Reg. No……...……...…… Name : ……...……...…… **P 130**

MSc DEGREE END SEMESTER EXAMINATIONS – NOVEMBER 2015

SEMESTER- 1, SUBJECT: PHYSICS

COURSE: P1PHYT03 -ELECTRODYNAMICS

Time: Three Hours. Max. Marks: 75

Part A (Objective Type)

(Answer all questions. Each question carries 1 Mark)

1. Which of the following is the correct expression for Coulomb gauge?
   a) div **A** = ρ/ε_0 b) div **A** = 0 c) curl **A**= μ_0**J** d) curl A = 0
2. The ratio of the relativistic energy to the rest energy of a particle moving at speed of 0.6*c* is….
   a) 1.25 b) 1. 50 c) 1.60 d) 1.75
3. In the case of TM waves in a rectangular waveguide, which of the following modes has the smallest cut off frequency?
   a) TM_{00} b) TM_{01} c) TM_{10} d) TM_{11}
4. Which of the following is a wrong approximation in the case of a perfect radiating magnetic dipole?
   a) $b<<r$ b) $b<< c/\omega$ c) $r>> c/\omega$ d) $b>> c/\omega$
5. A half wave loss less transmission line section has a load impedance of 10 ohms. The input impedance offered by the section is .... ohms
   a) 5 b) 10 c) 20 d) 100

(1 x 5 = 5)

Part B (Short answer)

(Answer any 5 questions. Each question carries 2 Marks)

6. Show that the gradient of scalar potential is irrotational.
7. Write down the different elements of Maxwell's stress tensor.
8. What are four vectors? Mention an example and give its components.
9. Show that the product **E**.**B** is relativistically invariant.
10. What do you mean by *retarded time* and *retarded potential*?
11. 'TEM waves cannot exist in a single-conductor hollow or dielectric filled wave guide'. Justify.
12. Give the physical basis of 'radiation reaction'.
13. What do you mean by radiation resistance of an antenna?

(2 x 5 = 10)

(PTO)

Part C (Problem/Short essay)

(Answer any 3 question. Each question carries 4 Marks)

14. Using Maxwell's equations, deduce the nonhomogenous wave equation for the scalar potential.

15. The coordinates of two events A and B in a certain frame of reference are (2, 5, 0, ct_A= 10) and (4, 8, 0, ct_B =15). Calculate the invariant space time interval between the two events. Find the speed of a reference frame, if any, in which the two events will appear at the same point.

16. A 500 M Hz plane wave is travelling through a medium of $\varepsilon_r = 1.6$ and μ_r=1.6. If the amplitude of the electric field is 50 mV/ m, calculate:
a) the velocity of propagation *b*) the wavelength and *c*) the magnitude of the magnetic field intensity.

17. Find the inductance per unit length, capacitance per unit length and characteristic impedance of a parallel plate loss less transmission line of width 5 mm and plate separation 1 mm with air s dielectric.

18. Define the term 'directivity' of an antenna. Prove that the directivity of a quarter wave antenna is same as that of a half wave antenna.

(3 x 4 = 12)

Part D (Essays)

(Answer all questions. Each question carries 12 Marks)

19. (a) Discuss the normal incidence of a plane electromagnetic wave at the interface of two linear media. Obtain the expressions for the reflected and transmitted amplitudes and hence find the reflection and transmission coefficients.

OR

(b) State Poynting's theorem and obtain its integral and differential form. Write down Poynting's vector and give its physical meaning.

20. (a) Deduce the transformation rules for the electric and magnetic field components.

OR

(b) Assuming the transformation rules for the electric and magnetic fields, obtain the electromagnetic field tensor. Describe how the tensor elements can be expressed using the scalar and vector potentials.

21. (a) Deduce the Lienard – Wiechert Potentials for a moving point charge. Using them obtain the expressions for the electric and magnetic fields of a moving point charge.

OR

(b) Derive the formula for the total energy radiated by an oscillating electric dipole.

22. (a) Discuss the theory of a rectangular waveguide. Derive the expressions for cut off frequency in the case of TM and TE waves.

OR

(b) Explain the propagation of TM and TE waves in a parallel plate wave guide and show that the cut off frequencies are equal.

(12 x 4= 48)

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