SEE MODEL QUESTION PAPER 2

UG

First Semester B.E. Degree Examination

Engineering Physics

Time: 3 hrs. **Course Code: 20PHY12** **Max. Marks: 100**

***Note: answer any Five full questions, choosing ONE full question from each module*.**

Physical constants: $m_e = 9.11 \times 10^{-31}$ kg, $h = 6.625 \times 10^{-34}$ Js, $e = 1.602 \times 10^{-19}$C, $g = 9.8 m/s^2$, $\varepsilon_o = 8.854 \times 10^{-12}$F/m, $k = 1.38 \times 10^{-23}$ JK^{-1}, $N_A = 6.023 \times 10^{26}$/ kmole.

		Module - 1	Marks
1	a	Define beam, neutral axis, neutral surface, bending moment, single cantilever.	5
	b	Explain underdamping and over damping with examples.	6
	c	Define Hooke's law. Describe the stress-strain graph for an elastic material.	5
	d	Calculate the force required to produce an extension of 1mm in steel wire of length 2m and diameter 1mm. Young's modulus for steel is $2X10^{11}$ N/m^2.	4
		OR	
2	a	Derive an expression for Young's modulus of a beam of rectangular cross-section using single cantilever.	7
	b	Define Poisson's ratio, lateral strain coefficient, longitudinal strain coefficient	3
	c	What are forced oscillations. Mention equation for amplitude and phase in forced oscillations. Explain the cases of forced oscillations	6
	d	An electric motor weighing 50kg is mounted on 4 springs each of which has a spring constant $2X10^3 Nm^{-1}$. The motor moves only in a vertical direction. Find the natural frequency of the system.	4
		Module – 2	
3	a	Explain the principles of laser action.	6
	b	How is laser used in data storage?	4
	c	Utilize Heisenbergs uncertainty principle to prove that the electron does not exist inside the nucleus.	6
	d	Compute the first 2 permitted energy values for an electron in a box of width 1 Å.	4
		OR	
4	a	Determine the eigen value and eigen function for a particle in a box.	7
	b	Summarize the physical significance of wave function.	2
	c	How laser is used to determine pollutants in the atmosphere?	7
	d	A ruby laser emits pulses of 20ns duration with average power/pulse being 0.1MW. If the number of photons in each pulse is $6.981X10^{15}$, calculate the wavelength of photons.	4

		Module – 3	
5	a	Describe density of state for different classes of nanomaterials	5
	b	What are metallic glasses? Discuss the different types of metallic glasses.	5
	c	Explain the principle, construction & working of Scanning tunneling microscope along with two applications.	10
		OR	
6	a	Describe the top down and bottom up approach in the synthesis of nanomaterials.	5
	b	Explain ball milling and arch discharge method of synthesis of nanomaterials.	10
	c	Explain five applications of shape memory alloys in detail.	5
		Module - 4	
7	a	Define Fermi factor. Discuss the dependence of Fermi factor on temperature and energy.	8
	b	Mention the four assumptions of quantum free electron theory.	4
	c	Distinguish between polar and non-polar dielectric materials with one example of each.	4
	d	Calculate the Fermi velocity and the mean free path for the conduction electrons in silver, given that its Fermi energy is 5.5eV, and the mean collision time for electrons is 3.97 x10^{-14} s.	4
		OR	
8	a	Define dielectric polarization. Discuss the different types of polarization mechanisms.	8
	b	Define internal field. Obtain an expression for internal field in solids and liquids in one dimension.	8
	c	The dielectric constant of Helium at 0^{o}C is 1.000074. The density of atoms is 2.7x10^{25}m^{-3}. Calculate the dipole moment induced in each atom when the gas is in an electric field of 3x 10^{4} Vm^{-1}.	4
		Module – 5	
9	a	Explain Gauss law in electrostatics and magnetism.	5
	b	Derive Maxwell- Ampere's law using equation of continuity.	5
	c	Discuss the mechanisms involved in attenuation of the signal in optical fibers.	6
	d	The numerical aperture of an optical fiber is 0.2 when surrounded by air. Determine the refractive index of its core given the refractive index of cladding as 1.59. Also find the acceptance angle when it is in a medium of refractive index 1.33.	4
		OR	
10	a	Derive the expression for numerical aperture & angle of acceptance in an optical fiber.	6
	b	List the Maxwell's equations for static and time varying conditions.	4
	c	Derive differential form of Faraday's law	6
	d	The magnetic field intensity given in a certain region of space as $\vec{H} = \left(\frac{x+2y}{z^2}\right)\hat{a}_y + \frac{2}{z}\hat{a}_z$ A/m. Find the curl of the magnetic field.	4

* * * * *

SCHEME OF VALUATION FOR MODEL QUESTION PAPER 2
ENGINEERING PHYSICS(20PHY12)

