



Final Assessment Test – Jan /Feb 2023

Course: BPHY101L - Engineering Physics
Class NBR(s): 5673 / 5693 / 5705 / 5720 / 5726 / 5733 /
5746 / 5768 / 5887
Time: Three Hours

Slot: C2+TC2

Max. Marks: 100

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

Answer any **TEN** Questions

(10 X 10 = 100 Marks)

1. Discuss the physical significance of the characteristic impedance of a string. [4+4+2]
2. Show that transverse wave produced on a string suffers a phase change of π , if it encounters a medium of infinite impedance. Sketch the waveforms for the incident and reflected wave when it encounters the medium of infinite impedance.
2. (a) Derive the expression for the eigen frequencies of standing waves formed on a string clamped at both the ends. [5]
b) A transverse sinusoidal wave of amplitude 6.0 cm and wavelength 35 cm travels along a light string of 2 gram/cm mass density, which is joined to a heavier string of 6.0 gram/cm mass density. The joined strings are held under constant tension. Calculate the wavelength and amplitude of the wave as it travels along the heavier string. [5]
3. Provide the physical significance of the divergence and curl of a vector. Write Maxwell's equation in differential forms and explain their significance. What was Maxwell's contribution to the Ampere's - Maxwell equation? [2+4+4]
4. What is ultraviolet catastrophe in the case of Black Body radiation? Describe the spectral features of a Blackbody at different temperatures. Why the Rayleigh-Jeans model failed to explain the Black body spectrum at higher frequencies. [2+4+4]
5. Obtain Schrodinger's time independent wave- equation for a particle moving with momentum. [5]
6. If an X-ray photon of wavelength 80 picometer is incident on a graphite target. Calculate the wavelength of the X-ray scattered at an angle of 30° . Calculate the maximum shift in the wavelength of the scattered X-Ray from the incident X-Ray. [5]
7. Given an electron confined in an infinite one-dimensional potential well of width L. Obtain the energy eigenfunctions and eigenvalues for the electron. Interpret the probability density plots of the ground state and the first excited state of the electron. Predict the most likely positions of the electron for the first excited state. [6+2+2]
8. Classify nanostructures materials based on quantum confinement. How does the confinement affect the properties of nanostructures? Using a schematic diagram, describe the working principle of the Scanning Tunnelling Microscope. [3+3+4]
9. Discuss three important properties of a laser. What is population inversion and why it is needed in laser? Using an energy level diagram discuss the working of a He-Ne Laser. [3+2+5]

9. a) Compare stimulated and spontaneous emissions. What is the significance of Einstein's coefficients? [4+1]
- b) Calculate the threshold gain coefficient of a LASER consisting of two mirrors of reflectance coefficients, $R_1 = 1$ and $R_2 = 0.85$ respectively. The cavity length is 8 mm, given that the loss coefficient, $\alpha = 1 \text{ cm}^{-1}$. [5]
10. Derive the expression for acceptance angle and a numerical aperture for a given step-indexed fiber. [5+5]
- Show that an intermodal dispersion in the step-indexed fiber is proportional to the Numerical Aperture of the fiber.
11. a) Draw the ray paths and the index profiles for a step-index and a graded-index fiber. Explain the reasons for the difference in the ray paths in the step-indexed and graded indexed fibers. [2+3]
- b) If a fiber is kept in a medium of refractive index 1.35, calculate the numerical aperture and acceptance angle of an optical fiber of core refractive index, $n_1 = 1.52$ and cladding refractive index, $n_2 = 1.50$. [3+2]
12. Compare the constructions and working principles of a Light emitting diode and a laser diode. [5+5]

