PUNE INSTITUTE OF COMPUTER TECHNOLOGY, PUNE Department of First Year Engineering S.No.-27, Pune Satara Road, Dhankawadi, Pune-411043	
Question Bank for Engineering Physics (107002) Unit 3 to Unit 6	
Academic Year	**2021-22 Sem II.**
Examination Scheme	**In Semester Exam :** 30 marks **End Semester Exam :** 70 marks **Practical :** 25 marks

Unit-3-Quantum Mechanics.

Sr.No.	Questions.
1	Explain de Broglie's concept of matter waves. Show that the wavelength associated with electrons accelerated by a potential difference V volts is given by $\lambda = \frac{h}{\sqrt{2meV}}$
2	State and explain the principle of uncertainty; and illustrate it by a thought experiment of electron diffraction at a single slit.
3	What are matter waves? State and explain properties of matter waves.
4	What is wavefunction? Explain the physical significance of $\psi\ and\ \|\psi\|^2$
5	Derive Schrodinger's time independent wave equation.
6	Derive Schrodinger's time dependent wave equation.
7	Derive expression for energy when a particle is confined to an infinite potential well.
8	Explain tunneling effect.
9	What accelerating potential would be required for a proton with zero initial velocity to acquire a velocity corresponding to its de -Broglie wavelength of 10^{-10}m.
10	Calculate De-Broglie's wavelength associated with i) Proton having kinetic energy 1 MeV. ii) Proton accelerated by 10 kV Potential difference. iii) Proton moving with 1% of velocity of light. iv) Electron having kinetic energy 1 KeV. v) Electron accelerated by potential difference of 200 V.
11	The position and momentum of 1 KeV electron are simultaneously measured. If its position is located within 1 A^0
12	The uncertainty in location of the particle is equal to its De-Broglie wavelength. Show that uncertainty in the velocity to a particle is equal to the particle velocity itself.
13	Lowest energy of electron trapped in potential well is 38 eV.Calculate the width of the well.
14	the lowest energy of electron trapped in rigid box is 4.19 electron Volt. Find the width of the box in A.U.
15	calculate the energy difference between ground state and first excited state of an electron in the rigid box of length 1 A^0
16	An electron is bounded by an infinite potential well off with $2 \times 10^{-8} cm$ Calculate the lowest to permissible energy of an electron.
17	an electron is trapped in rigid box of width 2 A^0. Find its lowest energy level and momentum. Hence find energy of the 3rd energy level.

18	Calculate the first 3 energy eigen values of electron in eV trapped in rigid box of length 1 A .U.

Unit 4-Semiconductor Physics.

Sr.No.	Questions.
1	What will be the effect of impurity concentration and increasing temperature on the conductivity of semiconductors?
2	Explain classification of solids into conductors, semiconductors and insulators on the basis of energy band theory.
3	What is Fermi level? Explain fermi Dirac probability distribution function.
4	Define Fermi level for the semiconductor. Draw a neat and labelled diagram showing position of Fermi level in intrinsic semiconductor & in n type semiconductors.
5	Derive an expression for conductivity of intrinsic and extrinsic semiconductors.
6	Explain the working of PN Junction diode on the basis of Fermi energy level in i) Zero bias. ii) Forward bias iii) Reverse biased mode.
7	Explain the construction and working of solar cell. Also draw IV characteristics of solar cell and define fill factor.
8	List any 3 applications of solar cell. Explain any one of them in brief.
9	Define hall effect derive the expression for hall coefficient hall voltage and discuss their applications.
10	Calculate the conductivity of pure silicon at room temperature when the concentration of carrier is 1.5 x $10^{16}/m^3$ and the mobilities of the electrons and holes are 0.12 and 0.05 m^2/V-sec respectively at room temperature.
11	Calculate the conductivity of Germanium specimen if a donor impurity is added to the extent of one part in 10^8 Germanium atoms at room temperature.
12	The resistivity of n type semiconductor is 10^{-6} Ω - cm. Calculate the number of donor atoms which must have been added to obtain the resistivity.
13	In Germanium the energy gap is 0.75 eV. What is the wavelength at which the Germanium starts to absorb the light?
14	The mobilities of charge carriers in intrinsic germanium sample at room temperature are μ_n = 3600 cm^2/V-s and μ_p = 1700 cm^2/V-s. If the density of electrons is same as holes and is equal to 2.5 x 10^{13} per cm^3, calculate the conductivity.
15	At room temperature the conductivity of a silicon crystal is 5 x 10^{-4} mho/cm. If the electron and hole mobilities are 0.14 m^2/V-s and 0.05 m^2/V-s respectively, determine the density of carriers.
16	Compute the conductivity of copper for which μ = 34.8 cm^2/V-s and d = 8.9 gm/cm^3. Assume that there is one free electron per atom. Avogadro's Number = 6.025 x 10^{23} /gm-mole, atomic weight of Cu = 63.5. If an electric field is applied across such a copper bar with an intensity of 10 V/cm, find the drift velocity of free electrons.
17	Calculate the energy gap in silicon if it is given that it is transparent to the radiation of wavelength greater than 11000 Å.
18	A copper specimen having length 1 m, width 1 cm and thickness 1 mm is conducting 1 amp current along its length and is applied with a magnetic field of 1T along its thickness. It

