VIT®
Vellore Institute of Technology

Final Assessment Test – April 2019

Course: PHY1701 - Engineering Physics
Class NBR(s): 3706 / 3715 / 3724 / 3731 / 3741 / 3748 / 3759 / 3958 Slot: E1+TE1
Time: Three Hours Max. Marks: 100

General Instructions :

Make use of the following constant values wherever necessary

(Mass of the electron, $m_e = 9.1\times10^{-31}$ kg; Charge of the electron, $e = 1.602\times10^{-19}$ C; Planck's constant, $h = 6.626\times10^{-34}$ Js; Velocity of light, $C = 3\times10^{8}$ ms^{-1}; Boltzmann's constant, $K_B = 1.38\times10^{-23}$ JK^{-1})

Answer any TEN Questions

(10 X 10 =10 Marks)

1. Discuss an experiment which confirms both deBroglie hypothesis and wave nature of electron. Substantiate your answer with proper evidence. **[10]**

2. a) We all long for certainty. In fact, we are wired to find home in a comfortable place, especially when we live in a world so full of uncertainty. Discuss, how Heisenberg solve this problem while measuring physical variables. **[5]**

   b) A nucleon is confined to a nucleus of radius 5 X 10^{-15}m.Calculate the minimum uncertainty in the momentum of the nucleon. Also calculate the minimum kinetic energy of the nucleon. **[5]**

   Given, mass of the nucleon = 5 X 10^{-15}kg, Planck's constant 6.623 x10^{-34} Js.

3. If a particle is trapped in a one dimensional potential well what will happen? With necessary theory and applying boundary conditions find out the eigen value and eigen functions for this trapped particle. **[10]**

4. a) Why carbon plays a major role in carbon nanotube? How, single wall carbon nanotube is classified on the basis of chiral vector? Explain. **[5]**

   b) You may have noticed how different very small animals are compared to larger ones. Ants have legs that are very skinny compared to their bodies, and they can lift many times its own weight. Elephants on the other side have thick legs and they cannot lift great weights compared to their own mass. **[5]**

   State the reason and correlate this incident with nanoparticle.

5. Discuss in detail the atomic gas laser, which produces both IR and visible light. State the ways and means by which how can you restrict the IR to obtain the visible light only. **[10]**

6. a) Can you obtain the laser without metastable state? How the problem of two level laser has been sorted out in three and four level laser? **[5]**

   b) In a Ga As laser diode,$R_1 = R_2 = 0.34$ for uncoated facets and material absorption α is 10/cm.Calculate the threshold gain K_{th} for a laser diode of length 500 μm and width 10 μm. **[5]**

7. Write Maxwell's equations for an electromagnetic field and obtain a wave equation for E and B in a homogeneous, isotropic, non conducting medium. **[10]**

8. a) An electromagnetic wave, propagating with the speed of light in free space is incident normally on a perfect dielectric medium for which the relative permittivity is 5.0. By what factor will the velocity of the wave will get reduced? **[5]**

   b) Determine the conduction current and displacement current densities in a material having conductivity of 10^{-3} mhos/m and relative permittivity $\varepsilon_r = 2.45$.The electric field in the material is given by E = 4 X10^{-6} sin(9x10^{9} t)V/m. **[5]**

9. What do you mean by dispersion? Derive a relation how much intermodal dispersion occurs when the light propagates through the optical fiber. With necessary diagrams state how these problems can be eliminated. **[10]**

10. a) State any five differences between direct bandgap and indirect bandgap semiconductor. [5]

b) In a 100-ns pulse 6×10^6 photons at a wavelength of 1300 nm fall on an InGaAs photodetector. On the average 5.4×10^6 electron-hole pairs are generated. Determine the quantum efficiency. [5]

11. State the postulates of Einstein's special theory of relativity and from there deduce the Lorentz transformation for space and time co-ordinates from one inertial frame to another which is in uniform relative motion with respect to the first. [10]

12. a) Explain the phenomena of Time dilation. [5]

b) A rod is lying at rest along the X-axis in frame S. The length of the rod measured by an observer in frame S' moving with a velocity of 0.5C along xx' axes is 0.75 m. What is the length of the rod measured by an observer at rest in the S frame? [5]

⇔⇔⇔

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test – II

Programme Name & Branch: B. Tech & M. Tech

Course Name & Code: Engineering Physics (PHY 1701)

Class Number: **Slot: D1+TG1** **Exam Duration:** **1.5 hrs** **Maximum Marks: 50**

