac{ne^2\tau}{m}$ B) $\frac{ne^2\tau_F}{m}$ C) $\frac{ne^2\tau_F}{m^*}$ D) $\frac{e^2\tau_F}{nm}$

4.The energy band gap between valence band and conduction band in a conductor is [ ]
A) Zero B) small C) large D) none

5.The energy band gap between valence band and conduction band in a semiconductor is[ ]
A) Zero B) small C) large D) none

6.The energy band gap between valence band and conduction band in a insulator is [ ]
A) Zero B) small C) large D) none

7.The classical free electron theory is based on the principle of [ ]
A) classical mechanics B) statistical mechanics C) quantum mechanics D) none

8. The quantum free electron theory is based on the principle of [ ]
A) classical mechanics B) statistical mechanics C) quantum mechanics D) none

9.In classical free electron theory, electrons are moving in [ ]
A)any were in the metal B) outside the metal C) not moving D) none

10.In quantum free electron theory, electrons are moving in [ ]
A)a stationary orbital B) a non-stationary orbital C) not moving D) none

11.In Band theory of solids, electrons are moving in [ ]
A) a non-periodic potential B) periodic potential C) not moving D) none

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) Drift velocity C) Relaxation time D) Average velocity

13.Classical free electron theory failed to explain [ ]
A) Specific heat of metals B) Magnetic susceptibility of metals
C) Thermionic emission D) all the above

14. The number of valence electrons in Si atom is [ ]
A) 1 B) 2 C) 3 D) 4

15.Extrinsic semiconductors are divide into _____ types. [ ]
A) 1 B) 2 C) both A & B D) none

16.The average velocity acquired by an electron is known as [ ]
A) Mean free path B) Drift velocity C) Relaxation time D) Average velocity

17.If the charge carriers are electrons, the Hall coefficient is [ ]
A) positive B) negative C) zero D) none

18.Phosphorous, arsenic and antimony are _____ elements. [ ]
A) pentavalent B) trivalent C) monovalent D) divalent

19. Electric conduction in a semiconductor occurs due to the motion of [ ]
A) free electrons only B) holes only
C) both free electrons and holes D) neither electrons nor holes

20.Holes are charge carriers in [ ]
A) intrinsic semiconductors B) ionic solids
C) n-type semiconductors D) metals

21.The time taken for the average velocity decays to 1/e of its initial value is known as [ ]
A) Mean free path B) Drift velocity C) Relaxation time D) Average velocity

22.Silicon is_____ group element. [ ]
A) first B)second C)Third D)fourth

23. The ratio of diffusion coefficient to mobility of charge carriers is proportional to [ ]
A) T B) T^2 C) 1/T D) $1/T^2$

24.At 0k, a pure semiconductor is [ ]
A) a conductor B) a resistor C) a power source D) an insulator

25.The majority charge carriers of a p-type semiconductors are [ ]
A) electron B) holes C) positive ions D) negative ions

26.The Fermi level in an n-type semiconductor lies [ ]
A) near the valence band B) near the conduction band
C) exactly at the middle of the energy gap D) none of these

27.The Hall coefficient, R_H = [ ]
A) 1/ne B) n/e C) e/n D) en

28.If the Hall coefficient is negative then the semiconductor is [ ]
A) p-type B) n-type C) intrinsic D) extrinsic

29. At 0 K pure silicon is [ ]
A) extrinsic semiconductor B) holes
C) a superconductor D) an intrinsic semiconductor

30.The majority charge carriers of a n – type semiconductors are [ ]
A) electrons B) holes C) positive ions D) negative ions

31.The Fermi level in an p – type semiconductor lies [ ]
A) near the valence band B) near the conduction band
C) exactly at the middle of the energy band D) none of these

32.The diffusion current is proportional to _____ of charge carriers. [ ]
A) concentration gradient B) drift velocity
C) mobility D) none of these

33.If the Hall coefficient is positive then the semiconductor is [ ]
A) p – type B) intrinsic C) n – type D) extrinsic

34.In intrinsic semiconductor the carrier concentration varies as [ ]
A) $T^{3/2}$ B) T^2 C) T^{-2} D) T

35.The product np varies by changing [ ]
A) pressure B) temparature
C)doping trivalent impurities D) doping pentavalent impurities

36.In intrinsic semiconductor,the electron concentration is equal to [ ]
A) ion concentration B) hole concentration
C)proton concentration D) none

37.The relation between n & p as incase of intrinsic semiconductor is [ ]
A) n = p B) n > p C) n < p D)none

38.The relation between n & p as incase of N-type extrinsic semiconductor is [ ]

A) n = p B) n > p C) n < p D)none

39.The relation between n & p as incase of P-type extrinsic semiconductor is [ ]

A) n = p B) n > p C) n < p D)none

40.Semiconductors are divided into _____ types. [ ]

A) 1 B) 2 C)3 D)none

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 (atomic precision)? [ ]
   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 nano particle 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. Cloths 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 [ ]
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. Carbon nanotubes are [ ]
A) Copper tubes B) Plastic tubes
C) Sheet of graphite rolled into a tube D) Orange in color

20. Diameter of one carbon atom is [ ]
A) 0.5 nm B) 0.05 nm C) 0.15 nm D) 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 size about 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 spectrum? [ ]
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 spacetime
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 [ ]
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. Quantum coupling refers to [ ]
A) Interaction or energy exchange on the quantum level
B) The method used by nanoscale life forms for reproduction
C) Supra-paramagnetic oscillations within quantum well devices
D) None of the above

39. Which of the following products contain nanoscale manufactured parts or materials? [ ]
A) Sunscreens B) Tennis balls C) Device that read computer hard drives D) All

40. FET stands for [ ]
A) Field effect thermostat B) Field effect transistor
C) Field effect triode D) Function

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