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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Examination, July 2020

Programme: B TECH (CSE+ALL SOCS) **Semester : II**
Course Name: PHYSICS **Max. Marks : 100**
Course Code: PHYS 1008 **Attempt Duration : 3 Hrs.**
No. of page/s:

Note:

1. Read the instruction carefully before attempting.
2. This question paper has two section, Section A and Section B.
3. There are total of six questions in this question paper. **One** in **Section A** and **five** in **Section B**
4. **Section A** consist of multiple choice based questions and has the total weightage of 60%.
5. **Section A** will be conducted online on BB Collaborate platform
6. **Section B** consist of long answer based questions and has the total weightage of 40%. The questions for section B shall also appear in BB Collaborate
7. **Section B** is to be submitted within 24 hrs from the scheduled time i.e. if the examination starts at 10:00 AM, the long answers must be submitted by 09:59:59 AM next day. Similarly, if the examination starts at 2:00 PM it must be submitted by 01:59:59 PM next day. (*Exceptional provision due extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
8. No submission of **Section B** shall be entertained after 24 Hrs.
9. **Section B** should be attempted after **Section A**
10. **Section B** should be attempted on blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sap id at the top (as in the format) and signature at the bottom (right hand side bottom corner)
11. Both section A & B should have questions from entire syllabus.
12. The COs mapping, internal choices within a section is same as earlier

Section – A (Attempt all the questions)
(60 marks. Please write how marks have been distributed)

1. MCQs

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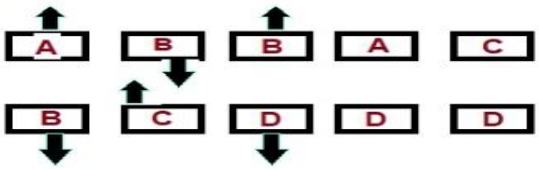
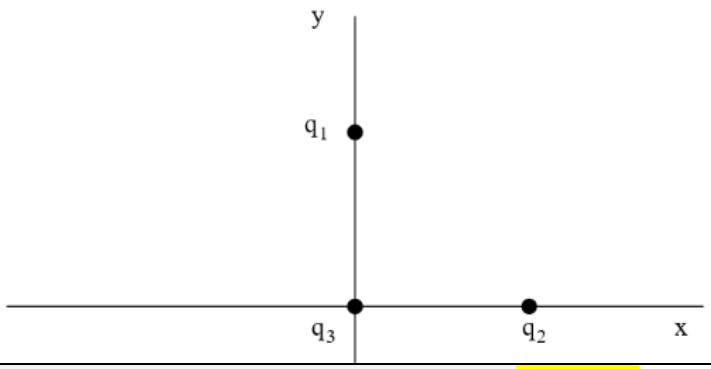
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination - Part A, July 2020

Program Name: B. Tech (SoCS)- All SoCS branches **Semester – II**
Course Name : Physics **Max. Marks: 60**
Course Code : PHYS 1008 **No. of page/s:**
Instructions: All bold quantities represent vector.

a	Match the following based on Laser and Pumping Mechanisms (a) Ruby Laser – Optical Pumping (b) Helium Neon Laser – Electrical Pumping (c) Carbondioxide laser – Chemical Pumping	**[2]**	**CO1**
b	An Optical fiber has an attenuation 3 dB/km. If 0.75 mW optical power is initially launched into the fiber, what is the power level after 8 km? (CO1) (2 Marks) (a) 1.99 μW (b) 2.99 μW (c) 3.99 μW (d) 0.99 μW	**[2]**	**CO1**
c	At what temperature are the rates of spontaneous and stimulated emissions are equal. Assume $\lambda = 6000$ Å. (Given $h = 6.626 \times 10^{-34}\ J-s, K = 1.38 \times 10^{-23}\ J/K$, $c = 3 \times 10^{8}\ m/s$) (a) 10,781 K (b) 15,781 K (c) 20,781 K (d) 25,781 K	**[3]**	**CO1**
d	A glass-clad fiber is made with the core glass of refractive index 1.6 and the cladding is doped to give a fractional index difference of 0.006. Calculate (i) the refractive	**[3]**	**CO1**

