K23U 0528

Reg. No. : .....

Name : .....

VI Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/ Improvement) Examination, April 2023
(2019 and 2020 Admissions)
CORE COURSE IN PHYSICS
6B13 PHY : Electrodynamics and Circuit Theory

Time : 3 Hours Total Marks : 40

SECTION – A **(6 Marks)**

Short answer. **Six** questions. Answer **all** questions. **Each** question carries **1** mark.

1. Write down Neumann integral formula for the mutual inductance of two coils.
2. Give the relation between wavelength and wave number of electromagnetic waves.
3. SI unit of $\frac{1}{\sqrt{\mu_0 \in_0}}$ is
4. Ideal constant current source is that voltage source whose internal resistance is
5. If C and R represent the capacitance and resistance then the unit of RC is
6. If the impedance of an AC circuit is 3+ 3j, $\left(\text{Here } j = \sqrt{-1}\right)$ then the phase difference between current and applied voltage is **(6×1=6)**

SECTION – B **(12 Marks)**

Short essay. **Eight** questions. Answer **any six** questions. **Each** question carries **2** marks.

7. Give the differential equations for time varying electric scalar potential V and magnetic vector potential A in the Lorentz Gauge condition.

P.T.O.

8. Obtain an expression for current density in a conductor in terms of electric field.

9. How momentum conservation is rescued in electrodynamics even though Newton's third law does not hold in electrodynamics ?

10. Maxwell's equations beg for magnetic charge to exist. Explain.

11. From Maxwell's equations in vacuum, derive the three-dimensional wave equation for electric field E.

12. State reciprocity theorem for a linear electrical network.

13. Illustrate delta to star conversion in electric networks with diagrams and write down the equation for conversion of resistances.

14. What do you mean by wattless current ? **(6×2=12)**

SECTION – C **(12 Marks)**

Problems. **Six** questions. Answer **any four** questions. **Each** question carries **3** marks.

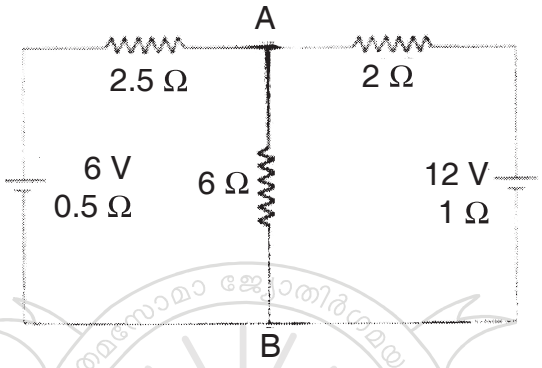
15. Find the self-inductance of a toroidal coil with rectangular cross section of inner radius a, outer radius b, height (or thickness) h, that carries a total of N turns.

16. The electric field in a linear dielectric medium is $E = 9 \cos (20z - 3 \times 10^9 t) \hat{x}$ V/m. Determine the electric displacement D and magnetic field B using Maxwell's equations. The medium has a relative permittivity of 3 and does not contain any free charges or free currents.

17. The electric field of an electromagnetic wave propagating along x direction in a medium is $E = 5 \cos (15x - 3 \times 10^9 t) \hat{J}$ V/m, where t and x are in seconds and metres respectively. Determine the velocity of electromagnetic wave and refractive index of the medium.

18. Calculate the reflection and transmission coefficients for normal incidence of electromagnetic waves on glass-air interface ($n_1 = 1.5$ and $n_2 = 1.0$).

19. In the diagram the battery emfs. are 6 V and 12 V, their internal resistances 0.5 ohm and 1 ohm. The values of other resistances are as indicated in ohm. Find the current flowing in the branch AB by superposition theorem.



20. An AC supply of rms value 230 V, 50 Hz is applied to a series RC circuit containing a capacitor of 5 μF and a resistor of 1000 Ω. Calculate the average power consumed by the circuit. **(4×3=12)**

SECTION – D **(10 Marks)**

Long essay. **Four** questions. Answer **any two** questions. **Each** question carries **5** marks.

21. Discuss the various charge and current densities in matter and derive Maxwell's equations in matter.

22. Explain energy density, momentum density, pointing vector, intensity and radiation pressure associated with uniform plane monochromatic electromagnetic waves.

23. State Norton's theorem and explain with a sample diagram how a circuit can be nortonized.

24. An AC voltage is applied to a circuit containing inductance L, capacitance C and resistance R in series. With the help of a neat diagram, derive the expression for the impedance of the circuit and obtain the equation for resonant frequency.

(2×5=10)

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