D 103069 **(Pages : 2)** **Name.....**

Reg. No.....

FOURTH SEMESTER (CBCSS–UG) DEGREE EXAMINATION
APRIL 2024

Physics/Applied Physics

PHY4B04.APH4B04—ELECTRODYNAMICS – II

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

The symbols used in this question paper have their usual meanings

Section A - Short Answer type

Answer questions in two or three sentences, each correct answer carries a maximum of 2 marks. **All** *questions can be attended.*

1. Write down the differential and integral forms of Faraday's law.
2. Explain polarization of electromagnetic waves.
3. What are the conditions for a moving coil galvanometer to be ballistic ?
4. Draw the circuit diagram for obtaining balance using Anderson's bridge.
5. State Thevenin's theorem.
6. Write down general wave equation. Give its solution.
7. Write down Maxwell's equations inside matter.
8. What is the power factor in inductor-resistor series circuit ?
9. Write down the dimensions of electric flux.
10. How do the energy density and momentum density of electromagnetic waves relate to Poyntings vector ?
11. Define the r.m.s value of e.m.f.
12. How can the refractive index of a medium be obtained from basic electro-magnetic constants ?

(Ceiling 20 marks)

Turn over

Section B – Paragraph Problem type

All questions can be attended.
Answer questions in a paragraph of about half a page to one page, each correct answer carries a maximum of 5 *marks.*

13. Draw and explain circuit diagram for decay of current in L-R circuit.
14. Explain mutual inductance and obtain Neumann's formula for the same.
15. Find the field outside a uniformly charged solid sphere of radius R and total charge q.
16. A coil having a resistance of 10 Ω and inductance 4 H is connected to a dc source of e.m.f. 100 V. How long does it take for the voltage across the resistance to attain a value of 50 V ?
17. A choke of 0.5 H, a capacitance of 15μF and a resistance of 100 Ω are connected in series across 200 V 50 Hz main. Find the current in the circuit.
18. Check whether the following function is a solution to the one dimensional wave equation. $Y = 2 \sin x \cos vt$.
19. Find the potential inside and outside a spherical shell of radius R that carries a uniform surface charge. Set the reference point at infinity.

(Ceiling 30 marks)

Section C – Essay type

Essays – Answer in about two pages.
Any **one** *question.*
The question carries 10 *marks.*

20. Explain how Maxwell modified Ampere's theorem. Derive Maxwell's equation in matter.
21. Briefly discuss electrostatic boundary conditions.

(1 × 10 = 10 marks)

C 41238 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2023

Physics/Applied Physics

PHY 4B 04/APH 4B 04—ELECTRODYNAMICS—II

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

The symbols used in question paper have their usual meanings

Section A (Short Answer Type)

Answer **all** *questions in two* **or** *three sentences, each correct answer carries a maximum of* 2 *marks.*

1. Explain the Neumann formula in mutual inductance.
2. Write down the equation of continuity in electrodynamics. Explain the terms involved.
3. Show that the Maxwell's equations for E and B are symmetric in free space.
4. Explain the term polarization in the context of electromagnetic waves. Draw a suitable figure to indicate the polarization vector.
5. Write down wave equation for the electric field vector E in free space and explain the terms involved. What is the expression for the speed of the wave ?
6. Write down the boundary conditions for the electric field vector E at an interface separating two linear media of permittivities ε_1 and ε_2 and permeabilities μ_1 and μ_2.
7. What are gauge transformations ?
8. Discuss the two different types of transient currents in circuits.
9. Give an expression for the DC transient current in an R-C series circuit. Explain the terms involved.
10. What are the differences between a ballistic galvanometer and an ordinary moving-coil galvanometer ?
11. What is Kirchhoff's current law ?
12. What is maximum power transfer theorem ?

(Ceiling - 20)

Turn over

Section B (Paragraph/Problem Type)

Answer **all** *questions in a paragraph of about* **half a page** *to* **one page**, *each correct answer carries a maximum of* 5 *marks*

13. A long solenoid of radius a is driven by an alternating current so that the field inside is sinusoidal, given by $B(t) = B_0 \cos(\omega t)\ \hat{z}$. A circular loop of wire, of radius $a/2$ and resistance R, is placed inside the solenoid and co-axial with it. Determine the current induced in the loop as a function of time.