	index of the cladding, (ii) the critical angle, (iii) the numerical aperture and (iv) the acceptance angle. (Select the nearest answer in the options given, by doing calculation up to the third decimal) (a) $(i)\ 1.590, (ii)\ 83.72^{\circ}, (iii)\ 0.176, and\ (iv)\ 10.14^{\circ}$ (b) $(i)\ 1.490, (ii)\ 93.72^{\circ}, (iii)\ 0.276, and\ (iv)\ 20.14^{\circ}$ (c) $(i)\ 1.690, (ii)\ 73.72^{\circ}, (iii)\ 0.176, and\ (iv)\ 15.14^{\circ}$ (d) $(i)\ 1.590, (ii)\ 83.72^{\circ}, (iii)\ 0.276, and\ (iv)\ 20.14^{\circ}$		
e	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 **J** at (1, 1, 1)	**[2]**	**C02**
f	The figure shows five pairs of plates; A, B, and D are charged plastic plates and C is an electrically neutral copper plate. The electrostatic forces between the pairs of plates are shown for three of the pairs. Which of the following statements is correct?  Identify the force between last two pairs.	**[2]**	**C02**
g	Consider a solid charged sphere of radius **R**, which of following statements are true for Electric field Intensity **E (Choose all that apply)** o **E** = 0, at any point inside the sphere o **E** is maximum at the surface of the Sphere o **E** varies exponentially from the center to the surface of the sphere o As we move away from the sphere, **E** decreases	**[2]**	**C02**

h	Charge $q_1 = 3.0 \times 10^{-6}$ C is located at $(x, y) = (0, 10\text{ cm})$, charge $q_2 = 4.0 \times 10^{-6}$ C is located at $(x, y) = (10\text{ cm}, 0)$, and charge $q_3 = -1.0 \times 10^{-6}$ C is at the origin, as shown in the figure. What is the magnitude of the force on q_3? $(k = 9.0 \times 10^9\text{ N m}^2/\text{C}^2)$  	**[3]**	**C02**
i	Magnetostatics: Choose all the statements which you **disagree** ○ Ampere's law is similar to Gauss's law ○ Magnetostatic field is conservative ○ Ampere's circuit law states that the line integral of H around a closed path is the same as the net current **I** enclosed by the path ○ in case of a finite current sheet, the sheet cannot be regarded as consisting of filamentary pairs to determine **H**	**[2]**	**C03**
j	If ϵ_r is the relative permittivity and χ_e is the electric susceptibility of the materials, then the correct relation is A. $\epsilon_r = 1 + \chi_e$ B. $\epsilon_r = 1 - \chi_e$ C. $\epsilon_r = \sqrt{1 - \chi_e}$ D. $\epsilon_r = \sqrt{1 + \chi_e}$	**[2]**	**C03**
k	When there is a change in magnetic flux, emf is induced. This statement is"_____ Faraday's first law	**[2]**	**C03**
l	Faraday's Law: tick all the statements that you agree. (tick all that apply) ○ Michael Faraday introduced The idea of lines ○ Any surface on which the potential is the same throughout is known as an equipotential surface ○ The intersection of an equipotential surface and a plane results in a path or line known as an non-equipotential line	**[2]**	**C03**

	○ The human heart can be characterized as a dipole		
m	A region of space that has an electric field in the x-direction given by $\vec{E} = E_0 \hat{x}$ with $E_0 = 25\ mV$ and a magnetic field in the y-direction given by $\vec{B} = -2B_0 \hat{y}$ with $B_0 = 0.001\ tesla$. A charged particle, $Q = 5mC$, traveling in the z-direction with velocity $\vec{v} = v_0 \hat{z}$ enters the region. If the particle experiences no net force and continues with the same speed and direction, what is its speed v_0 (in m/s)	**[3]**	**C03**
n	The relation that can be used to determine de-Broglie wavelength associated with a particle of mass m and having energy E is (CO 4) (2 marks) (a) $\lambda = \frac{h}{\sqrt{2meV}}$ (b) $\lambda = \frac{h}{\sqrt{3mKT}}$ (c) $\lambda = \frac{h}{\sqrt{2mE}}$ (d) All the above	**[2]**	**C04**
o	The life time of an excited state of an atom is about $10^{-8}\ sec$. Calculate the minimum uncertainties in the determination of the energy (in eV) and frequency (in MHz) of the excited state. (a) $6.58 \times 10^{-8}\ eV, 15.9\ MHz$ (b) $6.58 \times 10^{-8}\ eV, 14.9\ MHz$ (c) $5.58 \times 10^{-8}\ eV, 15.9\ MHz$ (d) $5.58 \times 10^{-8}\ eV, 14.9\ MHz$	**[2]**	**C04**
p	The de-Broglie wavelength (in Å) of an electron accelerated through a potential difference of 182 volts is (CO 4) (2 marks) (a) 0.61 Å (b) 0.71 Å (c) 0.81 Å (d) 0.91 Å	**[2]**	**C04**

