18PH12

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R. V. COLLEGE OF ENGINEERING

Autonomous Institution affiliated to VTU

I Semester B. E. Examinations Nov/Dec-18

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: $Planck's\ constant = 6.625 \times 10^{-34} Js$
$Boltzmanns\ constant = 1.380662 \times 10^{-23} Jk^{-1}$
$Velocity\ of\ light = 3 \times 10^{8} ms^{-1}$
$Mass\ of\ electron = 9.11 \times 10^{-31} Kg$
$Charge\ of\ electron = 1.6 \times 10^{-19} C$
$Mass\ of\ proton/neutron = 1.67 \times 10^{-27} Kg$
$Avogadro\ number = 6.022 \times 10^{26}\ atoms\ (kmol)^{-1}$
$Permittivity\ of\ free\ space = 8.854 \times 10^{-12} Fm^{-1}$

PART-A

1	1.1	Name the active center which helps the lasing action in He Ne laser.	01
	1.2	What is refractive index profile (RI profile) of an optical fibre?	01
	1.3	Find the de Broglie wavelength associated with an electron accelerated form rest with a potential of $1200V$.	01
	1.4	Calculate the energy of the lowest energy state in a one dimensional infinite potential well of length 'a'.	01
	1.5	Sketch the position of Fermi level of a p-type semiconductor at zero kelvin.	01
	1.6	Write the classical expression for the electrical conductivity of a metal in terms of mean collision time.	01
	1.7	What is tensile strength of an elastic material?	01
	1.8	Write an expression for Rigidity modulus in terms of Young's modulus and Poisson ratio.	01
	1.9	What type of oscillation is exhibited by dead beat galvanometer?	01
	1.10	What is the condition for an electrical resonance of a series LCR circuit?	01
	1.11	Fractional index change and refractive index of core of an optical fibre are 0.0043 and 1.55 respectively. Find the refractive index of cladding.	02
	1.12	Matter waves are not electromagnetic waves. Justify the statement.	02
	1.13	Find the polarization produced in a crystal by an electric field of strength $600\ V/mm$ if it has a dielectric constant of 8?	02
	1.14	Find the bulk modulus of the material, if the material has Young's modulus $6.62 \times 10^{10} Nm^{-2}$ and Poisson ratio of 0.4.	02
	1.15	Find the maximum velocity of a particle executing simple harmonic motion with a period $10s$ and amplitude of 1.5 meter.	02

PART-B

2	a	Explain the construction and working of He-Ne laser with neat diagrams.	07
	b	With a neat block diagram, explain point to point communication of an optical fibre and explain the role of optical repeater in fibre optic communication. Give any two advantages of point to point communication over wired communication.	06
	c	Find the v-number and number of modes for a fibre of core diameter $60\mu m$ with refractive indices of 1.50 and 1.45 respectively for core and cladding, when a wavelength of the propagating wave is $632.8\,nm$.	03
3	a	What are matter waves? Arrive at an expression for de-Broglie wavelength of electron accelerating from rest under a potential V.	05
	b	Setup one dimension time independent Schrodinger's wave equation.	07
	c	An electron and a $150g$ base ball are travelling at a velocity of $220m/s$. measured at an accuracy of 0.065%. Find the uncertainty in position of each.	04
		OR	
4	a	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 $a/2$ marked symmetrically at the center of the box?	06
	b	State Heisenberg's uncertainty principle. Applying Heisenberg's uncertainty principle, explain the broadening of spectral lines.	06
	c	An atom makes a transition from second excited sate to ground state by emitting a photon in an infinite potential well of width $0.5nm$. Find the wavelength of the photon emitted.	04
5	a	Derive an expression for electron concentration in a metal at zero Kelvin.	04
	b	What is Hall effect? Arrive at an expression for Hall voltage and Hall coefficient for a p-type semiconductor.	06
	c	Sketch the variation of Fermi level with temperature for a n-type semiconductor.	02
	d	What is dielectric polarizability? An elemental solid dielectric material has polarizability $7 \times 10^{-40} Fm^2$. Assuming the internal filed to be Lorentz field, find the dielectric constant for the material if the material has 3×10^{28} atom$/m^3$.	04
		OR	
6	a	Arrive at an expression for electron concentration in conduction band of an intrinsic semiconductor.	06
	b	What is polarization of dielectric? Explain electronic and orientation polarization mechanisms with diagrams.	07
	c	Find the probability of an electron occupying an energy level $0.02eV$ above the Fermi level and $0.02eV$ bleow the Fermi level at $200K$.	03

