Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: PHYSICS I **Semester: II**
Course Code: PHYS1007
Programme: BTech : GIE GSE and FSE **Max. Marks: 100**
Time: 03 hrs.
Instructions: All questions are compulsory (**Q9**, **Q10** and **Q12** have internal choice)
Total pages: 2

SECTION A

S. No.		Marks	CO
Q1.	What do you understand by magnetic flux and explain why net magnetic flux from a bar magnet is zero.	**4**	**CO2**
Q2.	A grating surface has 90000 ruled lines. What is the resolving power of the grating in the first order	**4**	**CO1**
Q3.	Write the properties of a well-behaved wave function.	**4**	**CO3**
Q4.	Briefly discuss various types of interference with examples.	**4**	**CO1**
Q5.	Calculate the energy and momentum of a photon of wavelength 1 Å.	**4**	**CO3**

SECTION B

Q6.	Discuss the origin of diamagnetism, paramagnetism and ferromagnetism in materials. How temperature affects magnetism in these materials? Explain with suitable diagrams of susceptibility versus temperature.	**8**	**CO2**
Q7.	Discuss the characteristics of blackbody spectrum with diagram. From Wien's displacement law calculate the blackbody temperature for the emitted spectrum peaking at 550 nm. Wien's displacement constant = 0.29 cm-K.	**8**	**CO3**
Q8.	A light ray enters from air to step indexed multimode fiber. The refractive index of core is 1.5 and fractional index difference (Δ) is 0.015. Determine the refractive index of cladding, critical angle for propagation, numerical aperture and maximum acceptance angle.	**8**	**CO1**
Q9.	Explain, how circularly polarized light may be distinguished from a mixture of polarized and plane polarized light. **OR** Explain the construction and working of Ruby laser with suitable diagrams.	**8**	**CO1**

Q10.	The speed of an electron moving at 600 m/sec is measured to an accuracy of 0.005%. What will be the minimum error in determining its position? **OR** Calculate the de-Broglie wavelength of an alpha particle accelerated through a potential difference of 1000 volts.	**8**	**CO3**
SECTION-C			
Q11.	(a) Derive Clausis-Mosotti equation using internal (Lorentz) field at an atom in cubic structure $\left(E_L = E + \frac{P}{3\epsilon_0}\right)$. Where P is the polarization vector due to externally electric field E on dielectric material. (b) Calculate the polarizability and relative permittivity in hydrogen gas with a density of 9.8×10^{26} atoms/m^3. The radius of the hydrogen atom to be 0.50Å.	**10** **10**	**CO2**
Q12.	(a) Derive the expression for normalized wave function in the following form for a particle trapped in 1D potential box of length L. $$\psi_n(x) = \sqrt{2/L}\sin(n\pi x/L)\, for, 0<x<L$$ (b) Give the construction of Nicol prism and explain its working as polarizer and analyzer. **OR** (a) A beam of x-rays with wavelength λ is directed toward a sample. The x-ray scattered at an angle ϕ from the rest electron within the sample, and detected with a new wavelength λ'. If rest mass of the electron is m_0, find the following expression for the change in wavelength. $$\Delta\lambda = \lambda' - \lambda = \frac{h}{m_0 c}(1 - cos\phi)$$ (b) What is a plane diffraction grating? Derive the condition for absent spectra in plane diffraction grating. Also, deduce an expression for its dispersive power.	**10** **10** **10** **10**	**CO3** **CO2** **CO3** **CO2**
Physical constants: $h = 6.63\times10^{-34}\, J-s, c = 3\times10^8\, m/s, k_B = 1.38\times10^{-23}\, J/K, \mu_0 = 4\pi\times10^{-7}\, H/m$ $\varepsilon_0 = 8.854\times10^{-12}\, F/m$			

