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

QUESTION BANK (DESCRIPTIVE)

Subject with Code :ENGINEERING PHYSICS(16HS603) **Course & Branch**: B.Tech – ECE&CSE**Year &Sem:** I-B.Tech& II-Sem**Regulation:** R16

UNIT –I

PHYSICAL OPTICS, LASERS AND FIBRE OPTICS

1	a) Describe the formation of Newton's ring with necessary theory.	(7M)
	b) Explain how the wavelength of light sources is determined by forming Newton's ring.	(3M)
2	a) Discuss Fraunhofer single slit diffraction.	(7M)
	b) Draw intensity distribution curves and give condition for bright and dark fringes in single slit diffraction pattern.	(3M)
3	a)Describe the important characteristic of laser beam?	(6M)
	b)Explain the difference between spontaneous and stimulated emission of radiation?	(4M)
4	a) Derive the relation between the various Einstein's coefficients of absorption and emission of radiation.	(6M)
	b) Explain population inversion?	(4M)
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)Explain the construction and working of Nd:YAGlaser with suitable energy level diagram.	(8M)
	b)What are the advantages of Nd:YAG laser?	(2M)
7	a) Explain the different pumping mechanisms in laser.	(5M)
	b)Explain the construction and working principle of laser diode.	(5M)
8	a) What is the acceptance angle of an optical fibre and derive an expression for it.	(8M)
	b) An optical fibre has a core refractive index of 1.44 and cladding refractive index of 1.40. Find its acceptance angle,θ_a.	(2M)
9	a) What is the numerical aperture of an optical fibre and derive an expression for it.	(7M)
	b) An optical fibre has a numerical aperture of 0.20 and cladding refractive index of 1.59. Determine the refractive index of core and the acceptance angle for the fibre in water has a refractive index of 1.33.	(3M)
10	a) Differentiate step index and graded index fibers.	(5M)
	b) Write brief note on attenuation in optical fibers.	(5M)

UNIT –II

CRYSTALLOGRAPHY, ACOUSTICS AND ULTROSONICS

1. a) What is (i) Unit cell (ii) Basis (iii) Bravais Lattice. (3M)
   b) Explain the various types of crystal systems with a neat sketch and examples. (7M)
2. a) Derive the packing factor of SC. (5M)
   b) Derive the packing factor of BCC. (5M)
3. a) Define coordination number and atomic packing factor. (2M)
   b)Show that FCC is mostly closed packed structure than BCC and SC. (8M)
4. a) What are Miller indices?Mention the procedure to find Miller indices (7M)
   b) Write the important features of Miller indices. (3M)
5. a) Deduce the expression for the interplanar distances in terms of miller indices for a cubic system (7M)
   b) Draw miller indices of planes (1 0 0) , (1 0 1) and (0 1 1) (3M)
6. a) State and explain Bragg's law of X-ray diffraction. (7M)
   b) Find the ratio $d_{100}:d_{110}: d_{111}$ for a simple cubic structure. (3M)
7. a) Describe the production of ultrasonic by piezoelectric method. (7M)
   b) X-ray of wave length $1.5418A^0$ are diffracted by (111) planes in a crystal at an angle 30^0 in the first order. Calculate inter atomic spacing. (3M)
8. a) Write the properties of Ultrasonic waves. (5M)
   b) Explain the detection methods of Ultrasonic waves. (5M)
9. a) Explain Piezoelectric effect. (4M)
   b) Describe the application of Ultrasonic in non destructive testing(NDT) of material. (6M)
10. a) Define Reverberation and Reverberation time? (4M)
    b) What are the basic requirement of acoustically good hall? (6M)

UNIT-III

QUANTUM MECHANICS AND FREE ELECTRON THEORY

1 a) What is de Broglie Hypothesis? Derive the expression for de Broglie wavelength for an electron?. (6M)
   b) Explain the properties of matter waves. (4M)
2 a) Explain Heisenberg uncertainty principle. (5M)
   b) What are it's applications. (3M)
   c) 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? (2M)
3 a) Derive Schrödinger's time independent wave equation. (8M)
   b) An electron is moving under a potential field of 15kv. Calculate the wavelength of electron wave. (2M)

