

R. V. COLLEGE OF ENGINEERING
Autonomous Institution affiliated to VTU
I Semester B. E. Examinations Nov/Dec-16
Common to All Branches
ENGINEERING PHYSICS

Time: 03 Hours

Maximum Marks: 100

Instructions to candidates:

1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2, 7 and 8 are compulsory. Answer any one full question from 3 and 4 & one full question from 5 and 6.

Physical constants:

$$\text{Planck's constant} = 6.625 \times 10^{-34} \text{ Js}$$

$$\text{Boltzmanns constant} = 1.380662 \times 10^{-23} \text{ Jk}^{-1}$$

$$\text{Velocity of light} = 3 \times 10^8 \text{ ms}^{-1}$$

$$\text{Mass of electron} = 9.11 \times 10^{-31} \text{ Kg}$$

$$\text{Charge of electron} = 1.6 \times 10^{-19} \text{ C}$$

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

PART-A

1	1.1	What is zero point energy of a particle bound in a potential well of width 'a'?	01
	1.2	Find the de Broglie wavelength associated with an electron with a kinetic energy of 1000eV.	01
	1.3	What is the physical significance of numerical aperture in an optical fibre?	01
	1.4	Find the ratio of populations of two energy states in a He-Ne laser that produces light of wavelength 6328 Å at 27°C.	01
	1.5	What is resonance in an LCR series circuit?	01
	1.6	What is simple harmonic motion?	01
	1.7	What is Fermi energy of a metal at room temperature?	01
	1.8	Sketch the position of Fermi level at zero Kelvin in a band diagram of p-type semiconductor.	01
	1.9	What is relaxation time of a dipole.	01
	1.10	Define thermal conductivity of a good conductor.	01
	1.11	Fractional index change and refractive index of core of an optical fibre are 0.00432 and 1.555 respectively. Find the refractive index of cladding.	02
	1.12	Matter waves are not electromagnetic waves. Justify the statement.	02
	1.13	Using the normalized wave function for a particle in one dimensional potential well, sketch the variation of probability density for ground state and first excited state.	02
	1.14	Find the polarization produced in a crystal by an electric field of strength 600V/mm if it has a dielectric constant of 8?	02
	1.15	What is Density of state function in metals? Give the expression for the same.	02

PART-B

2	a	Explain the basic interaction of radiation with matter. Derive the expression for energy density of Electro Magnetic radiation in terms of Einstein coefficients.	07
	b	What is Refractive Index profile? With neat labeled diagram, explain the different types of optical fibres.	06
	c	The attenuation coefficient of light in an optical fibre is 5.4 dB/km , what fraction of its initial intensity remains after i) 1 km and ii) after 3 km of propagation.	03
3	a	What is Group velocity and Phase velocity? Derive the relation between them in a dispersive medium.	07
	b	Set up one dimension time independent Schrodinger's wave equation.	06
	c	A spectral line of wavelength 6328 \AA has a width of 10^{-4} \AA . Evaluate the minimum time spent by the electrons in the upper energy state between excitation and de-excitation processes.	03
OR			
4	a	What is Heisenberg's Uncertainty principle? Apply the Heisenberg's uncertainty principle to show that the electron cannot pre exist inside the nucleus.	07
	b	What are Eigen function and Eigen values? A quantum particle confined to one dimensional box of width ' a ' is in its ground state. What is the probability of finding the particle over an interval of ' $a/4$ ' marked symmetrically at the center of the box?	06
	c	An electron is associated with de Broglie wavelength of $2 \times 10^{-10} \text{ m}$. Find its kinetic energy and the group velocity of the de Broglie waves.	03
5	a	What is damped oscillation? Establish the differential equation for a damped harmonic oscillator and obtain an expression for displacement. Discuss the case of critical damping.	07
	b	Apply the theory of forced oscillations to the series <i>LCR</i> circuit and arrive at the expression for current in the circuit.	05
	c	A massless spring is suspended vertically by attaching a mass of 0.8 kg at its free end. If the spring is pulled down and released, it executes simple harmonic motion. Find the period of simple harmonic function, given that a mass of 6 kg stretches the spring by 18 cm under gravity.	04
OR			
6	a	What do you mean by forced harmonic oscillations? Establish the differential equation and obtain an expression for amplitude for a system performing forced harmonic oscillation. Discuss the resonance condition.	08
	b	Derive an expression for the time period of a body when it executes angular simple harmonic motion.	05
	c	List the characteristics of Simple harmonic motion.	03
7	a	Derive an expression for positive charge carrier concentration in an intrinsic semiconductor.	07

	b	What is hall effect? Derive an expression for Hall voltage and Hall coefficient in <i>p</i> -type semiconductor.	06
	c	Find the probability of an electron occupying an energy level $0.04eV$ above the Fermi level and $0.04 eV$ below the Fermi level at $27^{\circ}C$.	03
8	a	What is internal field in dielectrics? Derive an expression for internal field in case of one-dimensional array of atoms in dielectric solids.	07
	b	Derive an expression for Thermal conductivity of a poor conductor by Lee's and Charlton's method.	06
	c	An elemental solid dielectric material has polarizability $8 \times 10^{-40} Fm^2$. Assume the internal field to be Lorentz field, find the dielectric constant for the material if the material has 2×10^{28} atoms m^{-3} .	03