Answer **All** questions

1.	a) A two level laser is not practically possible. Justify. b) What are the advantages of four level laser over three level laser ? (2+3)
2.	Consider the two level system in the photosphere of sun (6000 K). What are the relative population of N_1/N_0 at 6000 Å and 150 GHz where N_0 is the ground state and N_1 is the first excited state ?
3.	The lifetime of $3^2P_{1/2} \rightarrow 3^2S_{1/2}$ transition of sodium atom at 5896 Å is 16.4 ns. Compute Einstein's coefficients A and B corresponding to this transition.
4.	Explain the principle and working of CO_2 laser. Use energy level diagrams to support the explanation.
5.	The intensity of the sun light on earth is 1.3 kW/m^2. 1. Evaluate the power within an area of 1 cm^2. 2. Estimate the intensity if the radiation incident on an area of 10 cm^2 is focused to a surface of 100 micrometer in diameter.
6.	1. Write a vector function (Not a constant) which has zero divergence and zero curl everywhere. 2. Find the gradient of $f(x,y,z) = e^x \sin(y) \ln(z)$
7.	The velocity of a particle is always equal to the group velocity of the packet. Justify
8.	Write the expression for E and B as a function of position and time for an EM wave propagating in the z direction. Frequency of the EM wave is 60.0 Hz and E_0 = 2.00 V/m. Assume that E is pointing in x-direction
9.	Equation of continuity is contained in Maxwell's equation. Justify the validity of this statement.
10.	What are the various modes in a rectangular waveguide for microwave propogation? How are they different?

VIT
Vellore Institute of Technology

Continuous Assessment Test – I

Programme Name & Branch: B.Tech

Course Name & Code: Engineering Physics & PHY 1701

Class Number: Slot:C1/TC1 and C2/TC2 Exam Duration: 1 Hour 30 minutes Maximum Marks: 50

Standard physical constants

Plank constant (h) = 6.626×10^{-34}Js, Velocity of light (c) =3×10^{8}m/s, Mass of electron (m_e) = 9.1×10^{-31}kg

Answer All Questions

Sl. No.	Question	CO
1.	The de-Broglie wavelength of an electron is 85 nm. Determine the electron energy (eV), momentum and velocity? Sketch the black body spectrum (Intensity verses wavelength) at two different temperatures? (3+2)	1,2
2	What is ultraviolet catastrophe? A light source of wavelength 2000 Å emits 0.5 J of energy. Calculate the number of photons emitted? (2+3)	1,2,3
3.	State Compton effect? The X-rays of wavelength 0.2 nm are aimed at a block of carbon. The scattered X-rays are observed at an angle of 45° to the incident beam. Calculate the increased wavelength of the scattered X-rays at this angle? (2+3)	1,3
4.	Arrive at one dimensional Schrödinger's time dependent wave equation. $\psi(x,t) = Ae^{-i(\omega t - kx)}$; E=ħω ; P_x=ħk (5)	1,3
5	Obtain the appropriate wave function and energy of a particle of mass 'm' moving in a 1-dimensional box of length 'L', with boundaries at, x = 0 and x = L? V(x) = 0 for $0 \le x \le L$, V(x) = ∞ for $x \ge L$, $x \le 0$ $\psi = A\sin kx + B\cos kx$ (5)	1,2,3
6	Sketch the wave function and probability distribution for quantum number (n) = 1,2,3 in a 1-dimensional box of length 'L', with boundaries at, x = 0 and x = L? (5)	1,2,3
7	Explain the working principle of Scanning tunneling microscope? (5)	2
8	What are nanomaterials? Explain the types of confinements in nanomaterials with examples? (1+4)	2,3
9	Explain Electrical and optical properties of nanomaterials with examples? (5)	2,3
10	The uncertainty in the momentum Δp of a football thrown by Raja during the superbowl traveling at 40 m/s is 1×10^{-6} of its momentum. What is its uncertainty in position Δx ? Mass=0.40kg (5)	1,2,3

VIT
Vellore Institute of Technology

Continuous Assessment Test – II

Programme Name & Branch: B.Tech/M.S
Course Name & Code: Engineering Physics PHY 1701

Slot: E1 +TE1 **Exam Duration:** 1h 30 min **Maximum Marks:** 50

General instruction(s):

Only '**Hand Written**' notes are permitted.

Section – A (10 x 5 = 50 Marks)	
S.No.	**Question**
1.	Explain the working of three level laser using proper energy level diagram. An electron in the ground state first absorbs one photon at 500 nm, then a second photon at 1000 nm, to reach an excited state. What is the wavelength of the photon it would emit if it dropped all the way back to the ground state? (3+2)
2.	Prove that the vector field $\vec{F} = < x, y, z >$ can be represented as a gradient of a scalar potential. Find the corresponding the scalar potential. (2+3)
3.	What is the drawback in Ampere's law to be used for electromagnetic waves, explain? How did Maxwell fix this flaw? (2+3)
4.	What are the different vibrational modes in CO_2 laser? Explain it's working using energy level diagram. (3+2)
5.	Establish the relationship between the Einstein coefficients for two level laser system. (5)
6.	Using Maxwell's equation constitute the wave equation for electromagnetic waves in a free space. (5)
7.	What are waveguides? Discuss different modes in the waveguides. (5)
8.	A laser beam of wave length 740 nm has coherence time $4 \times 10^{-5} sec$. Deduce the order of magnitude of it's coherence length and spectral half width. (2.5 + 2.5)
9	The electric field of an electromagnetic wave traveling in vacuum is described by the following wave function: $\vec{E} = (5.0\ V/m) \cos[kx - (6 \times 10^{6} s^{-1})t]\ j$. Where k is the wavenumber in rad/m, x is in m, t is in sec. Find out the fallowing quantities (i) amplitude (ii) frequency (iii) wavelength (1+1+1+1+1)
10	What is coherence? Discuss the type of coherence by giving suitable experimental observation. (2 + 3)