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Name of the School (Please tick, symbol is given)	:	**SOE**	✓	**SOCS**		**SOP**	
Programme	:	**BTech: GSE, GIE, FSE**					
Semester	:	**I**					
Name of the Course	:	**PHYSICS- I**					
Course Code	:	**PHYS1007**					
Name of Question Paper Setter	:	**Dr S. K. Joshi**					
Employee Code	:	**40000723**					
Mobile & Extension	:	**9412034458**					

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SECTION A

S. No.		Marks	CO
Q1.	Explain the hysteresis curve in magnetism. Based on hypothesis curve, how will you distinguish between hard and soft magnetic materials.	**4**	**CO2**
Q2.	Two coherent sources whose intensity ratio is 144:1 produce interference fringes. Deduce the ratio of maximum to minimum intensity of the fringe system.	**4**	**CO1**
Q3.	Write the statements and expressions of Heisenberg's uncertainty principle.	**4**	**CO3**
Q4.	Briefly discuss various types of interference with examples.	**4**	**CO1**
Q5.	Show that the expectation value of momentum for a particle in a one-dimensional box is zero.	**4**	**CO3**

SECTION B

S. No.		Marks	CO
Q6.	List the main properties of diamagnetic, paramagnetic and ferromagnetic materials. What is Curie-Weiss law ?	**8**	**CO2**
Q7.	Give the experimental findings of Photoelectric effect experiment. Find maximum wavelength of light that can liberate electrons from a metallic surface of work function 2.24 eV.	**8**	**CO3**
Q8.	A 15 km long cable uses an optical fiber with a loss of 1.5 dB/km. The fiber is joined every kilometer with connectors, which give attenuation of 0.8 dB each. Determine the minimum optical power which optical power which must be launched with this cable to maintain a power level of 0.3 µW at the receiving end.	**8**	**CO1**
Q9.	Discuss the properties of double refracting materials. Discuss their use in Quarter wave plate (QWP) and half wave plate (HWP). Deduce the expressions of thickness for HWP and QWP. **OR** Explain construction and working of Ruby laser with suitable diagrams.	**8**	**CO1**
Q10.	Calculate the maximum percentage change in wavelength due to Compton scattering for incident photons of wavelength 1Å and 10Å. What information do you draw from the result? **OR**	**8**	**CO3**

	Can a photon and an electron of the same momentum have the same wavelength? Compare their wavelengths if the two have the same energy.		
	SECTION-C		
Q11.	(a) Derive Clausis-Mosotti equation using internal (Lorentz) field at an atom in cubic structure $\left(E_L = E + \frac{P}{3\epsilon_0}\right)$. Where P is the polarization vector due to externally electric field E on dielectric material. (b) An electron in a hydrogen atom moves in a circular orbit of radius 0.5 Angstroms. The electron performs 10^{16} revolutions per second. Determine the magnetic moment associated with the orbital motion of the electron.	**10** **10**	**CO2**
Q12.	(a) Determine the expression for the eigenvalue (E_n) and eigenfunction (φ_n) for a particle trapped in 1-Dimensional box.	**10**	**CO3**
	(b) Give a systematic procedure for production and analysis of Plane Polarized light (PPL), Circular polarized light (CPL) and Elliptical polarized light (EPL).	**10**	**CO2**
	OR		
	(a) A beam of x-rays with wavelength λ is directed toward a sample. The x-ray is scattered at an angle ϕ from the rest electron within the sample, and detected with a new wavelength λ'. If rest mass of the electron is m_0, find the following expression for the change in wavelength. $$\Delta\lambda = \lambda' - \lambda = \frac{h}{m_0 c}(1 - cos\phi)$$	**10**	**CO3**
	(b) From the expression of resultant intensity ($I = I_0 \frac{\sin^2\alpha}{\alpha^2}$) for a single slit diffraction show that the intensity ratios of central maxima and secondary maxima varies approximately as 1: $4/9\pi^2$: $4/25\pi^2$: $4/49\pi^2$.	**10**	**CO2**
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