4 a) Derive Schrödinger's time dependent wave equation. (6M)
b) Explain the physical significance of wave function. (4M)
5 a) Describe the behavior of particle in a one dimensional infinite potential box or well in terms of Eigen values and function. (7M)
b) Draw normalized wave functions for ground and first excited states. (3M)

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6 a) What are the salient features of classical free electron theory? Derive an expression for electrical conductivity in a metal (7M)
b) Mention its drawbacks (3M)
7 a) Derive an expression for electrical conductivity in a metal using Quantum Free Electronic theory (7M)
b) Write its advantages over classical free electron theory. (3M)
8 a) Using classical free electron model derive an expression for electrical conductivity in metal. (7M)
b) Find relaxation time of conduction electron in metal if its resistivity is $1.54 \times 10^{-8}\Omega m$ and it has 5.8×10^{28} conduction electron/m^3. Given m= 9.1×10^{-31} kg, e= 1.6×10^{-19} C. (3M)
9 Classify the solids into conductor, semiconductor and insulators based on band theory. (10M)
10 a) Explain the origin of energy bands in solids. (6M)
b) For the matal having 6.5×10^{28} conduction electron/m^3 . Find the relaxation time of conduction electrons if the metal has resistivity $1.43 \times 10^{-8}\Omega$ m. Given m= 9.1×10^{-31} kg, e= 1.6×10^{-19} C. (4M)

UNIT-IV

SEMICONDUCTORS AND MAGNETIC MATERIALS

1. a) What are intrinsic and extrinsic semiconductors? (4M)
b) Derive the expression for intrinsic carrier concentraton. (6M)
2. a) Explain N-type semiconductor. (4M)
b) Explain Drift processes in semiconductors. (6M)
3. a) What is Fermi level? Show that Fermi level $E_F = \frac{E_C + E_V}{2}$. (5M)
b) Derive Einstein's relation in semiconductors? (5M)
4. a) Explain P-type semiconductor. (4M)
b) Explain Diffusion processes in semiconductors. (6M)
5. a) Describe the Hall effect in a semiconductor. (7M)
b) Write the applications of Hall effect. (3M)
6. a) Distinguish between direct and indirect band gap semiconductors. (6M)
b) The R_H of a specimen is $3.66 \times 10^{-4} m^3 c^{-1}$. Its resistivity is $8.93 \times 10^{-3}\Omega m$. Find mobility and charge carrier concentration. (4M)
7. a) Define i) magnetic moment ii) magnetic permeability and iii) magnetic susceptibility. (3M)

b) Explain the origin of magnetic moments. (7M)

8. a) Define i) magnetization ii) magnetic flux density and iii) relative permeability. (3M)
   b) Derive relation between μ_r and χ. (5M)
   c) A magnetic material has a magnetization of 3300 A/m and flux density of 0.0044 Wb/m^2.Calculate the magnetizing force and relative permeability of the material. (2M)
9. a) Describe the classification of magnetic materials based on spin magnetic moments. (7M)
   b) Discuss the applications of soft magnetic materials. (3M)
10. a) Explain B-H curve of ferromagnetic material. (6M)
    b) What are soft and hard magnetic materials. (4M)

UNIT-V

SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS

1. a) What is superconductivity? Write the properties of super conductors. (5M)
   b) Explain penetration depth in superconductor. (5M)
2. a)What is critical temperature, critical magnetic field and critical current? (3M)
   b) Prove that super conductor is a very good diamagnetic material. (7M)
3. a) Explain the types of superconductors. (6M)
   b) Write properties of super conductors. (4M)
4. a) Explain critical magnetic field? (3M)
   b) Explain BCS theory of superconductors. (7M)
5. a) Explain flux quantization in superconductors. (7M)
   b) A superconducting material has a critical temperature of 3.7K and a magnetic field of 0.0306T at 0K. Find the critical field at 2K. (3M)
6. a) What is Meissner effect? (5M)
   b) Explain Josephson effect in superconductors. (5M)
7. a) Explain Type-I and Type-II superconductors. (6M)
   b) Write the applications of super conductors. (2M)
   c) Calculate the critical current for a lead wire of 0.5mm radius at 4.2k . Given for lead T_c = 7.18K, Ho=6.5 x 10^4A/m. (2M)
8. a) What is nanomaterial? Write the classification of nanomaterials (4M)
   b) Explain the basic principle of nanomaterials. (6M)
9. a) What is Quantum Confinement? (4M)
   b) Write the applications of nanomaterial. (6M)
10. a) What are the techniques available for synthesizing nanomaterials? (3M)
    b) Explain ball milling technique for synthesis of nanomaterial. (7M)

