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QUESTION BANK (DESCRIPTIVE)

Subject with Code : PHYSICS(18HS0849) **Course & Branch**: B.Tech – EEE

Year & Sem: I-B.Tech & I-Sem **Regulation:** R18

UNIT –I

WAVES & OSCILLATIONS

Short Answer (2 mark) Questions

1 What are damped oscillations? Give examples. (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)

Essay Answer (10 mark) Questions

1 a) What are damped oscillations? Derive the equation of motion and solution 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?. (7M)
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.. (3M)

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)

7. 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)

8. 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- factor? (4M)
9. 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 in terms of inductance & capacitance? (6M)

UNIT –II

LASERS

Short Answer (2 mark) 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)

Essay Answer (10 mark) 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

Short Answer (2 mark) 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)

Essay Answer (10 mark) 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. (6M)
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? (4M)
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 4×10^{-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 1.66×10^{-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

Short Answer (2 mark) Questions

1.Define Drift Veloctity?. (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)

Essay Answer (10 mark) 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 1.54×10^{-8} Ω-m, if the metal has 5.8×10^{28} conduction electrons per m^3.Given m= 9.1×10^{-31} kg. e =1.6×10^{-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 8.5×10^{28} m^{-3} . and resistivity of 1.69×10^{-19} Ω-m. Given m= 9.1×10^{-31} kg,T = 300 K, e =1.6×10^{-19} J. $K_B = 1.38 \times 10^{-23}$ 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,$n_i = 2.4 \times 10^{-19}$ m^{-3},$\mu_e = 0.39$ m^2 v^{-1} s^{-1}, $\mu_h = 0.19$ 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 x $10^{-4}m^3c^{-1}$. Its resistivity is 8.93x$10^{-3}\Omega$m. Find mobility and charge carrier concentration.

UNIT-V

Short Answer (2 mark) Questions

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)

Essay Answer (10 mark) 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)