	experiences Hall Effect and Hall voltage of 0.074 μV appears along its width. Calculate the Hall coefficient and the mobility of electrons in copper.(Given for copper σ=5.8x10^7 mho m)
19	A slab of copper 2 mm in length and 1.5 cm wide is placed in a uniform magnetic field with magnitude 0.40 T. When a current of 75 amp flows along the length .the voltage measured across the width is 0.81 μV determine Hall coefficient .
20	Calculate the number of acceptors to be added to a germanium sample to obtain the resistivity of 20 $\Omega\ cm$. (Given μ =1600 $\frac{cm^2}{V.s}$)
21	Number of acceptor items that need to be doped in German sample to obtain the resistivity of 8 Ω cm. . $(Given\ \mu = 1500\ cm^2/V.s)$
22	A slab of silicon 2.5 cm in length, 1.5 cm wide and 2 mm thick is applied with magnetic field of 0.4 T along its thickness. When a current of 75 A flows along the length, the voltage measured across the width is 0.81 mV. Calculate the concentration of mobile electrons in silicon.

Unit 5- Magnetism and Superconductivity.

Sr.No.	Questions.
1	Define i) Magnetic Susceptibility ii) Magnetic induction iii) Magnetization iv) Intensity of magnetization v) Relative permeability
2	Derive an expression of magnetic dipole moment & calculate value of Bohr's magnetron with proper unit.
3	Discuss classification of magnetic materials.
4	Explain the phenomenon of superconductivity.
5	Discuss zero electrical resistance property of superconductor.
6	State and explain Meissner effect and hence show that superconductivity is influenced by perfect diamagnetism.
7	State and explain i) Critical magnetic field ii) Critical Temperature iii) Critical Current iv) Persistent Current
8	Differentiate between Type I and Type II Superconductors with diagram.
9	Explain AC & DC Josephson effect.
10	Explain any two applications of superconductivity.
11	Explain BCS Theory of superconductivity.
12	Discuss formation of cooper pairs in superconductors with the help of electron phonon interaction.
13	A long thin superconducting wire of a metal produces a magnetic field of 105×10^3 A/M on its surface due to a the current through it at a certain temperature T. The critical field of the Metal

	is 100×10^3 A/M at T=0 K. The critical temperature T_c of the metal is 8.20 K. What is the value of T?
14	The critical field of Niobium is 1×10^5 A/M at 8 K and 2×10^5 A/M at 0 K. Calculate the transition temperature of the element.
15	The transition temperature for Pb is 6 K .However, at 5 K it loses the superconducting Property if subjected to a magnetic field of 3.3×10^4 A/M. Find the maximum value of H which will allow the metal to retain its superconductivity at 0 K.
16	Calculate the critical current that is required to change a superconducting wire of radius 1.5 mm into a normal conductor. Given that the transition temperature is equal to 300K and critical magnetic field is equal to 4 tesla.
17	The critical field for a superconducting material is 2×10^4 A/m at 10 K and 4×10^4 A/m at 0 K. Calculate critical temperature of the metal.
18	A superconducting material has a critical temperature of 3.7K in zero magnetic field of 0.0305 tesla at 0K. Find the critical field at 2K.

Unit 6-NDT and Nanotechnology.

Sr.No.	**Questions.**
1	State various types of non-destructive techniques. Explain any two of them in brief.
2	What is NDT? State advantages as compared with destructive testing.
3	Discuss the use of ultrasonic for flow detection.
4	Explain how ultrasonic waves are used for detection of flaws in metal.
5	Explain how X ray radiography is used for detection of flaws?
6	Explain how acoustic emission testing is used for detection of flaws in metal.
7	State the objectives of NDT.
8	Write the classification of NDT and explain any one of them in brief.
9	Write the working principle of i) Ultrasonic Testing. ii) X Ray Radiography. iii) Acoustic emission Testing.
10	What is nanotechnology.
11	Explain optical properties of nanotechnology with the help of quantum confinement effect.
12	Why are the properties of nanoparticles are different from the bulk materials?
13	Explain the electrical properties of Nano-particles.
14	Explain the optical properties of Nano-particles.
15	Explain the Magnetic properties of Nano-particles.
16	Explain the Mechanical properties of Nano-particles.
17	Explain the applications of nanotechnology in a) Medical industry b) Automobile industry. c)Electronics industry.
18	Explain any two applications of nanotechnology.
19	Give brief explanations of magnetic properties of nanoparticle with the help of hysteresis curve.