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QUESTION BANK (OBJECTIVE)

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UNIT –I

PHYSICAL OPTICS, LASERS AND FIBRE OPTICS

1. Wave nature of light is supported by [ ]
   A) Photoelectric effect B) Interference
   C) Black body radiation D) All
2. Two sources are said to be coherent if their emitted waves have [ ]
   A) same wavelength B) same amplitude
   C) constant phase difference D) All
3. In the presence of a plane parallel film, the path difference is equal to [ ]
   A) $2\mu \sin i$ B) $2\mu t \cos r$ C) $2\mu \sin r$ D) $2\mu t \cos i$
4. In Newton's rings experiment, what is the condition for dark fringes in case of reflected light
   A) D α $\sqrt{2n+1}$ B) D α n[ ]
   C) D α $\sqrt{n}$ D) D α $\sqrt{2n-1}$
5. If a light wave is refracted from air to denser medium then the phase and path difference is
   A) π and λ B) π and λ/2 [ ]
   C) π/2 and λ D) π/2 and λ/2
6. When the light wave is reflected from the glass-air interface, the change of the reflected wave will be [ ]
   A) 0 B) π/2 C) π/4 D) π
7. The convex lens in Newton's ring apparatus is replaced by an ordinary glass plate, then
   A) non-interference occurs B) circular rings are still obtained [ ]
   C) interference takes place but the shape of fringes is irregular
   D) straight line fringes are observed
8. When the light wave is reflected from the air-glass interface, the change of phase of the reflected wave will be [ ]
   A) 0 B) π/2 C) π/4 D) π
9. In Newton's rings experiment, what is the condition for bright fringes in case of reflected light

A) D α $\sqrt{2n+1}$ B) D α n [ ]

C) D α $\sqrt{n}$ D) D α $\sqrt{2n-1}$

10. In a diffraction grating, the condition for principal maxima is [ ]

A) $e \sin\theta = n\lambda$ B) $(e + d) \sin\theta = n\lambda$

C) $d \sin\theta = n\lambda$ D) $\sin\theta = n\lambda$

11. In a single slit experiment if the slit width is reduced [ ]

A) the fringes become narrower B) the fringes become brighter

C) the fringes become wider D) the colour of the fringes change

12. In which experiment the screen and sources are at finite distance [ ]

A) Fraunhofer diffraction B) Fresnel's diffraction

C) Young's diffraction D) Newton's diffraction

13. Maximum number of orders possible with a grating is [ ]

A) independent of grating element B) inversely proportional to grating element

C) directly proportional to grating element D) directly proportional to wavelength

14. In a grating, the combined width of a ruling and a slit is called _____ [ ]

A) diffraction B) corresponding points C) grating element D) none

15. 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

16. He-Ne laser is a good example for a _____ level system. [ ]

A) two B) three C) four D) nine

17. 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

18. 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

19. The pumping process used in a He-Ne gas Laser is [ ]

A) optical pumping B) electric discharge

C) chemical reaction D) passing forward bias

20. He-Ne gas laser is [ ]

A) solid state laser B) semiconductor laser C) continuous laser D) pulsed laser

21. 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) $\frac{2\pi h\vartheta^3}{c^3}$

22. Population inversion cannot be achieved by [ ]

A) optical pumping B) chemical reaction

C) electric discharge D) thermal process

23. Laser radiation is [ ]

A) monochromatic B) highly directional C) coherent and stimulated D) all

24. 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

25. In a He-Ne laser, atoms involved in laser emission are [ ]

A) neon B) helium C) hydrogen D) chlorine

26. Propagation of light through fiber core is due to [ ]

A) diffraction B) interference
C) total internal reflection D) refraction

27. 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) $\sin^{-1}\sqrt{{n_1}^2 + {n_2}^2}$