7	a	What is bending moment? Arrive at an expression for bending moment of a rectangular beam of uniform area of cross section.	05
	b	What is Young's modulus and bulk modulus of a material? Derive the relation between Bulk modulus and Young's modulus in terms of Poisson ratio.	07
	c	Find the angular twist of a wire of length $0.3m$ and radius $0.2mm$ when a torque of $5 \times 10^{-4} Nm$ is applied. (Given: Rigidity modulus of the material $8 \times 10^{10} Nm^{-2}$).	04
8	a	What is damped oscillation? Set up the differential equation for a damped harmonic oscillator and obtain an expression for displacement. Discuss the case of under damping.	08
	b	Arrive at an expression for time period of a body when it executes angular simple harmonic motion.	05
	c	A vibrating system of natural frequency 500 cycles/s is forced to vibrate with a periodic force/unit mass of amplitude $100 \times 10^{-5} N/kg$ in the presence of a damping unit mass of $0.01 \times 10^{-3}\ rad/s$. Calculate the maximum amplitude of vibration of the system.	03

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ENGINEERING PHYSICS

Time: 03 Hours ***Maximum Marks: 100***

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PART-A

1	1.1	Define active medium in Lasers.	01
	1.2	Give the physical significance of numerical aperture in case of an optical fiber.	01
	1.3	Calculate the de-Broglie wavelength corresponding to an electron in its second excited state in one-dimensional infinite potential well of width 1Å.	01
	1.4	Write the equation for the lowest energy state in a one dimensional infinite potential well of width 'a'.	01
	1.5	Why extrinsic semiconductors are electrically neutral?	01
	1.6	Define density of energy states in material.	01
	1.7	What is neutral axis in a beam?	01
	1.8	The period of a torsion pendulum is T. What is the period if the couple per unit twist of the suspension wire is doubled?	01
	1.9	What are forced oscillations?	01
	1.10	Define force constant of a spring.	01
	1.11	Define angle of acceptance and Refractive index profile in an optical fiber.	02
	1.12	What is the physical significance of a wave function?	02
	1.13	Find the polarization produced in a crystal by an electric field of strength $500 V/mm$ if it has a dielectric constant of 6?	02
	1.14	Calculate the torque required to twist a wire of length $1.5m$, radius $4.25 \times 10^{-4} m$ through an angle $\left(\frac{\pi}{45}\right)$ radian, if the value of rigidity modulus of its material is $8.3 \times 10^{10}\ N/m^2$.	02
	1.15	An electric motor weighing $50kg$ is mounted on 4 parallel springs each of which has a spring constant $2 \times 10^3\ N/m$. The motor moves only in vertical direction .Find the natural frequency of the system.	02

PART-B

2	a	Explain the terms spontaneous emission and stimulated emission. Derive a relation for energy density in terms of radiation on field in terms of Einstein's coefficients.	06
	b	With neat labeled diagram, explain the different types of optical fibers. Give the advantages of optical fiber communication.	08

