PES INSTITUTIONS	PESIT-BSC Department of Science & Humanities	**QUESTION BANK**

17PHY12/22 ENGINEERING PHYSICS

Name of Faculty: **Dr. Gajanan V. Honnavar**

Dr. Muhammad Faisal

Dr. Mohana Lakshmi

Ms. Sneha L

Module – 1
Modern Physics and Quantum Mechanics

Chapter 1 – Modern Physics

1. Explain the concept of ideal black body and black body spectrum.
2. Explain the energy distribution in the spectrum of a blackbody. Give an account of the attempts made through various laws to explain the spectrum.
3. Give a brief account of blackbody radiation and Planck's radiation law leading to quantization of energy.
4. State the assumptions of Plank's law of radiation and deduce Raleigh-Jean's law and Wein's law from Plank's formula.
5. Write a note on Ultraviolet Catastrophe.
6. Explain Compton Effect and give its physical significance.
7. What are matter waves? State and Explain de-Broglie's hypothesis.
8. Define phase velocity and group velocity and derive the relation between them.
9. Explain phase velocity and group velocity. Show that group velocity is equal to particle velocity.
10. Derive an expression for group velocity in terms of phase velocity.

Chapter 2 – Quantum Mechanics

11. Explain Heisenberg's uncertainty principle. Give its physical significance.
12. Using Heisenberg's uncertainty principle, show that the electrons cannot exist within the nucleus of an atom.
13. What is a wave function? Give its physical interpretation.

14. What is the physical significance of wave function? Mention its properties.
15. What is normalization of wave function?
16. Derive an expression for time independent Schrödinger wave equation for a particle in motion.
17. Solve the Schrödinger wave equation for the allowed energy values in the case of particle in a box.
18. What are Eigen functions and Eigen values?
19. Find Eigen values and Eigen functions for a particle in one-dimensional potential well of infinite height.
20. Obtain energy values and normalized wave function with respect to a particle in one-dimensional potential well of infinite height.
21. Discuss the Wave function, Probability density and Energy Eigen values for a particle in one dimensional potential well.
22. Derive the expression for energy Eigen value for a material particle in a one-dimensional infinite potential well.

Module – 2
Electrical Properties of Materials

Chapter 3 – Electrical Conductivity in Metals

23. Mention the assumptions of classical free electron theory.
24. Explain the salient features of Drude-Lorentz theory.
25. Define the terms relaxation time, mean collision time, mean free path and drift velocity.
26. Explain the variation of resistivity with temperature for a metal.
27. Discuss the failures of classical free electron theory.
28. What are the assumptions of quantum free electron theory? Derive an expression for electrical conductivity based on quantum free electron theory.
29. Explain density of states.
30. Define Fermi level, Fermi Energy, Fermi Velocity and Fermi Temperature.
31. Discuss the probability of occupation of various energy states by electrons at $T=O^0K$ and $T>0^0K$ on the basis of Fermi factor.
32. Discuss the concept of effective mass.
33. What are the merits of Quantum Free Electron Theory?

Chapter 4 – Semiconductor Physics

34. Derive the expression for electrical conductivity of an intrinsic semiconductor.
35. State and explain law of mass action for semiconductors.
36. Derive the expression for carrier concentration in semi-conductors.

Chapter 5 – Superconductivity

37. Explain the phenomenon of super conductivity and critical temperature
38. Discuss Meissner effect in super conductors.
39. Discuss BCS theory of super conductivity.
40. Discuss Type I and Type II super conductors.
41. Explain critical magnetic field and temperature dependence of critical field.
42. Give a brief account of high temperature superconductors.
43. Write short note on maglev vehicle.

Module – 3
Lasers and Optical Fibers

Chapter 6 – Lasers

44. Explain the terms I) Spontaneous emission, II) Stimulated emission and III) Induced absorption.
45. Derive an expression for the energy density of radiation in terms of Einstein's coefficients. Give inference.
46. State and explain the conditions for laser action.
47. What is population inversion? Discuss the need of population inversion in lasing action.
48. Give difference between laser light and ordinary light.
49. With neat diagrams explain the construction and working of carbon dioxide laser.
50. With neat diagrams explain the construction and working of semiconductor laser
51. Write a note on Industrial Applications of Lasers.
52. Describe briefly the applications of laser in welding, drilling and cutting. Mention the nature and property of laser used.
53. Write a note on measurement of pollutants in the atmosphere using laser.
54. What is holography?

55. Explain the principle behind recording and reconstruction of holograms.
56. Mention the characteristics of laser beam.

Chapter 7 – Optical Fibers

57. Explain the principle behind the light propagation in optical fibers.
58. Define numerical aperture, acceptance angle, fractional index change and V – Number.
59. Obtain an expression for numerical aperture in terms of refractive indices of core and cladding of an optical fiber.
60. Obtain an expression for numerical aperture and arrive at the condition for wave propagation.
61. What do you mean by refractive index profile for an optical fiber?
62. Explain the classification of optical fibers.
63. Explain attenuation in optical fibers. Mention the factors contributing to fiber losses.
64. What is attenuation of signal? Discuss the parameters contributing for attenuation.
65. Describe point to point communication system using optical fibers with the help of a block diagram.

Module – 4
Crystal Structure

Chapter 8 – Crystal Structure

66. Define the terms: Space lattice, basis, Bravais lattice, crystal structure, basis vectors.
67. What are lattice points and lattice parameters?
68. Define unit cell, primitive cell and non-primitive cell.
69. Define coordination number and atomic packing factor.
70. Discuss the seven types of basic crystal systems with neat diagrams.
71. What are Miller indices? Explain the procedure to find miller indices.
72. Derive the expression for inter planar spacing in terms of Miller indices.
73. Draw the following planes in cubic unit cell (110), (130), (101),(001) and (123)
74. Derive the relation between ‘a’ and ‘r’ for SC, BCC and FCC structures and calculate the atomic packing factor for these crystal structures.
75. Define allotropy and polymorphism with examples.

76. Describe the crystal structure of Diamond.
77. Write a short note on perovskites.
78. State and derive Bragg's law of X-ray diffraction.
79. Explain how Bragg's spectrometer is used to determine the wavelength of unknown X – rays and to determine interplanar spacing.
80. Describe how Bragg's spectrometer is used to determine the crystal structure.

Module – 5
Shock waves and Science of Nanomaterials

Chapter 9 – Shock Waves

81. What is Mach number?
82. Distinguish between acoustic, ultrasonic, subsonic and supersonic waves.
83. Distinguish between subsonic and supersonic flights of a body with the help of diagrams.
84. What is a shock wave? Give example for strong and weak shock waves.
85. State the three conservation laws.
86. Explain the construction and working of Reddy tube.
87. Give an account of Rankine-Hugoniot equations.
88. Mention few applications of shock waves.

Chapter 10 – Science of Nanomaterials

89. Write a brief note on nanotechnology.
90. What are nano materials?
91. Describe various quantum structures.
92. Give an account of density of states for various quantum structures.
93. With simple illustration, describe the two methods of preparation of nanomaterials.
94. Describe ball milling method of synthesis of nanomaterials.
95. Describe Sol-gel method of producing nanomaterials.
96. Write a note on carbon nanotubes.
97. What are the potential applications of nanotubes?

98. Discuss the structure and properties of carbon nanotubes.
99. Explain the pyrolysis method of synthesis of carbon nanotubes.
100. Describe arc discharge method of obtaining carbon nanotubes with the help of a diagram.
101. Describe the principle, construction and working of a scanning electron microscope.