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M23BPHYS202

Maharaja Education Trust (R), Mysuru
MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE
An Autonomous Institute, affiliated Visvesvaraya Technological University, Belagavi
Belawadi, Srirangapatna Taluk, Mandya – 571 477
Approved by AICTE, New Delhi |Recognized by Govt. of Karnataka|

I/II Semester B.E Semester End Examinations

July /Aug 2024

Applied Physics for CSE stream

Duration: **3 hrs** Max. Marks: **100**

Note:
01. Answer any **FIVE** full questions, choosing at least **ONE complete** question from each **MODULE**.
02. Draw neat sketches wherever necessary.
03. **Constants:** Speed of Light 'c' = 3×10^8 ms^{-1}, Boltzmann Constant 'k' = 1.38×10^{-23} JK^{-1}, Planck's Constant 'h' = 6.626×10^{-34}Js, Acceleration due to gravity 'g'= 9.8 ms^{-2},Permittivity of free space (ε_0) =8.854×10^{-12} Fm^{-1}

		Questions	Marks	CO	RBT
		Module -1			
Q. 01	**a.**	With a neat ray diagram and explanation for numerical aperture, derive the expression for numerical aperture in terms of refractive indices of core, cladding and surrounding medium of an optical fiber. Mention the condition of propagation of the signal through the fiber.	**08**	**3**	**L4**
	b.	Describe the construction and working of Semiconductor LASER with a neat sketch and energy level diagram.	**08**	**2**	**L3**
	c.	Obtain the attenuation coefficient of the given fiber of length 1300 m, given the input and output power 100 mW and 80 mW.	**04**	**2**	**L3**
		OR			
Q. 02	**a.**	Deduce the expression for the energy density of radiation at equilibrium in terms of Einstein coefficients and thus conclude on $B_{12} = B_{21}$.	**08**	**3**	**L4**
	b.	Discuss the application of LASER in the bar-code scanner and Laser Cooling.	**08**	**2**	**L3**
	c.	The ratio of the population of two energy levels is 1.059×10^{-30}. Find the wavelength of the light emitted at 330K.	**04**	**2**	**L3**
		Module -2			
Q. 03	**a.**	Describe Heisenberg's uncertainty principle. Show that an electron does not exist inside the nucleus based on Heisenberg's Uncertainty Principle.	**08**	**3**	**L4**
	b.	Discuss the Wave function and its physical significance in terms of probability density and Normalization.	**07**	**2**	**L3**
	c.	The ground state energy of an electron in an infinite well is 6.6 meV. Calculate the ground state if the width of the well is doubled.	**05**	**2**	**L3**
		OR			
Q. 04	**a.**	Assuming a time-independent Schrödinger wave equation, show that in the bound state of a dimensional potential well infinite height, the Energy Eigen value is discrete.	**08**	**3**	**L4**
	b.	Describe in brief Phase velocity and Group velocity with neat figure. Mention the properties of the Wave function.	**07**	**2**	**L3**
	c.	The particle of mass 0.5 MeV/c^2 has a kinetic energy of 150 eV. Find	**05**	**2**	**L3**

		its de-Broglie wavelength.			
		Module -3			
Q. 05	**a.**	Explain the Hadmard-gate. Show that the Hadmard-gate is unitary. Explain the operation of Hadmard-gate on $\|0>$ and $\|1>$ along with the circuit symbol and Truth Table.	**08**	**3**	**L4**
	b.	Write in brief about 3 Qubit Quantum gates and hence discuss the Tofolli (CCNOT) -gate along with its circuit symbol and Truth Table.	**08**	**2**	**L3**
	c.	Consider the following two kets $\|\psi> = \begin{pmatrix} -4+i \\ 3 \\ 4+3i \end{pmatrix}$ and $\|\phi> = \begin{pmatrix} 3 \\ i \\ 2 \end{pmatrix}$. Check if, $\|\psi>$ and $\|\phi>$ are orthogonal.	**04**	**3**	**L4**
		OR			
Q. 06	**a.**	Explain the T-gate. Show that the T-gate is unitary. Explain the operation of T-gate on $\|0>$ and $\|1>$ along with the circuit symbol and Truth Table	**08**	**3**	**L4**
	b.	Discuss the Qubit state $\|\psi>$ on a 3D Bloch sphere by determining the appropriate polar angle(θ) and azimuthal angle(φ).	**08**	**2**	**L3**
	c.	Show that the matrix is unitary, $U = \frac{1}{5}\begin{pmatrix} -1+2i & -4-2i \\ 2-4i & -2-i \end{pmatrix}$.	**04**	**3**	**L4**
		Module -4			
Q. 07	**a.**	Describe the failures of the classical free electron theory of different Metals in explaining electrical conductivity dependence on temperature and electron concentration.	**08**	**2**	**L3**
	b.	Explain Meissner's Effect and the variation of the critical magnetic field with the temperature of a superconductor.	**07**	**2**	**L3**
	c.	Find the temperature at which there is a 1% probability that a state with energy with energy 0.05 eV above Fermi energy is occupied.	**05**	**2**	**L3**
		OR			
Q. 08	**a.**	Describe the variation of the Fermi factor based on energy value and temperature, and analyze their occupancy with a neat diagram.	**08**	**2**	**L3**
	b.	Discuss in brief the dependence of resistivity on temperature and impurities of metals based on Mathessian's Rule.	**07**	**2**	**L3**
	c.	The Critical field for Niobium is 8×10^6 A/m at 8 K and 12×10^6 A/m at 0K. Find the critical transition temperature of the element.	**05**	**2**	**L3**
		Module -5			
Q. 09	**a.**	Explore the odd rule and odd rule scenarios with a suitable example and an odd rule multiplier table.	**09**	**3**	**L4**
	b.	With a neat diagram describe walking with the help of step, stride and Gait cycle.	**06**	**2**	**L3**
	c.	In the case of the Jump action, the push height is 0.5 m and the Jump magnification is 5. Calculate the jump height, and push acceleration. Acceleration due to gravity = 9.8 m/s^2.	**05**	**2**	**L3**
		OR			
Q. 10	**a.**	Estimate the value of Pi by explaining the Monte Carlo method.	**09**	**3**	**L4**
	b.	Describe Jumping and explain the different parts of jumping with a suitable example.	**06**	**2**	**L3**
	c.	The number of particles emitted randomly by a radioactive sample obeys the Poisson distribution with $\lambda = 4$. Calculate P(x=0), P (x =1) and P(x =2).	**05**	**2**	**L3**

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