28. The refractive index of core and cladding are 1.563 and 1.498 respectively and then NA is
A) 0.346 B) 0.246 C) 0.192 D) 0.446 [ ]

29. Attenuation in optical fibres is mainly due to [ ]
A) scattering losses B) absorption losses
C) bending losses D) All the above

30. 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

31. Numerical aperture depends on [ ]
A) Acceptance angle B) critical angle
C) refractive angle D) refraction angle

32. 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 [ ]

33. In step index fibers, the signal travel in a [ ]
A) linear manner B) random manner
C) zigzag manner D) skew manner

34. 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 [ ]

35. The refractive index of core and cladding are 1.50 and 1.44 respectively and then acceptance angle is [ ]
A) 24˚50′ B) 26˚ C) 23˚ D) 23˚65′

36. In graded index fibers, the refractive index of the core varies [ ]
A) linearly B) exponentially C) parabolically D) none

37. Losses in fiber are expressed in [ ]
A) dB/km B) constant C) w/m D) none

38. 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) $\frac{n_1+n_2}{n_2}$

39. 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 [ ]

40. In graded index fibre, signals travels in a [ ]
A) random manner B) skew manner C) zigzag manner D) linear manner

UNIT –II

CRYSTALLOGRAPHY, ACOUSTICS AND ULTROSONICS

1. The relation between atomic radius r and lattice constant a for the case of simple cubic structure is [ ]

   A) $a = 2r$ B) $a = r/2$ C) $4/\sqrt{3}\,r$ D) $2\sqrt{2}r$

2. Atomic packing factor of simple cubic crystal system in [ ]

   A) 0.68 B) 0.7 C) 1.00 D) 0.52

3. The crystal system of primitives a=b≠ c and interfacial angles $\propto = \beta = 90°, \gamma = 120° is$known as [ ]

   A) cubic B) tetragonal C) monoclinic D) hexagonal

4. Bragg's reflection can occur only for wavelengths [ ]

   A) $\lambda \leq 2d$ B) $\lambda \leq d$ C) $\lambda \leq 2a$ D) for all wavelengths

5. If miller indices are (101) then it represents [ ]

   A) Plane parallel to X-axis B) Plane parallel to Y-axis

   C) Plane parallel to Z-axis D) Plane parallel to X-axis and Z-axis

6. Triclinic system possesses lattice parameters is [ ]

   A) $a \neq b \neq c\ ;\ \alpha \neq \beta \neq \gamma \neq 90^0$ B) $a \neq b \neq c\ ;\ \alpha = \beta = \gamma \neq 90^0$

   C) $a = b = c\ ;\ \alpha \neq \beta \neq \gamma \neq 90^0$ D) $a = b \neq c\ ;\ \alpha = \beta = \gamma = 90^0$

7. Optimum reverberation time for music is [ ]

   A) 0.5 to 1 sec B) 0 to 1 sec C) 1 to 2 sec D) above 5 sec

8. Which radiation produces diffraction as they pass through the crystals? [ ]

   A) X-rays B) IR-rays C) γ-rays D) UV-rays

9. Which one of the following has maximum absorption coefficient [ ]

   A) marble B) carpet C) human body D) glass

10. To have good sound effect inside a hall [ ]

    A) The reverberation time has to be as large as possible

    B) The reverberation time has to be zero

    C) The hall should not have any sound absorbing material

    D) The reverberation time has to be optimum.