Q. NO.		SCHEME	MARKS
1	a	**One mark each for each definition**	5
	b	**Explain under damping** **Explain over damping**	3 3
	c	**Definition of Hooke's Law** **Diagram** **Explanation for stress strain**	1 1 3
	d	$Y = \frac{FL}{Ax}$ $2 \times 10^{10} = \frac{F \times 9.8 \times 2}{\pi \times (0.51 \times 10^{-3})^2 \times 1 \times 10^{-3}}$ $F = 78.54N$	1 1 2
2	a	**Diagram** ω (l-x) = $\frac{Y}{R} I$ R = $\frac{\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{3/2}}{\frac{d^2y}{dx^2}}$ $\frac{d^2y}{dx^2} = \frac{\omega}{YI}(l-x)$ $y_0 = \frac{\omega l^3}{3YI}$ $Y = \frac{4Mgl^3}{3bd^3y_0}$	1 1 1 1 2 1
	b	**Each definition one mark**	3
	c	**Definition** a) Definition Equation of amplitude and phase $a = \frac{\left(\frac{F}{m}\right)}{\sqrt{4b^2p^2+(\omega^2-p^2)^2}}$, $\alpha = \tan^{-1}\left[\frac{2\,bp}{\omega^2-p^2}\right]$ Three cases	1 1 4
	d	$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ $= \frac{1}{2\pi}\sqrt{\frac{4 \times 2 \times 10^3}{50}} = 2Hz$	1 1 2
3	a	**Induced absorption** **Spontaneous emission** **Stimulated emission**	2 2 2

	b	**Diagram** **Explanation**	**1** **3**
	c	**Till finding the value of Δp** **Finding the value of ΔE** **Conclusion**	**2** **2** **2**
	d	$E_1 = \frac{1^2 \times (6.625 \times 10^{-34})^2}{8 \times 9.1 \times 10^{-31} \times (1 \times 10^{-10})^2} = 6.02 \times 10^{-18} J = 37 eV$ $E_2 = n^2 E_1 = 1.67 \times 10^{-17} J = 150 eV$	**2** **2**
4	**a**	**Diagram** **Finding the constants A and B** **Eigen function** **Eigen Value**	**1** **2** **2** **2**
	b	**Explanation of Probability density**	**2**
	c	**Diagram** **Explanation**	**1** **6**
	d	$\lambda = \frac{hc}{\Delta E} = \frac{6.981 \times 10^{15} \times 6.625 \times 10^{-34} \times 3 \times 10^8}{0.1 \times 10^6 \times 20 \times 10^{-9}} = 6937 A^{\circ}$	**1** **1** **2**
5	**a**	**Diagram** **Density of state explanation**	**1** **4**
	b	**Definition** **2 types explanation**	**1** **4**
	c	**Diagram** **Principle** **Explanation**	**2** **2** **6**
6	**a**	**Top down and bottom up approach of synthesis of nanomaterials**	**5**
	b	**Diagram** **Ball Milling method** **Diagram** **Arc discharge method**	**1** **4** **1** **4**
	c	**One mark each for each application**	**5**
7	**a**	**Definition** **Each case 2 marks** **Graph**	**1** **6** **1**
	b	**Four assumptions**	**4**
	c	**Polar dielectric** **Non polar dielectrics**	**2** **2**
	d	$v_F = \sqrt{\frac{2E_F}{m}} = \sqrt{\frac{2 \times 11.63 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}} = 2.02 \times 10^6 m/s$ $\lambda = v_F \tau = 2.02 \times 10^6 \times 7.3 \times 10^{-15} = 1.47 \times 10^{-8} m$	**2** **2**
8	**a**	**Definition** **2 marks for each polarization mechanism**	**2** **6**
	b	**Internal field definition** **Diagram** **Explanation & derivation**	**1** **1** **6**
	c	Dipole moment = $\alpha_e E = \frac{8.854 \times 10^{-12}(1.000074-1)}{2.7 \times 10^{25}} \times 3 \times 10^4$ $= 7.27 \times 10^{-37} Cm$	**2** **2**
9	**a**	Gauss law in electrostatics	**3**

		Gauss law in magnetism	**2**
	b	$\nabla . \vec{J} = 0$ doesn't holds good for time varying condition. Equation of continuity $\nabla . \vec{J} = -\frac{\partial \rho_v}{\partial x}$ **Up to** $\nabla . \left[\vec{J} + \frac{\partial \vec{D}}{\partial t}\right] = 0$	**1** **2** **2**
	c	**2 marks for each case with figure**	**6**
	d	Numerical aperture, $N.A = \frac{\sqrt{n_1^2 - n_2^2}}{n_0}$ $0.2 = \sqrt{n_1^2 - 1.59^2}$ $n_1^2 = 0.2^2 + 1.59^2$ $n = 1.60$ When it is surrounded by medium of R.I of 1.33 $N.A = \frac{\sqrt{n_1^2 - n_2^2}}{n_0} = \frac{\sqrt{1.60^2 - 1.59^2}}{1.33} = 0.134$ $\sin\theta = N.A = 0.134$ $\theta = 7.71$	**1** **1** **2**
10	**a**	**Diagram** **Up to** $\sin\theta_o = \frac{n_1}{n_o}\sqrt{1 - \cos^2\theta_1}$ **Up to** NA = $\sqrt{n_1^2 - n_2^2}$	**1** **2** **3**
	b	**1 mark for each equation**	**4**
	c	**Statement** **Derivation**	**1** **5**
	d	**Formula** $\nabla \times H = \begin{vmatrix} \hat{a}_x & \hat{a}_y & \hat{a}_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ A_x & A_y & A_z \end{vmatrix}$ **Substitution & Calculation** $\nabla \times H = \frac{2(x + 2y)}{z^3} a_x + \frac{1}{z^2} a_z$	**1** **2** **1**