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M.Sc. DEGREE (C.S.S.) EXAMINATION, OCTOBER 2019

First Semester

Faculty of Science

Branch II—Physics (A)—Pure Physics

PH1 C03—ELECTRODYNAMICS

(2012 to 2018 Admissions)

Time : Three Hours   Maximum Weight : 30

Part A

Answer any **six** *questions.*
Each question carries 1 weight.

1. Show that the Ampere's law is inconsistent for time varying fields. How Maxwell corrected Ampere's law ?

2. What is meant by Gauge Transformation ?

3. Show that electromagnetic waves are transverse in nature.

4. Write down Maxwell's equation in phasor notation.

5. Distinguish between time like, space like and light like intervals.

6. Justify the statement "In every closed system the total relativistic energy and momentum are conserved".

7. Write a note on retarded potentials. Why they are called so ?

8. Why and advanced potential does not have direct physical significance ?

9. What is meant by characteristic impedance of the transmission line ?

10. What is meant by radiation efficiency of an antenna ?

$(6 \times 1 = 6)$

Part B

Answer any **four** *questions.*
Each question carries 2 weight.

11. Show that E and B are Gauge Invariate.

12. Find the potential of a point charge moving with constant velocity.

13. Find the matrix describing a Lorentz transformation with velocity U along y-axis followed by a Lorentz transformation with a velocity U along x-axis. Does it mattter in what order the transformations are carried out ?

Turn over

1/2

14. Prove the equation of continuity from Maxwell's equation in tensor notation.

15. Standard air filled rectangular waveguide has the dimension as $a = 2.29$ cm. and $b = 1.02$ cm. It is desired that the waveguide operate only in the dominal TE_{10} mode and that the operating frequency by atleast 25% above the cut-off frequency of the TE_{10} mode but not higher than 95% of the next higher cut-off frequency. What is the allowed operating frequency range ?

16. An antenna of length h carries alternating current of angular frequency w. Determine the total power radiated by the antenna by treating it as an oscillating dipole.

$(4 \times 2 = 8)$

Part C

Answer all questions.
Each question carries 4 weight.

17. (a) Deduce the boundary conditions of electromagnetic fields in Maxwell's theory.

Or

(b) Rewrite Maxwell's equation using potential formulation and simplify them using Lorentz gauge and Coulomb's gauge.

18. (a) Derive an expression for the energy flux for a magnetic dipole radiation.

Or

(b) Calculate E and B of a point charge in motion using Lienard Wiechert potential.

19. (a) Rewrite Maxwell's equation in tensor notation.

Or

(b) Explain in detail about the magnetism appears as a relativistic phenomenon.

20. (a) Explain the propagation of electro magnetic waves between two perfectly conducting infinite parallel plates.

Or

(b) Explain in detail about the propagation of radiation from a quarter wave monopole.

$(4 \times 4 = 16)$