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Reg. No. : .....

Name : .....

Third Semester B.Sc. Degree Examination, January 2023

First Degree Programme Under CBCSS

PHYSICS

Complementary Course for Mathematics

PY 1331.1 – OPTICS, MAGNETISM AND ELECTRICITY

(2013 – 2017 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in one or two sentences;
Each question carries **1** mark.

1. What is band width?
2. Why two independent sources are not coherent?
3. Explain Fraunhofer diffraction?
4. Define resolving power of a grating?
5. What is the full form of laser?
6. What is the basic principle of fiber optic communication?
7. What are hard and soft magnetic materials?
8. What is Larmor frequency?

P.T.O.

9. Why the core of a transformer made of laminated sheets?

10. What are the advantages of ac over dc?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, not exceeding a paragraph;
Each question carries **2** marks.

11. What is interference of light?

12. Why a thickness film cannot produce interference when illuminated with white light?

13. Why a soap bubble in bright sunlight is beautifully colored?

14. Explain diffraction of light?

15. What a grating? Explain grating element?

16. What is population inversion?

17. What are the applications of laser?

18. What is a graded index fiber? What is its advantage over step index fiber?

19. Explain the importance of metastable state in laser?

20. Discuss curie Weiss law?

21. Distinguish between reactance and impedance?

22. What is a choke coil?

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six, Each** question carries **4** marks.

23. Two waves having intensities in the ratio 1:9. Find the ratio of the intensity minimum to the maximum?

24. Two plane glass surface in contact along one edge are separated at the opposite adage by a thin wire. If 20 fringes are observed between these edges in sodium light (λ = 5890 A) of normal incidence. What is the thickness of wire?

25. Newton rings are formed by reflected light of wavelength 5895A with a liquid between the plane and curved surface. If the diameter of the 5th bright ring is 3mm and radius of curvature of the curved surface is 100cm, calculate the refractive index of the liquid?

26. Find the half angular width of the central bright maximum in the Fraunhoffer diffraction pattern of a slit of width 12×10^{-5} cm when the slit is illuminated by monochromatic light of wavelength 6000A.

27. What should be the minimum number of lines in a grating which will just resolve in the second order lines whose wavelengths are 5890A and 5896A?

28. A parallel beam of monochromatic light is allowed to be incident normally on a plane transmission grating having 5000 lines/cm and the third order spectral line is found to be diffracted through 45°. Calculate the wavelength of the light.

29. A glass fibre is made with core glass of refractive index 1.55 and cladding is doped to give a refractive index 1.5. Calculate the numerical aperture, acceptance angle and the fractional index change?

30. An ac voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which L = 25.48 Mh, C = 796 μF, and R = 3 Ω. Find the impedance of the circuit?

31. In a series LCR circuit the applied voltage is 5V, drops across the resistance and the inductance are 3V and IV respectively. What is the voltage across the capacitor?

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions; **Each** question carries **15** marks.

32. Explain the formation for Newton's ring? How can these be used to determine the wavelength of monochromatic light?

33. Discuss the theory of Fraunhofer diffraction by a single slit?

34. Explain Classical theory of diamagnetism?

35. With circuit diagram, explain briefly AC voltage applied to an LCR circuit? Describe resonance condition also?

(2 × 15 = 30 Marks)

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Reg. No. : .....

Name : .....

Third Semester B.Sc. Degree Examination, January 2023

First Degree Programme Under CBCSS

Physics

Complementary Course for Mathematics

PY 1331.1 – OPTICS, MAGNETISM AND ELECTRICITY

(2019 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** the questions. **Each** carries **1** mark.

1. Define bandwidth.
2. Define coherent sources.
3. What is the use of Fresnel's biprism?
4. What is interference in thin film?
5. What is wattless current?
6. What is the condition of constructive interference?
7. What is meant by diffraction of light?
8. What is magnetic susceptibility?

9. What is diamagnetism?

10. What is permanent magnet?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions. **Each** carries **2** marks.

11. What is diffraction?

12. What is ferromagnetism?

13. What are the properties of diamagnetic materials?

14. Why paramagnetic substances are those which get weakly magnetised when placed in an external magnetic field?

15. Define rms value of an AC.

16. What is optical pumping in laser?

17. Why Newton's rings are circular?

18. Intensities of spectral lines with a grating are much less than those with prism. Why?

19. Explain relative permeability.

20. Define magnetic flux density (B) and magnetic field intensity (H) and give the relationship.

21. What are the disadvantages of step index fiber?

22. What is dispersive power of grating?

23. What is LCR circuit?

24. Explain power factor.

25. Write the conditions for constructive and destructive interference.

26. Explain population inversion.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. **Each** carries **4** marks.

27. Find the radius of 25th Newton's ring if the wavelength is 750 nm and radius of 10th ring is 0.25 cm.

28. A capacitor of capacitance 2 μF is in an AC circuit of frequency 1000 Hz. If the rms value of the applied emf is 10 V. find the effective current flowing in the circuit.

