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PAQ-003-1015026 Seat No. _____

B. Sc. (Sem. V) (CBCS) (W.E.F. 2016) Examination

October / November - 2018

Physics : P - 502

(Electrodynamics & Relativity)

Faculty Code : 003

Subject Code : 1015026

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions : (1) Symbols and notations have their usual meaning.
(2) Total Marks of the question is indicated on the right side of the question.
(3) Attempt as maa questions as instructed in the main question.

UNIT – 1

1 (a) Objective type questions : (01 Mark each) **4**

(1) Write the equation of Lorentz force law.

(2) Write the faraday's law in terms of flux of the magnetic field.

(3) Write the Ohm's law in terms of conductivity of the material, Electric field and current density.

(4) Write the equation of the Poynting's vector.

(b) Answer in brief : (any **one** out of two) **2**

(1) A rectangle conducting wire loop of breath 5 cm and length of 10 cm is pulled out of uniform magnetic field of 1 Tesla in the direction of its length and perpendicular to magnetic field with the velocity of 0.5 m/sec. Find out the motional e.m.f. developed in the loop while one end of it is being pulled out.

(2) Calculate the mutual inductance of the two coils wound on one another and having turns of 1000 and 5000 on a bobbin having diameter of 2 cm and length of 5 cm. Consider the free space as medium.

(c) Answer in detail : (any **one** out of two) **3**

(1) Discuss the energy stored in the magnetic field when a current is increased to value I from the value zero flowing in a wire. Show it in terms of Magnetic field $\vec{B}$ for the whole space.

(2) Discuss the Maxwell modification in the Ampere's law of magnetostatics for electrodynamics.

(d) Write a note on following : (any **one** out of two) **5**

(1) Discuss in detail the Poynting's theorem in electrodynamics.

(2) Discuss in detail the Maxwell's stress tensor in electrodynamics.

UNIT – 2

2 (a) Objective type questions : (01 Mark each) **4**

(1) Write the wave equation in one dimension.

(2) Write the Euler's formula for the complex notation.

(3) Write the Maxwell's equations for the space where there is no charge or current.

(4) Write the equation of the velocity of electromagnetic wave in free space in term of the permeability and permittivity of free space.

(b) Answer in brief : (any **one** out of two) **2**

(1) The intensity of the sun light on Earth surface is 1300 W/m^2 . What pressure it exerts on a perfect absorber and perfect reflector ?

(2) The intensity of the sun light on Earth surface is 1300W/m^2. What is the amount of momentum density stored in the electromagnetic wave of light?

(c) Answer in detail : (any **one** out of two) **3**

(1) Write note on sinusoidal waves.

(2) Write note on the polarization of Electromagnetic waves.

(d) Write a note on following : (any **one** out of two) **5**

(1) Write detailed note on monochromatic electromagnetic waves.

(2) Write detailed note on the Energy and Momentum in Electromagnetic waves.

UNIT – 3

3 (a) Objective type questions : (01 Mark each) **4**

(1) Write the equation which replaces Poisson's equation in the case of Electrodynamics.

(2) Write the gauge transformations equations for any given scalar function λ for the sets of scalar potentials (V, V') and vector potentials $\left(\vec{A}, \vec{A'}\right)$.

(3) Write the equation showing differential operator d'Alembertian.

(4) Write the equation showing relation between the Electric and Magnetic fields of a moving charge with constant velocity $\vec{v}$.

(b) Answer in brief : (any **one** out of two) **2**

(1) Find the fields $\vec{E}$ and $\vec{B}$ for the following potentials

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

(2) Transform the above potentials with the scalar gauge function $\lambda = -\frac{1}{4\pi\varepsilon_0}\left(\frac{qt}{r}\right)$

(c) Answer in detail : (any **one** out of two) **3**

(1) Write note about the Gauge transformations.

(2) Write note about the Jefimenko's equations.

(d) Write a note on following : (any **one** out of two) **5**

(1) Write detailed note about the Lienard-Wiechert potentials.

(2) Write detailed note on the Retarded Potentials.

UNIT – 4

4 (a) Objective type questions : (01 Mark each) **4**

(1) What is radiation ?

(2) What is an electric dipole ?

(3) What is a magnetic dipole ?

(4) The Blueness and Redness of sky originate from the radiation from the atmospheric dipoles and from the sun. The statement is true or false ?

(b) Answer in brief : (any **one** out of two) **2**

(1) If a dipole with charge 1.602×10^{-19}C with distance 1×10^{-10}m oscilates at the frequency 3.75×10^{14} Hz, then calculate the total power radiated by this dipole.

(2) What would be the ratio of power radiated by oscillatory magnetic and electric dipole if the frequency is 3.75×10^{14} Hz and the radius of loop in magnetic dipole is b $=10^{-10}$m ?

(c) Answer in detail : (any **one** out of two) **3**

(1) Explain the Blueness and Redness of the sky.

(2) Write note on Radiation reaction.

(d) Write a note on following : (any **one** out of two) **5**

(1) Write detailed note on electric dipole radiation.

(2) Write detailed note on magnetic dipole radiation.

UNIT – 5

5 (a) Objective type questions : (01 Mark each) **4**

(1) Write the two postulates on which the Einstein's theory of relativity is based.

(2) Write the velocity addition rule using Galilean transformation.

(3) Write the statement of Relativity of simultaneity.

(4) "There is no Lorentz contraction in the dimension perpendicular to the velocity of body". Is this statement true or false ?

(b) Answer in brief : (any **one** out of two) **2**

(1) If one body is moving at the speed of 0.5 c in a reference frame which itself is moving with the velocity of 0.5 c with respect to an observer, what would be the speed of the body with respect to the observer according to the Einsteinian relativity ?

(2) At the time of birth of two twin brothers, one infant was taken to a star in a rocket which moves with the speed of 4/5 c, it reaches to the star and instantly comes back at the same speed. If the infant went to star when comes back was at the age of 18 years (according to his clock). What would be the age of his brother who left on Earth ?

(c) Answer in detail : (any **one** out of two) **3**

(1) Write short note on Lorentz contraction for the moving body.

(2) Write short note on the time dilation for the moving body.

(d) Write a note on following : (any **one** out of two) **5**

(1) Write detailed note on relativistic momentum and energy.

(2) Write detailed note on space-time diagrams.
