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RV COLLEGE OF ENGINEERING®

(An Autonomous Institution Affiliated to VTU)

I Semester B. E. Examinations April-2022

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 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, 9 and 10
3. *Physical constants*: $Planck's\ constant = 6.625 \times 10^{-34}\ Js$,
   $Boltzmann's\ constant = 1.38 \times 10^{-23} JK^{-1}$
   $Velocity\ of\ Light = 3 \times 10^{8} ms^{-1}$,
   $Mass\ of\ electron = 9.11 \times 10^{-31} kg$
   $Charge\ of\ electron = 1.6 \times 10^{-19} C$
   $Mass\ of\ proton/\ neutron = 1.67 \times 10^{-27} kg$
   $Avogadro\ number = 6.022 \times 10^{26} atoms\ (kmole)^{-1}$
   $Permittivity\ of\ free\ spcae = 8.854 \times 10^{-12} Fm^{-1}$

PART-A

1	1.1	Name the type of electrical oscillation executed by series LCR circuit	01
	1.2	What is neutral surface of a cantilever?	01
	1.3	Mention one property of a matter wave.	01
	1.4	What is zero point energy of a particle in a potential well?	01
	1.5	Sketch the energy band diagram with Fermi level of n-type semiconductor at absolute zero.	01
	1.6	What is dielectric polarization?	01
	1.7	Name the type of optical fiber in which light signal suffers maximum intermodal dispersion.	01
	1.8	Name the type of stretching in CO_2 molecule which has highest vibration energy state.	01
	1.9	Write an expression for Lorentz force in a crossed electric and magnetic field with proper explanation of notations used.	01
	1.10	What is the magnetic force acting on the electron when it enters into a uniform magnetic field parallel to magnetic field lines?	01
	1.11	Find the force required to produce an extension of 1mm in steel wire of length 2m and diameter 1mm. Assume Young's modulus for steel is $2 \times 10^{11} N/m^2$.	02
	1.12	Find the momentum of an electron accelerated from rest under the potential of 100V.	02
	1.13	Find the probability of an electron in a metal occupying an energy level 0.04 eV above the Fermi level at 200K.	02

	1.14	Find the fractional index change of an optical fiber having acceptance angle 30° and refractive index of core 1.5.	02
	1.15	Find the acceleration of an electron when it starts from rest and moves freely in a uniform electric field of intensity of 1500 V/m.	02

PART-B

2	a	Set up the differential equation for a damped harmonic oscillator and obtain the expression for displacement. Discuss the case of under damping.	07
	b	Derive an expression for bending moment of a beam having rectangular area of cross section.	06
	c	Find the angular twist of a wire of length 0.3m, and radius $0.2 \times 10^{-3}m$ when a torque of $5 \times 10^{-4}Nm$ is applied. Rigidity modulus of the material $8 \times 10^{10}Nm^2$.	03
3	a	Set up one-dimensional time independent Schrodinger's wave equation.	07
	b	State Heisenberg's uncertainity principle. Applying Heisenberg's uncertainity principle, explain broadening of spectral line.	06
	c	An electron is confined in a one-dimensional potential well of infinite height with depth 1 A° is in its first excited state. Find the energy and wavelength of the electron.	03
		OR	
4	a	Obtain an expression for energy and normalized wave function for a particle in a one dimension potential well of infinite height by solving time independent Schrodinger's wave equation.	08
	b	State de-Broglie's hypothesis. Arrive at an expression for de Broglie wave length of an electron in terms of accelerated potential V.	05
	c	The position and momentum of 0.5 keV electron are simultaneously determined. If its position is located within 0.2nm, what percentage uncertainity in its momentum?	03
5	a	Derive an expression for electron concentration in conduction band of an intrinsic semiconductor.	07
	b	Explain electronic and orientation polarization mechanism in dielectrics.	06
	c	An elemental solid dielectric material has polarisability $5 \times 10^{-40}Fm^2$. Assuming the internal field to be Lorentz field, find the dielectric constant for the material if the material has $3 \times 10^{28}\ atoms/m^3$.	03
		OR	

6	a	What is Hall effect? Arrive at an expression for Hall voltage and Hall co-efficient of a p-type semiconductor.	06
	b	Derive Clausius Mossotti equation for a three dimensional solid dielectric material.	06
	c	Assuming the effective mass of electron is equal to the effective mass of hole, compute the concentration of intrinsic charge carriers in a Germanium crystal of energy gap 0.72 eV at 300K.	04
7	a	With a neat label diagram, explain the construction and working of CO_2 laser.	09
	b	What is attenuation in optical fiber? Explain absorption loss in optical fiber.	04
	c	A step index fibre has a normalized frequency (V-number) 26.6 at 1300nm wavelength. If the core radius is 25μm, find the Numerical Aperture.	03
		OR	
8	a	What is acceptance angle of an optical fiber? With a neat diagram arrive at an expression for Numerical Aperture. Give physical significance of Numerical Aperture.	07
	b	With neat diagrams, explain the principle of three level pumping mechanisms and role of optical resonator in laser production.	06
	c	The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted by spontaneous emission at 300K.	03
9	a	What is electrostatic deflection? With a neat diagram, arrive at an expression for electrostatic deflection caused by an electron under transverse electric filed.	07
	b	Show that the radius of orbit of a charged particle moving at right angles to magnetic field is proportional to its momentum.	05
	c	Find the time of flight and maximum height attained by an electron when projected at an angle of 30° to the horizontal at an initial speed of $4.5 \times 10^5 m/s$ In a region of uniform electric field 200 N/C.	04
		OR	
10	a	With a neat labeled diagram, explain the construction and working of Scanning Electron Microscope.	08
	b	With a neat diagram, explain the focusing of electron beam by an electron lens.	05
	c	An electron is accelerated through a potential difference of 9 kV and enters into a uniform transverse magnetic field of 0.05wb/m^2. Find the radius of the path.	03