Final Assessment Test – Jan / Feb 2023

VIT® Vellore Institute of Technology

Course: BPHY101L - Engineering Physics

Class NBR(s): 5753/5776/5804/5819/5862/5872/ 5877/5881

Slot: E2+TE2

Time: Three Hours

Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE

General Instructions:

1) **Useful constants: 1 eV = 1.6×10^{-19} J**
2) **Mass of electron = 9.1×10^{-31} kg**
3) **Mass of neutron = 1.67×10^{-27} kg**
4) **Planck's constant = 6.626×10^{-34} Js**

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. Deduce the expression for the velocity of transverse waves on a long stretched string.

2. Write the expression for reflection and transmission coefficient for the transverse wave on a string when there is a sudden change in the impedence at the boundary. [5]

3. A string attached in piano produces a frequency of 400 Hz. If the linear mass density of the string is 0.020 kg/m, estimate the wavelength of the standing waves and the speed of the waves on the string. Consider the tension on the wire to be 7.0 N. [5]

4. "Light is a form of EM wave". Verify on the light of Maxwell's equation using suitable mathematical arguments. What is the nature of these waves? What are the plane wave solution for the variation of E and B?

5. Discuss an experiment which confirms both de Broglie hypothesis and wave nature of electron.

6. a) Why are x-ray used in the Compton experiment, rather than visible light? Justify mathematically. [5]

   b) The atomic spacing in rock salt, NaCl, is 0.282 nm. Find the kinetic energy (in eV) of a neutron with de Broglie wavelength of 0.282 nm. Is a relativistic calculation needed? Explain. [5]

7. With necessary theory and applying boundary conditions, find out the eigen value and eigen functions for a particle trapped in a one dimensional potential well. Also plot the variation in energy for the first three energy levels. [6+4]

8. What is quantum confinement? List the classification of nanoparticles based on this with proper schematic and example for each case. Also sketch their variation of density of states.

9. Design an Nd-YAG laser specifying the various components using a neat diagram. Discuss the working using energy level diagram.

9. a) Discuss the various pumping methods. [5]

b) Calculate the value of threshold gain coefficient of the laser with cavity length 2.5 cm and loss coefficient of 12/cm. The value of reflectance R_1 is 0.99 and R_2 is 0.95. [5]

10. How does the optical fiber communication system work? Explain with necessary block diagram.

11. a) Using proper profile diagram, explain the classification of optical fibre based on refractive indices. [5]

b) A step index fiber in air has a numerical aperture of 0.16, a core refractive index of 1.45 and a core diameter of 60 μm. Determine the normalized frequency for the fiber when light at a wavelength of 0.9 μm is transmitted. Further, estimate the number of guided modes propagating in the fiber. [5]

12. Construct an LED (schematic) along with its working principle. Mention the merits of the PIN photo diode over the PN photo diode.

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