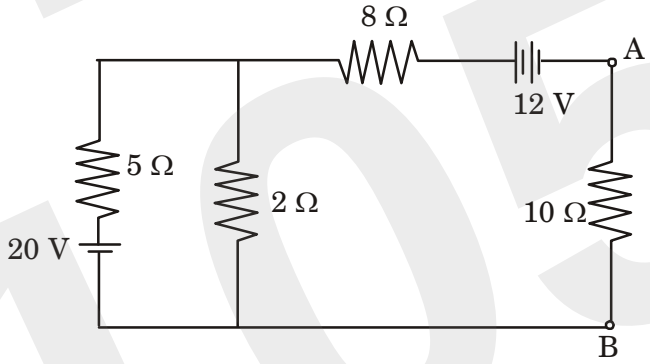
14. Show that the radiation pressure caused by an electromagnetic wave is equal to the ratio of the intensity of the electromagnetic wave and the velocity of light.

15. A coil of 10 H inductance and 5 Ω resistance is connected in parallel with a 20 Ω resistor across a 100 V d.c. supply, which is suddenly disconnected. Determine the voltage across the 20 Ω resistor initially and after 0.3 s.

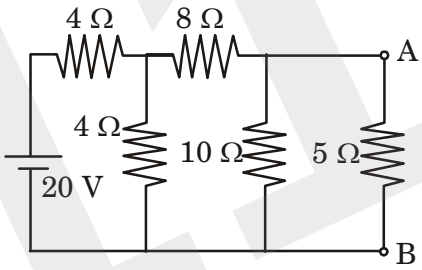
16. A large coil of inductance 1.405 H and resistance 40 Ω is connected in series with a capacitor of 20 μF. Determine the frequency at which the circuit resonates.

17. Give an expression for the power consumed in a series LCR circuit. Show that in a purely inductive or a purely capacitive circuit, the power consumed is zero.

18. Use Thevenin's theorem to determine the current through the 10 Ω resistance of the following circuit :



19. Use Norton's theorem to determine the current through the 5 Ω resistance of the following circuit.



(Ceiling - 30)

Section C (Essay Type)

Answer in about **two pages**, *any* **one** *question.*
Answer carries 10 *marks.*

20. Explain Faraday's law and Ampere's law. Give the integral and differential forms of the laws. Discuss how Maxwell modified Ampere's law in the case of time varying electric fields.

21. Discuss the potential formulation of electrodynamics.

(1 × 10 = 10 marks)

C 21551 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2022

Physics/Applied Physics

PHY4B04/APH4B04—ELECTRODYNAMICS—II

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

Section A

Answer at least **eight** *questions.*

Each question carries 3 *marks.*

All questions can be attended.

Overall Ceiling 24.

1. Explain Ohm's law. Discuss the terms involved.
2. What do you mean by the term displacement current ? Give an expression for the same.
3. Illustrate the symmetry of Maxwell's equations for E and B in the absence of the charge and current density terms.
4. What is Poynting vector ? Give an expression for the same.
5. Give the wave equation for the magnetic field vector B in free space and explain the terms involved. Write down the expression for the speed of the wave.
6. What do you mean by a monochromatic plane wave ? Give its general form.
7. Write down the boundary conditions for the magnetic field vector B at an interface separating two linear media of permittivities ε_1 and ε_2 and permeabilities μ_1 and μ_2.
8. Distinguish between initiation and transition transient currents.
9. What do you mean by wattles current ?
10. Give Kirchhof's mesh law.
11. What are the features of an ideal constant voltage source ?
12. What is reciprocity theorem ?

(8 × 3 = 24 marks)

Turn over

Section B

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Obtain an expression for the energy stored in a magnetic field due to a current.

14. Write down the integral forms of Maxwell's equations and explain the terms involved.

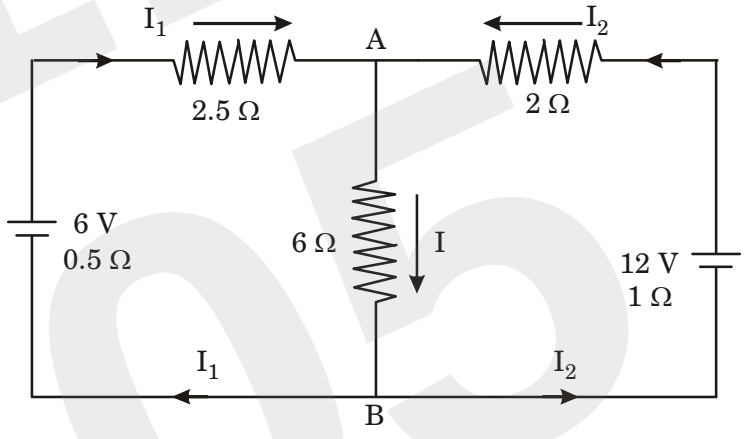
15. Prove that for a plane monochromatic wave, the Poynting vector is the energy density times the velocity of the wave.