29. Difference between interference and diffraction.

30. A plane transmission grating produces first order diffraction maximum at 19.5° for light of wavelength 5461 Å. Calculate the number of lines on the grating per unit length.

31. Derive the RMS value of an AC circuit.

32. A step index fiber has a numerical aperture of 0.15. If the core refractive index is 1.45 and the core diameter is 90 μm. find the number of modes supported by the fiber with a wavelength of 0.9 μm.

33. Distinguish between ferromagnetism and antiferromagnetism.

34. Explain the numerical problems with step index profile.

35. The Fraunhoffer diffraction pattern due to a narrow slit, a screen is placed 2 m away from the lens to obtain the pattern. If the slit width is 0.2mm and the first minima lie 5mm on either sides of the central maximum, find the wavelength of light.

36. Explain the principle of optical fiber.

37. In Newton's rings experiment the diameter of certain order of dark ring is measured to be double that of second ring. What is the order of the ring?

38. The volume susceptibility of a magnetic material is 30×10^{-4}. Calculate the relative permeability. What is the nature of the substance?

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** carries **15** marks.

39. Draw and explain the step index and graded index fiber.

40. Describe the phenomenon of Fraunhoffer diffraction at a single slit.

41. With necessary theory and schematics describe the Fresnel diffraction at a straight edge.

42. State the properties of ferromagnetic materials. Explain with the help of the domain theory and also explain Curie temperature.

43. Give the theory of the series resonance (L,C,R in series) circuit. Obtain an expression for the resonance frequency and for the impedance at resonance.

44. Discuss the theory of interference in thin transparent film due to reflected light and obtain condition for the intensity to be maximum and minimum.

(2 × 15 = 30 Marks)

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Reg. No. : .....

Name : .....

Third Semester B.Sc. Degree Examination, January 2023

First Degree Programme under CBCSS

Physics

Core Course – I

PY 1341 — ELECTRODYNAMICS

(2019 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions. **Each** carries **1** mark.

1. State Coulomb's Law.
2. What you mean by electric flux?
3. For plane symmetry, the Gaussian surface is ————
4. What are dielectrics?
5. Explain Polarization.
6. $A \times (B \times C) =$
7. Is current vector or scalar?
8. Give the integral form of Faraday's law.

P.T.O.

9. What is the required condition for resonant frequency?

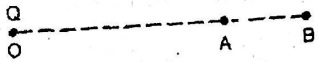
10. Current per unit area perpendicular to flow is called?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, **Each** carries **2** marks

11. A point charge Q is placed at point O as shown in the figure. Is the potential difference ($V_A - V_B$) positive, negative or zero, if Q is positive?



12. Two charges 5μC and -5μC are placed at points A and B 2cm apart. Depict an equipotential surface of the system.

13. What are the properties of electric filed lines?

14. Derive Laplace's equation.

15. "Magnetic force do no work". Justify the statement.

16. Give Stokes's theorem. What is its geometrical interpretation?

17. Define the term' potential energy' of charge 'q' at a distance V in an external electric field.

18. Illustrate hysteresis loop.

19. What do you mean by electric displacement?

20. Briefly explain electromotive force.

21. Give Maxwell's equations.

22. What do you mean by impedance?

23. Define quality factor (Q).

24. What is the significance of cosΦ in a series LCR circuit?

25. Differentiate between acceptor circuit and rejecter circuit.

26. Why we take rms values in case of ac current and voltages?

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions, not exceeding a paragraph. **Each** carries **4** marks.

27. Find the electric filed at a distance z above the midpoint of a straight-line segment of length 2L, which carries a uniform line charge λ.

28. A long cylinder carries a charge density that is proportional to the distance from the axis ρ = ks for some constant k. Find the electric filed inside this cylinder.

29. Using Ampere's circuital law, obtain an expression for the magnetic field along the axis of a current carrying solenoid of length l and having N number of turns.

30. Find the electric field produced by a uniformly polarized sphere of radius R.

31. Using Biot – Savarts law, Find the magnetic field at a distances from a long straight wire carrying steady current I.

32. Compare Magnetostatics and Electrostatics with suitable mathematical support.

33. How can you express Ohm's law in terms of current density and electric field? A cylindrical resistor of cross-sectional area A and length L is made from material of conductivity σ. If potential difference is V. What is the current flow?

