2012

M.Sc. (Physics), Third Semester

PHY-8034: Classical Electrodynamics - II

Max. Marks: 60

Time allowed: 3 Hours

NOTE: *Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I - IV.*

x-x-x

Unit I

1.(a) A photon strikes a stationary electron giving rise to an electro-positron pair as well as a recoil electron. Find the threshold for the reaction, in terms of electron mass m_0, using principle of energy-momentum invariance. (6)

(b) What are Lorentz transformations. Explain in detail. (6)

2.(a) Using energy-momentum invariant principle, find the kinetic energy of proton in the decay of $\Lambda \rightarrow p\,\pi^-$. Mass of proton (p) = 938.5 Mev, mass of $\pi^- = 139.6$ Mev. Mass of $\Lambda = 1115$ Mev. (6)

(b) Explain the terms i) time dilation ii) length contraction, iii) proper time. (2,2,2)

Unit II

3.(a) Show that motion of a non-relativistic charged particle in a crossed uniform and constant electric and magnetic fields is helical. (6)

(b) What are adiabatic invariants? What is Magnetic mirror. (3,3)

4.(a) What is the major difference in the behavior of a charged particle moving in constant magnetic field, moving with relativistic velocity in one case and in the other case when it is moving with non-relativistic velocity. Discuss in detail. (6)

(b) What is guiding center approximation? Describe the non-relativistic motion of charged particle in space varying magnetic field (6)

P.T.O.

(2)

Unit III

5.(a) Starting from the four-dimensional form of homogenous Maxwell's equations, obtain wave equation for A^μ. (6)

(b) Write down the matrix elements of electromagnetic tensor $F_{\mu\nu}$. State transformational properties of $F_{\mu\nu}$. (6)

6.(a)Express fundamental microscopic form Maxwell's equations in covariant form. (6)

(b) Obtain the expression for the Lagrangian of a charged particle in an Electromagnetic field

(6)

Unit IV

7.(a) Describe Thomson Scattering. (6)

(b) Obtain the Lienard-Wiechert potential expression for vector potential. (6)

8.(a)What are the characteristics of cyclotron radiation and synchrotron radiation? (6)

(b) Describe Rayleigh Scattering. (6)

Unit V

9.(a) What are time-like events? What are space-like events? (2)

(b) How does the velocities add up in Special Theory of Relativity. (2)

(c)Construct two Lorentz invariants using $F_{\mu\nu}$ (2)

(d) What are retarded potentials? (2)

(e) What is radiation reaction? Write Lorentz force equation taking this into account. (2)

(f) A charged particle in uniform motion does not emit radiation. True or false? Why? (2)

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