11. A smallest block whose repetition in space indefinitely generates a crystal is called [ ]

    A) Primitive cell B) Space lattice C) Unit cell D) None

12. The number of atoms present in a unit cell of simple cubic structure [ ]

    A) 8 B) 1 C) 4 D) 6

13. The relation between atomic radius r and lattice constant a for the case of BCC system is

    A) a=2r B) $4/\sqrt{3}\,r$ C) a=$2\sqrt{2}\,r$ D) a=$\sqrt{3}/4$r [ ]

14. The miller indices of the plane parallel to z-axis are [ ]

    A) (0 0 1) B) (1 0 1) C) (11 0) D) (100)

15. The crystal system of primitives a=b≠ c and interfacial angles $\propto = \beta = 90°, \gamma = 120° is$known as [ ]

A)cubic B) tetragonal C) monoclinic D) hexagonal

16. Sabine's formula is [ ]

    A) $T = \dfrac{0.651V}{\sum aS}$ B) $T = \dfrac{0.165V}{\sum aS}$ C) $T = \dfrac{\sum aS}{0.651V}$ D) $T = \dfrac{\sum aS}{0.165V}$

17. Lattice + Basis = [ ]
A) Unit cell B) Crystal C) Amorphous solid D) None of this

18. If Miller indices are (101) then it represents [ ]
A) plane parallel to x -axis B) plane parallel to y -axis
C) plane parallel to z-axis D) plane parallel to x-axis and z-axis

19. Interplanar distance for (111) plane is [ ]
A) $a\sqrt{3}$ B) $a/\sqrt{3}$ C) $3a$ D) $a/3$

20. The number of crystal system is [ ]
A) 4 B) 5 C) 6 D) 7

21. The number of atoms per unit cell in a BCC lattice is [ ]
A) 1 B) 2 C) 4 D) 8

22. Atomic packing factor of BCC crystal system is [ ]
A) 0.68 B) 0.74 C) 1.00 D) 0.52

23. The relation between atomic radius r and lattice constant a in the case of FCC crystal system is
A) $a = 2r$ B) $a = \frac{4}{\sqrt{3}}r$ C) $a = 2\sqrt{2}r$ D) $a = \frac{r}{2\sqrt{2}}$ [ ]

24. The materials having different properties along different directions are called [ ]
A) anisotropic B) isotropic C) amorphous D)None of the above

25. The planes (112) and (224) are [ ]
A) perpendicular to each other B) intersecting at angle other than 90^0
C) parallel to each other D) None of the above.

26. The Miller indices of the plane parallel to the x-axis and y-axis are [ ]
A) (1 1 0) B) (0 1 1) C) (1 0 0) D) (0 0 1)

27. The Miller indices (hkl) represents [ ]
A) the direction B) a plane C) system of planes D) a set of parallel plane.

28. The velocity of ultrasonic waves in air is [ ]
A) 120 m/s B) 420m/s C)330 m/s D) 480 m/s

29. There are ___ distinguishable ways of arranging points in three dimensional spaces called Bravaislattice [ ]
A) 7 B) 14 C) 8 D) 5

30. The number of atoms per unit cell in an FCC lattice is [ ]
A) 1 B) 2 C) 4 D) 8

31. Atomic packing factor of FCC crystal system is [ ]
A) 0.68 B) 0.74 C) 0.52 D) 1.00

32. Which one of the following has minimum absorption coefficient [ ]
A) glass B)felt C)open window D) wooden floor

33. The walls of a halls built for music concerns should [ ]
A) amplify sound B) reflect sound C) transmit sound D) absorb sound

34. The speed of propagation of ultrasonic waves _____with the increase of frequency [ ]
A) Increases B) Decreases
C) Exponentially increases D) Exponentially decreases

35. The principle used for the production of Ultrasonic wave is [ ]
A) Hall Effect B) Compton Effect
C) Piezoelectric Effect D) Photoelectric Effect

36. What is the range of infrasonic waves [ ]

A) 1 Hz – 20 Hz B) 20 Hz – 20 kHz

C) 20 Hz – 20MHz D) All

37. Which of the following frequencies lies in the range of Ultrasonic waves [ ]

A) 10 KHz B) 8 KHz C) 6 KHz D) 1MHz

38. Ultrasonic waves can be detected by [ ]

A) Kundt's tube method B) Sensitive flame method

C) Thermal detector method D) All of these

39. A quartz crystal of thickness t with young's modulus Y and density ρ then the fundamental frequency of vibration given by [ ]

A) $f = \frac{1}{2t}\sqrt{\frac{Y}{\rho}}$ B) $f = 2t\sqrt{\frac{Y}{\rho}}$ C) $f = \frac{1}{2t}\sqrt{\frac{\rho}{Y}}$ D) $f = \frac{1}{t}\sqrt{\frac{Y}{\rho}}$

