

2019**M.Sc.****1st Semester Examination****PHYSICS****PAPER – PHS-103 (Gr. – 103.1 + 103.2)****Full Marks : 50****Time : 2 Hours***Use separate answer scripts for 103.1 and Group 103.2**(Electrodynamics – PHS 103.1)**Answer Q1, Q2 and any one from Q3 and Q4*

1. Answer any two bits: 2X2 = 4
- (a) Why the advance potential is not physically acceptable?
- (b) Define the distribution function in phase space under plasma kinetic theory.
- (c) Show that $F^{\mu\nu}G_{\mu\nu} = 4\frac{\vec{E}\cdot\vec{B}}{c}$, where $F^{\mu\nu}$ is field tensor and $G_{\mu\nu}$ is the dual.
- (d) Write difference between bremsstrahlung and cherenka radiation.
2. Answer any two bits: 2X4 = 8
- (a) Deduce Boltzmann equation for plasma.
- (b) Write down the Lienard-Wiechart potentials and hence calculate the magnetic field for a moving point charge.
- (c) Calculate the differential cross section for scattering by dipoles induced in small scatters.

(Turn Over)

(d) Show that momentum four vector is constant using Hamiltonian action principle and $\partial_\mu F^{\mu\nu} = \mu_0 J^\nu$ where $F^{\mu\nu}$ is field tensor, $G^{\mu\nu}$ it's dual and $J^\nu = (c\rho, \vec{J})$

3. Calculate the Potential and fields for an oscillating electric dipole and also calculate radiation energy for this case. (6+2)

4. (a) Write down the retarded potentials and hence deduce the time dependent generalization of Coulomb's law.

(b) An infinite straight wire carries a linearly increasing current $I(t) = Kt$, $t > 0$; $= 0$, otherwise. Find the electric field generated. (5+3)

(Material Preparation & Characterization – PHS 103.2)

Answer Q1, Q2 and any one from Q3 and Q4

1. Answer any two bits: 2X2 = 4

(a) Why nanomaterials are more reactive than their bulk counterpart?

(b) Why electron microscopy is better than the optical microscopy?

(c) How will you distinguish between the XRD spectra of a crystalline and amorphous materials?

(d) What is the significance of the peak observed in UV-VIS-NIR spectra?

2. Answer any two bits: 2X4 = 8

(a) State briefly the principle of melt-quench method to prepare glass and explain glass transition temperature.

(b) Describe Atomic Layer Deposition (ALD) technique for the deposition of the Al_2O_3 thin film.

(c) Give the principle of the optical absorption spectroscopy and explain with block diagram.

(d) How the surface of a substrate can be cleaned? Considering very high kinetic energy (E) of an electron derive its de-Broglie wavelength in TEM. (2+2)

3. (a) Show schematically basic components of Atomic Force Microscopy (AFM) and explain the operational principle of the AFM?

(b) Discuss briefly the different sections of Transmission Electron Microscope (TEM) and explain how it can be operated in “diffraction mode” and “image mode”.

(c) Name different pressure gauges with their range to measure the different levels of vacuum. (3+4+1)

4. (a) What is X-ray photoelectron spectroscopy? Write its working principle. What are the sources of X-ray used in this spectroscopy? What is the advantage of using synchrotron radiation as the source of X-ray? Describe the mechanisms of energy loss of electron in the X-ray photoelectron spectroscopy. (2+1+1+2+2)

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Internal Assessment-10

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