q	The energy of the lowest three levels for an electron in a square well of width 3Å are (a) $E_1 = 5.7 \times 10^{-19}\,J, E_2 = 1.68 \times 10^{-18}\,J\ and\ E_3 = 6.03 \times 10^{-18}\,J$ (b) $E_1 = 5.7 \times 10^{-19}\,J, E_2 = 1.68 \times 10^{-18}\,J\ and\ E_3 = 5.03 \times 10^{-18}\,J$ (c) $E_1 = 6.7 \times 10^{-19}\,J, E_2 = 2.68 \times 10^{-18}\,J\ and\ E_3 = 6.03 \times 10^{-18}\,J$ (d) $E_1 = 6.7 \times 10^{-19}\,J, E_2 = 3.68 \times 10^{-18}\,J\ and\ E_3 = 5.03 \times 10^{-18}\,J$	**[2]**	**C04**
r	The value of the term α in the equation for the maximum kinetic energy of a recoil electron $$(K.E)_{Max} = h\upsilon[\frac{\alpha(1-\cos\theta)}{1+\alpha(1-\cos\theta)}]$$ (a) $\alpha = \frac{h\upsilon}{m_0 c}$ (b) $\alpha = \frac{h\upsilon}{m_0 c^2}$ (c) $\alpha = \frac{h\upsilon}{m_0}$ (d) $\alpha = \frac{h}{c}$	**[3]**	**C04**
s	Find the probability that a particle trapped in a box L wide can be found between $0.45\,L$ and $0.55\,L$ for the ground state (a) 0.098 (b) 0.198 (c) 0.228 (d) 0.298	**[3]**	**C04**
t	Select all that apply in Photoelectric Effect (a) Similar to thermionic emission (b) Stopping potential is independent on Intensity for a given photometal (c) Saturation current increases with increase in Intensity (d) Energy of the incident photon is less than 1 MeV (e) Energy of the incident photon is greater than 1 MeV	**[3]**	**C04**
u	Select all that satisfy for the properties of wave function ψ (a) The wave function must be single and finite valued (b) The wave function must be discontinuous (c) The wave function must be continuous (d) The wave function must be differentiable (e) The wave function must be infinite	**[3]**	**C04**

v	In Quantum computers Computations are _____	**[2]**	**C05**
w	Given the ket $\|\psi\rangle = 5\|0\rangle - i\,\|1\rangle$ find its probability amplitude.	**[2]**	**C05**
x	A "Qubit" can be Implemented by [choose all that apply] ○ Photonisation of photon ○ polarization of photon ○ The energy level of neutron ○ The Energy level of an atom ○ rotation of an electron ○ spin orientation of an electron	**[3]**	**C05**
y	Quantum Computing: Match the following Severe restrictions exist on copying and measuring signals — Quantum Computer No restriction exists on copying and measuring signals — Classical computer The destruction of information in a gate can cause heat that can destroy the superposition of _____. — Q- bit	**[3]**	**C05**

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Section – B (Attempt all the questions)
(40 marks)

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Assignment – Part B, July 2020

Program Name: B. Tech (SoCS)- BAO, CCVT, IFM & GG — **Semester – II**
Course Name : Physics — **Max. Marks: 40**
Course Code : PHYS 1008 — **No. of page/s: 01**
Instructions: All bold quantities represent vector.

2	a. Discuss characteristic properties of a LASER beam. How is it different from ordinary light beam? b. The numerical aperture of a fiber is 0.25 and refractive index is 0.02. Determine the refractive indices of the core and cladding of a fiber	**[8]**	**CO1**

3	Derive the boundary conditions for the electric field at the interface of two mediums with different dielectric constant ε_{r1} and ε_{r2} . Assume that the free charge density $\rho_s = 0$ across the boundary.	**[8]**	**CO2**
4	In the region $0 < r < 0.5\ m$, in cylindrical coordinates, the current density is $\mathbf{J} = 4.5\ e^{-2r}\boldsymbol{a_z}\ \boldsymbol{A/m^2}$ and $\boldsymbol{J} = 0$ elsewhere. Use Ampere's law to find $\boldsymbol{H}$.	**[8]**	**CO3**
5	Show that the direction of the recoiled electron in Compton's effect is given by: $$\tan\varphi = \frac{cot\frac{\theta}{2}}{1+\frac{hv}{m_0c^2}}$$ where θ is the scattering angle and φ represents the angle of recoiled electron	**[8]**	**CO4**
6	a. Explain the difference between quantum computers and classical computers b. Given the ket $\|\psi\rangle = 4\|0\rangle - 3i\ \|1\rangle$, find its normalized state.	**[8]**	**C05**

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