34. How will you measure high resistance by the method of leakage of charge of a capacitor?

35. Check that the following functions obey wave equation or not.

(a) $f(z,t) = Ae^{-b(bz^2 - vt)^1}$

(b) $f(z,t) = A\sin[b(z - vt)]^1$

36. Derive the expression for magnetic vector potential.

37. A dc voltage of 80V is switched on to a circuit containing resistance of 5Ω in series with an inductance of 20H. Calculate the rate of growth of current at the instant when current is 6A.

38. A resistor of 200 Ω and a capacitor of 15.0 μF are connected in series to a 220 V. 50 Hz ac source.

    (a) Calculate the current in the circuit

    (b) Calculate the voltage (rms) across the resistor and the capacitor.

($6 \times 4 = 24$ Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks

39. Briefly discuss electrostatic boundary conditions.

40. What do you mean by magnetic field? How Biot – Savart law is useful in determining the magnetic field at a point? Derive the expression for divergence and curl of B.

41. What you mean by motional emf? With a neat diagram, prove flux rule for motional emf.

42. What you mean by electromagnetic waves? Explain its properties. Also derive the one-dimensional wave equation and solve for it.

43. What are bound charges? Obtain the expression for surface and volume charge density. Also explain the physical interpretation of bound charges.

44. Briefly explain Growth and decay of current in CR circuit.

($2 \times 15 = 30$ Marks)

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Reg. No. : .....

Name : .....

Third Semester B.Sc. Degree Examination, January 2023.

First Degree Programme under CBCSS

Physics

Core Course

PY 1341 – ELECTRODYNAMICS

(2018 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in one or two sentences. Each question carries **1** mark.

1. State Gauss' law.
2. Write down the dimensions of electric flux.
3. What is polarizability?
4. Why does the electric displacement vector be so important?
5. Give the differential and integral form of Gauss' law in magnetostatics.
6. State Ohm's law.
7. How do the energy density and momentum density of electromagnetic waves relate to Poynting vector?

8. If a capacitor of 500nF is connected in series with a resistance of 50Ω, and 10*V* DC supply, find the time constant.

9. Express Q factor in terms of bandwidth.

10. What is power factor?

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. List the fundamental properties of electric charge.

12. How do Poisson's and Laplace equations be connected?

13. Distinguish between polar and nonpolar molecules with an example.

14. What is Biot-Savart Law? Why is it so important?

15. Write down the Maxwell's equations in magnetostatics and name them.

16. What do you understand from the solenoidal nature of magnetic induction?

17. By the method of leakage only high resistance can be measured. Why?

18. Compare series and parallel resonant circuits.

19. A series LCR circuit as an acceptor circuit. Explain why?

20. What are the losses when a current passes through a resistance wire?

21. What is the important role or a discharging capacitor through an inductor and resistor in wireless telegraphy?

22. Prove that the velocity of electromagnetic wave in any medium depends on the permittivity and permeability.

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions. Each question carries **4** marks.

23. Two equal charges are separated by a distance of 0.5m. The electric force between the charges is $9\mu N$. Find the value of the charge. What will be the force if the charges are halved and the distance between them is doubled?

24. Show that the curl of an electrostatic field is zero.

25. An electric line of force is going from a dielectric of dielectric constant 4 to another with dielectric constant 3 making an angle of 60° with the boundary in the first dielectric. Find its direction in the second dielectric using the law of refraction of electrostatic lines of force.

26. A circular coil of wire of diameter 20cm have 100 turns. The coil is placed in a uniform magnetic field of 0.5T. The current through the coil is 2A. Determine the maximum torque on the coil.

27. A copper wire of diameter 2mm and length 40cm is arranged in the shape of a square. A magnetic field exists perpendicular to the plane of the square and it changes with a rate –0.02T/s. Determine the current induced in the frame. Given the resistivity of copper $1.7\times10^{-8}\Omega m$.

28. A $1\mu F$ capacitor is charged by a 100V battery. It is then discharged through a $2M\Omega$ resistor. Determine the value of the potential difference across the capacitor in a time of 5s. How much time will take to become the voltage across the capacitor to half its initial value?

29. If the refractive index of glass is 1.50, find its permittivity and the speed of light through it.

30. Write down Maxwell's equation in both differential and integral forms.

31. A battery of emf 100V is connected in series with an inductance of 500mH, a resistance of 500Ω and a capacitor of $0.5\mu F$. Find the frequency of the oscillatory current, logarithmic decrement and the final capacitor charge.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions. Each question carries **15** marks.

32. (a) Derive the expression for energy of a continuous charge distribution.

    (b) Obtain the Gauss' law in dielectrics.

33. Discuss the properties of various types of magnetic materials.

34. Discuss the growth and decay of current through a circuit containing resistance and inductance. Plot the variations of current with various time constants. Find the expression for the time at which the growing current and decay current are equal.

35. Analyse the working of a circuit containing inductance with some resistance connected in parallel with a capacitor supplied with an ac voltage.

(2 × 15 = 30 Marks)