

B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

October / November 2021 Supplementary Examinations

Programme: B.E.

Branch: All Branches

Course Code: 18PY1BSPHY / 18PY2BSPHY

Course: Applied Physics

Semester: I / II

Duration: 3 hrs.

Max Marks: 100

Date: 31.10.2021

Answer five full questions, choosing one full question from each unit.

Physical constants:

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg

Electronic charge, $e = 1.602 \times 10^{-19}$ C

Boltzmann constant, $k_B = 1.38 \times 10^{-23}$ J/K

Avagadro number, $N_A = 6.023 \times 10^{26}$ /k mol

Mass of neutron/proton $m = 1.67 \times 10^{-27}$ kg

Planck constant, $h = 6.626 \times 10^{-34}$ Js

Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

Speed of light, $c = 3 \times 10^8$ m/s

UNIT - 1

1. a Evaluate the energy eigen values for a particle trapped in a potential well of infinite height and show that the values are quantized. 8
- b Define group velocity of matter waves. Show that the group velocity of a matter wave is equal to its particle velocity. 8
- c The group velocity of a particle is 3×10^6 m/s. Calculate its phase velocity and its kinetic energy. 4

OR

2. a State Heisenberg Uncertainty Principle (HUP). Using HUP, show that an electron cannot exist inside the nucleus. 8
- b What is wave function? Set up one-dimensional time independent Schrodinger's wave equation. 8
- c Calculate the zero point energy and energy of the first excited state in eV for an electron in a box of width 10×10^{-10} m 4

UNIT - 2

3. a State the postulates of quantum free electron theory (QFET). Discuss any two merits of QFET. 8
- b Define the term thermal conductivity. Arrive at the expression for the same using the concepts of classical free electron theory. 8
- c The Fermi energy of potassium is 2.1 eV. Calculate the energy for which the probability of occupancy at 300K is 0.5. 4

UNIT - 3

4. a Derive an expression for internal field in case of liquid or solid dielectrics. When can we take internal field in dielectric as Lorentz field? 8
- b Mathematically prove that for an intrinsic semiconductor, the Fermi level lies in the middle of band gap. Discuss the cases of Fermi level for extrinsic semiconductors with a neat diagram. 8
- c The relative permittivity of sulphur is 4. Calculate its atomic polarizability. Given that sulphur in cubic form has a density of 2.08×10^3 kg/m³ and atomic weight is 32. 4

UNIT - 4

5. a Derive the expression for energy density of radiation in terms of Einstein's A&B coefficients. 8
- b Arrive at the expression for numerical aperture of an optical fiber. Explain the significance of cone of acceptance. 8

Important Note:
Completing your
answers,
compulsorily draw

- c The attenuation of light in an optical fiber is 3.6dB/km. What fractional initial intensity remains after (i) 1km (ii) 3km? 4

OR

6. a What is a hologram? Describe with neat diagram the recording of a hologram. 8
b Define co-efficient of attenuation. Discuss the causes for attenuation. 8
c Light of wavelength 632.8nm is emitted by a He-Ne laser and has an output power of 2.3mW. Calculate how many photons are emitted in each minute by this laser. 4

UNIT - 5

7. a What do you understand by simple harmonic motion? Explain the case of electric to magnetic oscillations in an LC circuit. 8
b What are forced oscillations? Arrive at the expression for amplitude in case of forced oscillations. 8
c An electric motor weighing 50kg is mounted on 4 springs each of which has a spring constant 2×10^3 N/m. The motor moves only in vertical direction. Find the natural frequency and time period of the system. 4