40. A quartz crystal of thickness t with young's modulus Y and density ρ then the second overtone is given by [ ]

A) $f = \frac{3}{2t}\sqrt{\frac{Y}{\rho}}$ B) $f = 2t\sqrt{\frac{Y}{\rho}}$ C) $f = \frac{3}{2t}\sqrt{\frac{\rho}{Y}}$ D) $f = \frac{3}{t}\sqrt{\frac{Y}{\rho}}$

UNIT-III

QUANTUM MECHANICS AND FREE ELECTRON THEORY

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. 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 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. Velocity of matter waveis always _____ of velocity of light. [ ]

A) Less than B) equal C)greater than D) none of these

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. Probability density of a wave function ψ is [ ]
A) ψ B) $|\psi^2|$ c) $\int \psi\, \psi^* dt d\psi$ D) none

20. The wavelength of de Broglie wave associated with a moving particle is independent of it's
A) Mass B) Charge C) Velocity D) Momentum [ ]

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 is applicable to [ ]
A) Only small particles B) Microscopic particles
C) All material particles D) Only tiny particles

25. According to the de Broglie, electron exhibits which nature? [ ]
A) Wave B) Particle C) Wave and Particle D) Energy

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

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

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

31. The classical free electron theory is based on the principle of [ ]
A) classical mechanics B) statistical mechanics C) quantum mechanics 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. In classical free electron theory, electrons are moving in [ ]
A)any were in the metal B) outside the metal
C) not moving D) none

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

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

36. The uncertainty principle is applicable to
A) only small particles B) microscopic particles
C) all material particles D) only tiny particles [ ]

37. Lattice vibration is also known as [ ]
A) phonon scattering B) by impurities C) by defects D) all

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

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

40. 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) $\frac{e^2\tau_F}{nm}$ [ ]

UNIT-IV

SEMICONDUCTORS AND MAGNETIC MATERIALS

1. 1. The number of valence electrons in Si atom is [ ]
A) 1 B) 2 C) 3 D) 4
2. Gallium arsenide is a _____ band gap semiconductor. [ ]
A) indirectB) direct C) both A & B D) none
3. Under forward bias, the width of depletion region_____ [ ]
A) decreases B) increases C) constant D) All
4. If the charge carriers are electrons, the Hall coefficient is [ ]
A) positive B) negative C) zero D) none

5. Phosphorous, arsenic and antimony are _____ elements. [ ]
   A) pentavalent B) trivalent C) monovalent D) divalent
6. 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
7. Holes are charge carriers in [ ]
   A) intrinsic semiconductors B) ionic solids
   C) n-type semiconductors D) metals
8. Under reverse bias, the width of the depletion region [ ]
   A) increases B) decreases C) constant D) none
9. Silicon is a _____ band gap semiconductor. [ ]
   A) direct B) indirect C) Both A & B D) none
10. The ratio of diffusion coefficient to mobility of charge carriers is proportional to
    A) T B) T^2 C) 1/T D) $1/T^2$ [ ]
11. At 0K, a pure semiconductor is [ ]
    A) a conductor B) a resistor C) a power source D) an insulator
12. The majority charge carriers of a p-type semiconductors are [ ]
    A) electron B) holes C) positive ions D) negative ions
13. 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
14. The Hall coefficient, R_H = [ ]
    A) 1/ne B) n/e C) e/n D) en
15. If the Hall coefficient is negative then the semiconductor is [ ]
A) p-type B) n-type C) intrinsic D) extrinsic
16. At 0 K pure silicon is [ ]
    A) extrinsic semiconductor B) holes
    C) a superconductor D) an intrinsic semiconductor
17. The majority charge carriers of a n – type semiconductors are [ ]
    A) electrons B) holes C) positive ions D) negative ions
18. 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 band D) none of these
19. The diffusion current is proportional to _____ of charge carriers. [ ]
    A) concentration gradient B) drift velocity
    C) mobility D) none of these
20. If the Hall coefficient is positive then the semiconductor is [ ]
    A) p – type B) intrinsic C) n – type D) extrinsic
21. Copper is _____ magnetic material. [ ]
    A) dia B) para C) ferro D) anti-ferro
22. The SI unit of magnetic moment is [ ]
    A) Wb/m^2 B) Wb C) A/m^2 D) $A\ m^2$
23. Relation between B, H and M is [ ]
    A) $B = \mu_o(H+M)$ B) $M = \mu_o(H+B)$

