

MAHATMA GANDHI UNIVERSITY
PG-CSS MODEL QUESTION PAPER 2012
SEMESTER I

PAPER:

PH1RC3 ELECTRODYNAMICS AND NON LINEAR OPTICS

Time : 3 hrs

Total Weight:30

Part A (Short answer questions)

(Answer any six questions. Each question carries weight one.)

1. Write down the expression for displacement current if the charge on the capacitor is $q=q_0 \sin \omega t$.
2. Write the Maxwell's equation which remains unchanged due to change in medium.
3. Express the field vectors in terms of magnetic vector potential A and scalar potential ϕ
4. What are gauge transformations?. Distinguish between Coulomb and Lorentz gauge.
5. What are advanced and retarded potentials?
6. Show that the power radiated by a magnetic dipole is small compared to the power radiated by an electric dipole.
7. What is the difference between the magnetic fields of a moving charge for an observer moving with the charge and another observer at rest.
8. What are four vectors?
9. Write a short note on optical mixing.
10. What is meant by sum and difference frequency generation.?

6x1= 6 weight

Part B (Problems)

(Answer any four questions. Each question carries weight two.)

11. The intensity of sunlight hitting the earth is about 1300W/m^2 . If sun light strikes a perfect absorber, what pressure does it exert? How about a perfect reflector? What fraction of atmospheric pressure does this amount to?
12. Obtain the boundary conditions on electric field (E) and magnetic field (B) at an interface.
13. A plane electromagnetic wave travelling in the +ve z direction in an unbounded lossless dielectric medium with relative permeability $\mu_r=1$ and relative permittivity $\epsilon_r=3$ has a peak electric field intensity $E_0=6\text{ V/m}$. Find : (a) speed of the wave. (b)the intrinsic impedance of the medium.(c) The peak (b) magnetic field intensity(H_0) (d) The peak Poynting vector $S(z,t)$
14. Calculate the radiation damping of a charged particle attached to a spring of Natural frequency ω_0 , driven at a frequency ω .

15. If a particle's Kinetic energy is n times its rest energy, what is its speed.
16. Explain the process of four wave mixing. Show that the sufficient condition for this process is $K_3(\omega) = -K_4(\omega)$

4x2= 8 weight

Part C (Essay)

(Answer all questions. Each question carries weight four.)

17. (i) Discuss the propagation of electromagnetic waves in conductors and derive an expression for skin depth.
OR
(ii) State and prove the conservation of momentum principle in electrodynamics. Explain the significance of Maxwell's stress Tensor.
18. Explain the electric dipole radiation. Deduce the expressions for the fields due to oscillating electric dipole and deduce the power radiation
OR
(ii) Obtain the Lienard-Wiechart Potentials for a moving point charge and deduce the expressions for a moving point charge
19. (i) What is Electromagnetic field Tensor? Obtain the Lorentz transformation equations for the Electric and Magnetic fields.
OR
(ii) Express Maxwell's equations in terms of Field tensor F and dual tensor G . Obtain from them equations for Electromagnetic field in terms of E & B
20. (i) Explain the Second Harmonic Generation process. Obtain the expression for SHG efficiency.
OR
(ii) Discuss in detail the self focussing in non-linear medium. Also calculate the focal length of the medium.

4x4= 16 weight