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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May-2018

Program Name: B. Tech (SoCS) **Semester – II**
(CS-BFSI, BAO, CL, ECRA, DEVOPS, IFM, IOT, CSF, MFT, GG, MC)
Course Name : Physics **Max. Marks :100**
Course Code : PHYS 1002 **Duration : 3Hrs**
No. of page/s: 03

Instructions:
All questions are compulsory.
Question numbers to be written very clearly.
All bold representations are vectors.

SECTION A (All Questions are compulsory)

1	What are the main components required for the production of lasing action?	**[4]**	**CO1**
2	A vector in a frame S' is represented by $9\hat{i} + 8\hat{j}$. How this vector can be represented in frame S, while frame S' is moving with velocity 0.6c $\hat{j}$ w.r.t. frame S?	**[4]**	**CO2**
3	For a position vector $A = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$, prove that; ¿$(A)$ = ϕ(¿ A) + **A**.$(grad)$	**[4]**	**CO3**
4	Describe step index multimode fiber and graded index fiber with schematic diagrams.	**[4]**	**CO1**
5	Show that de-Broglie wave length of electrons accelerated through a potential of V volts is given by $\lambda = \left(\sqrt{\frac{150}{V}}\right) Å$	**[4]**	**CO2**

SECTION B
(All Questions are compulsory with an internal choice in Question 9**)**

6	(a) What are various kinds of losses that an optical signal suffer while propagating through fiber.	**[5]**	**CO1**
	(b) A three-level laser emits a light of wavelength of 5500 Å. What will be the ratio of population of upper energy level E_2 to the lower energy level E_1, if the optical pumping mechanism is shut off at T = 300 K. At what temperature the ratio of populations would be 1/2.	**[5]**	**CO3**
7	Describe the concept of Maxwell's displacement current and show how it led to the modification of Ampere's law.	**[10]**	**CO2**
8	(a) In a certain conducting region, $\mathbf{H} = yz(x^2 + y^2)\,\mathbf{a}_x - y^2xz\,\mathbf{a}_y + 4x^2y^2\mathbf{a}_z$ A/m . Determine the value of **J** at (5, 2, -3).	**[5]**	**CO3**
	(b) What do you mean by inertial and non-inertial frames of reference? State the Einstein's postulates of special theory of relativity.	**[5]**	**CO1**
9	A photon of energy E is scattered by an electron initially at rest (rest mass energy,E_0)	**[10]**	**CO3**

	(Compton scattering problem). Show that the maximum kinetic energy (KE_{max}) of the recoil electron can be calculated as- $$KE_{max} = \frac{\frac{2E^2}{E_0}}{1+\frac{2E}{E_0}}$$ (OR) Plot a variation of $\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ Vs (v/c) for the given values of v. Analyze how it depends upon the velocity v. Given v = 0, 6×10^7, 1.2×10^8, 1.8×10^8, 2.4×10^8, 3×10^8 m/s. Also plot the relativistic variation of length of a rod having proper length of 1 m.		
	SECTION C **(**All Questions are compulsory with an internal choice in Question 11**)**		
10	(a) State Faraday's law of electromagnetic induction. How it can be expressed as one of the Maxwell's equations for time varying field? (ii) A conducting circular loop of radius 20 cm lies in the z = 0 plane in a magnetic field $\mathbf{B}$ = 10 cos 377t $\mathbf{a_z}$ mWb/m^2. Calculate the induced voltage in the loop. (b) Explain the physical significane of the wave function. Derive Schrodinger's time independent wave equation.	**[5]** **[5]** **[10]**	**CO1** **CO3** **CO2**
11	(a) State Heisenberg's uncertainty principle. (b) On its basis prove that the electron can- not be the part of nucleus (c) Shows that in Compton Scattering, the recoil angle of an electron is given by ¿ $\tan^{-1}\left(\frac{\cot\frac{\theta}{2}}{1+\frac{h}{m_0c^2}}\right)$ where θ and ϕ are scattering angle of scattered photon and electron respectively. (OR) (a) Explain wave velocity and group velocity of matter waves? (b) Derive the relation between group velocity and phase velocity. (c) Derive Energy Eigen value of a particle confined in one-dimensional box and hence calculate the energies of first two excited energy levels in terms of ground energy level [E_0]	**[5]** **[5]** **[10]** **[5]** **[5]** **[10]**	**CO1** **CO2** **CO4** **CO1** **CO2** **CO4**

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
Permittivity of free space (ε_o)	8.854×10^{-12} Farad/meter
Velocity of Light c	3×10^{8} m/sec
Boltzmann constant (k_B)	1.38×10^{-23} J K^{-1}
Rest mass of an Electron	9.11×10^{-31} Kg
Charge of electron	1.6×10^{-19} C