C) $H = \mu_o(B+M)$ D) $B = \mu(H+M)$

24. Magnetic susceptibility is [ ]
A) torque per unit area B) dipole moment per unit volume
C) magnetization per unit magnetic field intensity D) none of these

25. One Bohr magneton μ_B is equal to [ ]
A) $\frac{4\pi m}{eh}$ B) 4πmhe C) $\frac{me}{4\pi h}$ D) $\frac{eh}{4\pi m}$

26. Relative permeability is related to magnetic susceptibility by [ ]
A) $\mu_r = 1 - \chi$ B) $\mu_r = 1 + \chi$ C) $\mu_r = \chi - 1$ D) $\mu_r = 1/\chi$

27. A field of strength 100 A/m produces a magnetization 2000 A/m in a ferromagnetic material. The relative permeability of the material is [ ]
A) 19 B) 3 C) 21 D) 1.05

28. The area enclosed by hysteresis loop is a measure of [ ]
A) retentivity B) susceptibility
C) permeability D) energy loss per cycle

29. Material which lack permanent dipoles are called_____ [ ]
A) diamagnetic B) paramagnetic
C) ferromagnetic D) ferrimagnetic

30. The permeability of free space is [ ]
A) $4\pi \times 10^{-7}$ H/m B) $4\pi \times 10^{-8}$ H/m
C) $2\pi \times 10^{-7}$ H/m D) $2\pi \times 10^{-8}$ H/m

31. To obtain p-type semiconductor out of the following impurities to be added [ ]
A) arsenic B) antimony C) indium D) phosphorus

32. The magnetic dipole moments of neighbouring atoms are antiparallel and unequal for __ magnetic material [ ]
A) dia B) para C) ferri D) anti-ferro

33. The hysteresis loss is less for _____ magnetic materials. [ ]
A) dia B) para C) soft D) hard

34. Diamagnetic susceptibility is [ ]
A) large, negative B) small, negative C) small, positive D) large, positive

35. One Bohr magneton equal to [ ]
A) 9.27×10^{-16} A m^2 B) 9.27×10^{-19} A m^2
C) 9.27×10^{-28} A m^2 D) 9.27×10^{-24} A m^2

36. Magnetic dipole moment per unit volume of material is called [ ]
A) Permeability B) Polarisation
C) Magnetisation D) Magnetic induction

37. The materials don't having permanent magnetic dipoles are [ ]
A) diamagnetic B) paramagnetic
C) ferromagnetic D) ferrimagnetic

38. The SI unit of magnetic field intensity is [ ]
A) H/m B) Wb/m^2 C) A/m D) no unit

39. One nuclear magneton equals to [ ]
A) 9.27×10^{-24} A m^2 B) 5.05×10^{-29} A m^2
C) 5.05×10^{29} A m^2 D) 9.27×10^{24} A m^2