	c	Find the number of modes of the standing waves in a resonant cavity of length $1m$ of $He-Nelaper$ operating at wavelength $632.8nm$.	02
3	a	Apply the time independent schridinger's wave equation to find the solutions for one dimensional potential well of width 'a' and infinite depth. Hence obtain the normalized wave function.	08
	b	What are matter waves? Arrive at an expression for de-Broglie wavelength of electron accelerating from rest under a potential V.	05
	c	An electron is confined to a box of length 10^{-9}m. find the minimum uncertainty in its velocity.	03
		OR	
4	a	State Heisenberg's uncertainty principle. Applying Heisenberg's uncertainty principle, explain the broadening of spectral lines.	06
	b	Set up one dimensional time independent schrodinger wave equation.	06
	c	A quantum particle confined to one dimensional box of width 'a' is in its first excited state. What is the probability of finding the particle over an interval of $\left(\frac{a}{2}\right)$ marked symmetrically at the center of the box.	04
5	a	Define Fermi factor. Discuss the Fermi factor $F(E)$ for cases $E < E_f, E > E_f$ at $T = 0K$ and $E = E_f$ at $T > 0K$.	06
	b	State and explain Hall effect in metals. Obtain an expression for carrier concentration in terms of Hall voltage for metals.	06
	c	What is dielectric constant? The dielectric constant of Sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of monovalent Sulphur, if its density $=2.7 \times 10^3\ kg/m^3$ and atomic weight=32.07.	04
		OR	
6	a	Derive an expression for the electron concentration in the case of an intrinsic semiconductor.	07
	b	What is polarization of a dielectric? Explain electronic and ionic polarization mechanisms with diagrams.	06
	c	The Fermi level in silver is $5.5eV$.What is the enrgy for which probability of occupancy is 0.91 at $300K$.	03
7	a	With a neat stress-strain diagram explain behavior of a elastic material under increasing load and define tensile strength of the material.	06
	b	Arrive at an expression for twisting couple for a cylinder of length 'l' and radius 'r'. Apply it to the case of a wire in torsional pendulum and obtain an expression for its rigidity modulus.	08
	c	The young's and rigidity modulus of steel are $18 \times 10^{10}\ N/m^2$ and $8 \times 10^{10}\ N/m^2$ respectively. Find the bulk modulus of the steel.	02
8	a	What is damped oscillation? Set up the differential equation for a damped harmonic oscillator and obtain an expression for displacement. Discuss the case of over damping.	07
	b	What is force constant? Derive an expression for an equivalent force constant for 2 springs in series. What is the expression for period of its oscillation?	06
	c	A sonometer wire under tension is plucked and left free for vibrations. Find its frequency of vibrations if the midpoint on the string attains a maximum velocity of $1.57m/s$ when its amplitude of oscillation is $5mm$. Treat the vibration as simple harmonic [Neglect the damping effect].	03

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II Semester B. E. Examinations Apr/May-19

Common to All Branches

ENGINEERING PHYSICS

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1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
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Physical constants: *Planck's constant* $= 6.625 \times 10^{-34} Js$

Boltzmanns constant $= 1.386 \times 10^{-23} Jk^{-1}$

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

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

Charge on 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* $(kmol)^{-1}$

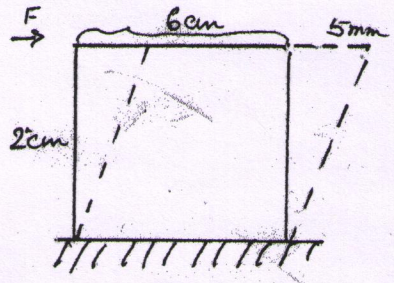
Permittivity of free space $= 8.85 \times 10^{-12} Fm^{-1}$

PART-A

1	1.1	Name the active medium in He-Ne laser.	01
	1.2	Mention one application of laser in industry.	01
	1.3	Write one property of matter waves.	01
	1.4	Mention the nature of free particle energy spectrum.	01
	1.5	Name the valency of impurities added to pure semiconductor in order to convert into n-type semiconductor.	01
	1.6	Mention the physical quantity which represents the extent of polarization in the dielectric material.	01
	1.7	Write the relation between rigidity modulus, Young's modulus and Poission's ratio.	01
	1.8	What is the range of Poisson's ratio?	01
	1.9	What is simple harmonic motion?	01
	1.10	Write the condition for resonance in series LCR circuit.	01
	1.11	Find the number of photons emitted per second in He-Ne laser which gives out power of $1mW$. Wavelength emitted from He-Ne laser = $632.9nm$.	02
	1.12	Find the de-Broglie wave length of neutron at $300K$.	02
	1.13	Write any two assumptions of quantum free electron theory.	02
	1.14	What are torsional oscillations? Write expression for period of torsional oscillation?	02
	1.15	Write the characteristics of simple harmonic motion.	02