16. Give the fundamental laws of geometrical optics considering the reflection and transmission of electromagnetic waves at a boundary separating two linear media.

17. A circuit consists of a non-inductive resistance of 50 Ω, an inductance of 0.3 H and a resistance of 2 Ω and a capacitor of 40 μF in series and is supplied with 200 V at 50 Hz. Find the impedance of the circuit.

18. An alternating voltage of 10 V at 100 Hz is applied to a choke of inductance 5 H and resistance 200 Ω. Determine the power factor of the coil.

19. For the circuit shown below, find the currents flowing in all branches and the voltage across the 6 Q resistor using superposition theorem.



(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*

The question carries 11 *marks.*

20. Obtain the wave equation for the E and B vectors in free space. Using a plane wave solution show that the electromagnetic waves are transverse in nature and the E and B vectors are in phase and mutually perpendicular.

21. Explain the construction and working principle of a ballistic galvanometer. Obtain the relation connecting the charge flowing and the ballistic throw of the galvanometer.

(1 × 11 = 11 marks)

C 3561 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2021

Physics/Applied Physics

PHY 4B 04/APH 4B 04—ELECTRODYNAMICS—II

Time : Two Hours Maximum : 60 Marks

The symbols used in question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Explain Joule heating law.
2. Comment on the statement "nature abhors a change in flux".
3. Illustrate the symmetry in Maxwell's equations for E and B in free space.
4. Write down the general wave equation. Give its solution.
5. Draw a monochromatic plane wave travelling in the z direction indicating the E and B vectors.
6. Give expressions for the electric and magnetic field vectors E and B in terms of the potentials.
7. Show that the Coulomb gauge leads to Poisson's equation.
8. List the origin of transient currents in circuits.
9. Write down an expression for the DC transient current in a series R-L circuit. Explain the terms involved.
10. Plot the growth and decay of DC transient currents in an RC series circuit.
11. Compare series and parallel resonant circuits.
12. Write down the Kirchhoff's voltage law.

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph/Problem Type)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Explain the boundary conditions for the electric and magnetic vectors E and B at an interface separating two linear media of permittivities ε_1 and ε_1 and permeabilities μ_1 and μ_2.

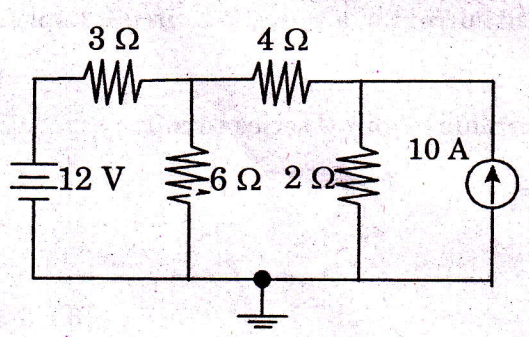
14. Show that, for a plane monochromatic wave, the momentum density stored in the field is the energy density divided by the velocity of the wave.

15. A ballistic galvanometer has a free period of 10 seconds and gives a steady deflection of 200 divisions with a steady current of 0.1 milli-amperes. A charge of 121 micro-coulombs is instantaneously discharged through the galvanometer giving rise to a first maximum deflection of 100 divisions. Calculate the decrement of the resulting oscillations.

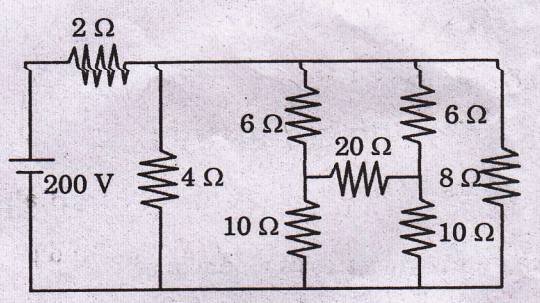
16. A coil having an inductance of 50 mH and resistance 10 Ω is connected in series with a 25 μF capacitor across a 200 V AC supply. Determine : (i) The resonance frequency of the circuit ; (ii) Current flowing at resonance ; and (iii) Q-factor.

17. Obtain an expression for the power consumed in a series LCR circuit.

18. Use Thevenin's theorem to determine the current flowing through the 4 Ω resistance of the following circuit.



19. Find the current through the 8 Ω resistor of the following circuit using Norton's theorem.



(5 × 5 = 25 marks)

Section C (Essay Type)

Answer any **one** *question.*

The question carries 11 *marks.*

20. Obtain Maxwell's equations in matter.

21. Obtain the wave equation for the electric and magnetic field vectors E and B in free space. Explain the term polarization and show that electromagnetic waves are transverse in behavior.

(1 × 11 = 11 marks)