F 5134   (Pages : 2)   Reg. No..................................

Name..................................

M.Sc. DEGREE (C.S.S.) EXAMINATION, JANUARY/FEBRUARY 2017

First Semester

Faculty of Science

Branch II : Physics-A-Pure Physics

PH 1C 03—ELECTRODYNAMICS

(2012 Admission onwards)

Time : Three Hours   Maximum Weight : 30

Part A

Answer any six questions.
Weight 1 for each question.

1. Prove that $E = -\nabla V - \dfrac{\partial A}{\partial t}$.

2. Write a note on Maxwell stress tensor T_{ij}. What does its diagonal elements and off diagonal elements represent ?

3. Explain Minkowsky force on a charge 'q'.

4. Write a note on skin depth. Write the equation for skin depth for poor conductor and good conductor.

5. Explain proper velocity 4 vector.

6. Explain Abraham-Lorentz formula for the radiation reaction force.

7. Explain characteristic impedance of transmission line.

8. Explain the difference between phase and group velocity.

9. Explain boundary conditions of electric and magnetic fields.

10. Write Lorentz transformation equations.

$(6 \times 1 = 6)$

Part B

Answer any four questions.
Weight 2 for each question.

11. Find the fields, and the charge and current distributions corresponding to :

$$V(r, t) = 0 \text{ and } A(r, t) = \frac{-1}{4\pi\varepsilon_0} \frac{qt}{r^2} \hat{r}.$$

Turn over

12. Prove that $E^2 - c^2 B^2$ is relativistically invariant.

13. An infinite straight wire carries a current $I(t) = \begin{cases} 0 & for\ t \leq 0 \\ I_0 & for\ t > 0 \end{cases}$. Find the resulting electric field.

14. A rectangular wave guide has dimension 3×2 cm. operates at 10 GH_Z. Find f_c, λ_c, λ_g and V_p of TE_{10} mode.

15. Electric field intensity of a uniform plane wave in free space is given by $E = 94\cos(\omega t + 6z)\,\hat{x}$. Find the magnetic field.

16. A plane electromagnetic wave has magnetic field given by :

$$B(x, y, z, t) = \sin\left((x+y)\frac{k}{\sqrt{2}} + \omega t\right)\hat{k}.$$ Find the pointing vector ?

(4 × 2 = 8)

Part C

*Answer **all** questions.*
Weight 4 for each question.

17. (a) Derive 'work energy theorem' of electrodynamics.

Or

(b) Explain reflection and transmission at oblique incidence. Obtain the expression for reflectance and transmittance.

18. (a) Explain electromagnetic field tensor.

Or

(b) (i) Explain proper time and proper velocity.

(ii) Write a note on relativistic potential formulation.

19. (a) ExplainTM wave propagation in rectangular wave guide.

Or

(b) Explain radiation form quarter wave monopole.

20. (a) (i) Discuss Jefimenko's equations.

(ii) Calculate the retarded potentials of a point charge.

Or

(b) Explain magnetic dipole radiation.

(4 × 4 = 16)