PART-B

2	a	Derive an expression for energy density of radiation in terms of Einsten's coefficients. Identify the importance of stimulated emission in context of laser.	06
	b	List and explain types of optical fiber with reference to refractive index profile of core and cladding.	06
	c	A multimode step index fibre with core diameter $80\mu m$ and relative $R.I.$ difference of 1.5% is operating at $0.85\mu m$. The core $R.I.$ is 1.48. Estimate the core diameter for the same optical fibre parameters if it operates at a wavelength of $0.80\mu m$.	04
3	a	Apply Schrodinger wave equation for a particle in one dimensional potential box of infinite height and hence solve for eigen values and eigen functions of the particle.	07
	b	Justify – radiation from any source (or system) cannot be perfectly monochromatic.	04
	c	A free electron bounces elastically back and forth in one dimension between two walls separated by $L = 0.5nm$ and infinite wall height. Assuming that electron behaves as de-Broglie waves, i) Show that permitted de-Broglie wavelengths are $\lambda = \frac{2L}{N}$, $n = 1,2,3 \ldots$ ii) Calculate the values of kinetic energy of e^- for $n = 1, 2$ and 3.	05
		OR	
4	a	State and explain de-Broglie hypothesis of matter waves and Heisenberg's uncertainty principle. What is the physical interpretation of $\int_{-\infty}^{+\infty} \varphi^2 dx = 1$	07
	b	Setup one dimensional time independent Schrodinger's wave equation. Extend it to three dimension.	06
	c	Assume an electron beam in television tube is accelerated through a $P.D.$ of $25kV$. Find: i) De-Broglie wavelength $= 7.77 \times 10^{-12} m$ ii) Kinetic energy iii) Velocity of the electron.	03
5	a	What is Fermi factor? Explain with the graph the variation of Fermi factor with energy for $T = 0\,K$ and $T > 0\,K$.	06
	b	What is Hall effect? Derive an expression for Hall coefficient.	06
	c	The dielectric constant of solid with cubic symmetry is $7 \times 10^{-40}\ Fm^2$. Calculate the dielectric constant of the material if the material has $3 \times 10^{28}\ atoms/m^3$.	04
		OR	
6	a	Derive an expression for electron concentration in conduction band in intrinsic semiconductor. By analogy write the expression for holes in valance bond.	07
	b	What is dielectric polarization? Explain any two different dielectric polarization mechanisms.	05
	c	Find the temperature at which there is 1% probability that a state with energy $0.5eV$ above the Fermi level will be occupied by electrons.	04

7	a	Write the labeled stress vs strain graph for a ductile (or elastic) material. Why the load required to break is less than the maximum load?	05
	b	Show that shearing strain is equal to sum of equal linear strain and lateral strains.	06
	c	An unstretched block of gelatin has dimensions $6cm \times 6cm \times 2cm$ as shown in the fig 7c. If force of $0.3N$ is applied tangentially to the upper surface as shown in the figure, causes displacement of $5mm$ relative to the lower surface, calculate the shearing strain, shearing stress and rigidity modulus of the sample.  Fig 7c	05
8	a	Write the differential equation for a damped simple harmonic motion. Discuss the solution for the case of under damped system.	07
	b	Explain resonance with reference to LCR circuit.	05
	c	The length of weight less spring increases by $2cm$ when weight of $1.0kg$ is suspended from it. The weight is pulled down by $10cm$ and released. Determine: i) Period of oscillation of the spring. ii) Maximum $K.E.$ of oscillation of the spring.	04

$$\lambda = \frac{h}{\sqrt{2mEV}} = 7.7 \times 10^{-12} m$$

$$E = \frac{h^2}{2m\lambda^2}$$