40. Paramagnetic susceptibility varies as [ ]
A) T^2 B) 1/T C) T D) $1/T^2$

UNIT-V

SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS

1. 1. The conductivity of superconductor is [ ]
A) zero B) finite C) infinite D) none
2. Type – I superconductors are [ ]
A) soft B) hardC) ductile D) flexible
3. A lead superconductor with $T_C = 7.2$ K has a critical magnetic field of 6.5×10^3 A/m at absolute zero. What could be the value of critical field at 5K? [ ]
A) 3.365 A/m B) 33.65 A/m C) 336.5 A/m D) 3365 A/m
4. The critical temperature is _____ for different substances. [ ]
A) same B) different C) Both A and B D) none
5. Theory which explains superconductivity is [ ]
A) Lattice theory B) Lorentz theory C) BCS theory D) all
6. Type – II superconductors are [ ]
A) soft B) hard C) ductile D) flexible
7. Superconductors exhibiting complete Meissner effect is called _____ [ ]
A) soft B) hard C) ductile D) flexible
8. The following element will not show superconductivity [ ]
A) Copper B) Gold C) Silver D) All
9. The maximum current that can be passed through a superconductor is called [ ]
A) super current B) critical current C) optimum current D) none
10. Superconductivity mainly occurs due to [ ]
A) electron – electron interaction B) electron – proton interaction
C) proton – proton interaction D) none
11. Hysteresis means ____ of an effect behind the cause of effect. [ ]
A) laggingB) advancing C) Both A & B D) none
12. The superconducting transition temperature of mercury is [ ]
A) 4.2 ^oC B) 4.2 K C) 4.2 ^oF D) none
13. Cooper pairs are broken at _____ temperature. [ ]
A) critical temperature B) below critical temperature
C) above critical temperature D) 0 K
14. The magnetizations of a superconductor is [ ]
A) 0 B) H C) 1 D) -H
15. At low temperature, the normal conductor acts as a [ ]
A) semiconductor B) insulator C) superconductor D) none
16. Above Curie temperature, a ferromagnetic substance becomes [ ]

A) Paramagnetic B) diamagnetic
C) antiferromagnetic D) strongly ferromagnetic

17. The critical magnetic field at temperature T K is [ ]
A) $H_0\left[1-\left(\frac{T}{T_C}\right)^2\right]$ B) $H_C\left[1-\left(\frac{T}{T_C}\right)^2\right]$
C) $H_0\left[1+\left(\frac{T}{T_C}\right)^2\right]$ D) $H_C\left[1+\left(\frac{T}{T_C}\right)^2\right]$

18. A superconductor is a perfect _____ material. [ ]
A) diamagnetic B) dielectric C) insulator D) semiconductor

19. In a superconductor [ ]
A) $\chi = -1$ B) B = 0 C) H = -M D) All

20. A superconductor exhibits _____ resistance. [ ]
A) small B) large C) zero D) infinite

21. 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

22. 1 nm = [ ]
A) 10^{-9} mm B) 10^{-9} cm C) 10^{-9} m D) 10^{-9} m^2

23. The relation between critical current and critical magnetic field is [ ]
A) $H_C = \frac{I_C}{2\pi r}$ B) $H_C = \frac{I_C}{\pi r^2}$
C) $I_C = \frac{H_C}{\pi r^2}$ D) $I_C = \frac{H_C}{2\pi r}$

24. Nanomaterials are catalysts because of their enhanced ____ [ ]
A) Chemical activity B) thermal activity
C) Mechanical activity D) optical activity

25. In quantum confinement effect, the energy levels of ------- changes. [ ]
A) electrons B) atoms C) molecules D) nanoparticles

26. Who first visualised the concept of nanotechnology? [ ]
A) Eric Drexler B) Richard Feynman
C) Norio Taniguchi D) Newton

27. Quantum dot is an example of [ ]
A) 1D nanomaterial B) 2D nanomaterial C) 3D nanomaterial D) all

28. For a cubic nanoparticle of side 'a' surface area to volum ratio is given by
A) 3/a B) 4/a C) 5/a D) 6/a [ ]

29. 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

30. For nanomaterials, the surface area to volume ratio is [ ]
A) largeB) very large C) small D) very small

31. 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

32. Cloths made up of nanofibres are [ ]

A) water repellent B) wrinkle free C) stress resistant D) all of these

33. 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

34. 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

35. The technique used for the fabrication of nanomaterials [ ]

A) Ball milling B) Sol-gel C) CVD D) All of these

36. Gold nanospheres of 100 nm appear [ ]

A) blue in color B) red in color

C) violet in color D) orange in color

37. The superconducting transition temperature of Lead is [ ]

A) 7.2 K B) 4.2 K C) 4.12 K D) none

38. Soft superconductors are [ ]

A) Type – I B) Type – II C) ductile D) flexible

39. Hard superconductors are [ ]

A) Type – I B) Type – II C) ductile D) flexible

40. Super conductors are good conductors at _____ temperature.

A) Below 27°C B) above 27°C C) 27°C D) 27°K

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