2022

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Answer the following :   1 × 8

   a) When is an electric line of force straight ?

   b) The total charge on a body is always _____.

   c) The magnetic field intensity is maximum, when the observation points lies at the centre of current carrying circular coil.   (True/False)

   d) What is the S.I unit of vector potential ?

   e) What is the value of susceptibility of a diamagnetic substance.

   f) Do you agree that the inductance can also be referred as electrical inertia.

   g) Write the resonant ferquency of LCR series circuit.

   h) The current in the idicator at steady state is _____.

[Turn over

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

a) Calculate the number of electric lines of force originating from a charge of 10C. Given $\epsilon_0 = 8.854 \times 10^{-12}C^2N^{-1}m^{-2}$

b) What is an equipotential surface, can two equipotential surfaces intersects.

c) Write the differential equation of Electric field and electric potential.

d) Write the basic difference between electro static field and magnetic field.

e) What is the physical significance of electrical damping ratio ?

f) When fan is switched off a spark is produced in the switch, why ?

g) State Lez's law.

h) The equation of AC is gives by

$I = 30\sin(300\pi t + \phi)$. Find the frequency of current.

i) Why a Parallel LCR a.c circuit at resonance is known as rejector circuit.

j) State Thenvenin's Theorem.

Part-III

3. Answer any **eight** of the following : 2×8

   a) State Gauss's law in dielectric and write its differential form.

   b) State Uniqueness theorem.

   c) Write an expression for torque on a dipole.

   d) State and derive Ampere's circuital law.

   e) Given that $\vec{B} = \vec{\nabla} \times \vec{A}$ and $\vec{\nabla} . \vec{A} = 0$. Prove that $\nabla^2 A = -\mu_0 J$.

   f) A 8μc charge moving around a circle with a frequency of 6.25×10^{12} Hz produce a magnetic field of 6.28 Tesla at centre of the circle of radius 'R'. What is the value of R.

   g) Difference between polar and non polar dielectric.

   h) State the relation between $\vec{B}$, $\vec{H}$ and $\vec{M}$.

   i) State Faraday's Law and write its differential form.

   j) Difference between Series resonant and Parallel resonant circuit.

Part-IV

4. a) Derive an expression for electric field at a point outside and inside of uniformly charged spherical shell. 6

OR

b) Deduce Poisson's and Laplace's equations from differentail form of Gauss law of electrostatics.

5. a) State Biot Savart's law. Derive the magnetic field due to an infinitely long wire carrying current using Biot Savart's law. 6

OR

b) What is a balastic galvanometer. Explain construction and theory of it.

6. a) Describe the formation and significance of the hysteresis loop. 6

OR

b) Derive Maxwell's First and Third equation of electromagnetic waves. What are the basic laws in physics that these equation.

7. a) Explain sharpness of resonance and quality factor in LCR series resonant circuit 6

OR

b) Explain the growth of current in a circuit containing resistance and inductor.

2022

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Answer *all* questions

Part-I

1. Answer the following :   1 × 8

   a) Unit of power of a lens is ____.

   b) The Ramsden's eyepices consists of two plano-convex lens of focal length 'f' (True/False)

   c) What does a travelling wave carry along ?

   d) Write the relation between group velocity and phase velocity.

   e) What type of the central fringe in Fresnel biprism ?

   f) What are the main advantage of Fabry Perot interferometer over Michelson's interometer ?

   g) The intensity of principal maximum in the spectrum of grating having N Slits is proportional to ____.

[Turn over

h) Area of second half period zone (S_2) and that of the first half period zone (S_1). Write the relation between S_1 and S_2.

Part-II

2. Answer any *eight* of the following :　　　　$1\frac{1}{2} \times 8$

a) What is the difference between Geometrical and Physical optics ?

b) Define Cardinal point of an optical system.

c) Write the velocity of electromagnetic waves in vaccum.

d) Write the differential equation of simple harmonic oscillator.

e) Explain why wave velocity is also called phase velocity.

f) Difference between longitudinal and Transverse wave.

g) State Stoke's law is term of phase change on reflection.

h) What are interference filters ?

i) Find the radius of the first half period zone of a zone plate that behave like a convex lens of focal length 80cm.
Given $\lambda = 5000A^0$.

j) What is a plane diffraction grating ?

Part-III

3. Answer any *eight* of the following : 2×8

   a) Define temporal and spatial coherence.

   b) What is an eyepiece ?

   c) What is the difference between Huygen's Eyepiece and Ramsden's eyepiece ?

   d) What do you mean by intensity of a wave ?

   e) A travelling wave has rating of 440Hz at 360m/s. How far will two position be from each other of phase difference = π radian.

   f) Define ripple and gravity wave.

   g) State and explain Huygen's principle.

   h) The mirrors in a Fabry-Perot interferometer have a reflection co-efficient of 0.89. Derive the co-efficient of finesses.

   i) What do you mean by Fresnel's integral.

   j) What is a zone plate ? How it is constructed.

Part-IV

4. a) Discuss the construction and theory of Huygen's eyepiece.   6

OR

b) Derive laws of refraction using Huygen's principle.

5. a) Show that in case of a spherical wave, amplitude is inversely proportional to the distance from the centre. 6

OR

b) Obtain Lissajous figure for superposition of two orthogonal simple harmonic vibrations with same frequency.

6. a) With necessary theory, describe the formation of Newton's ring in reflected light, determine the measurement of wavelength. 6

OR

b) Explain Principle, Theory and working of Fabry-Perot interferometer.

7. a) Discuss the Pattern obtained in Fraunfer diffraction for a circular aperture. 6

OR

b) Show that the radii of half period zone of a zone plate are proportional to the square root of natural numbers.

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2022

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Answer *all* questions from any one section
as applicable.

SECTION-A

[Phy-(GE)-II]

Part-I

1. Answer the following : 1×8

   a) If the three vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} + \lambda\hat{k}$ and $3\hat{i} - 4\hat{j} + 5\hat{k}$ are coplanar the value of λ is _____.

   b) What is S.I unit ϵ_0 ?

   c) Energy stored per unit volume of the capacitor is called energy density. (True/False)

   d) What is the condition under which the alignment of molecule in polar dieelectric is perfect ?

   e) The relation between $\vec{E}$, $\vec{D}$ and $\vec{P}$ is _____.

   f) The unit of magnetic movement is _____.

   g) What is the value of velocity of electromagnetic wave in air ?

   h) Write the equation of continuity of current.

[Turn over

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

   a) Derive the value of $\vec{\nabla} \cdot \vec{r}$.

   b) Why two electric lines of force can not intersect each other.

   c) In which form the electric energy of the atmosphere get dissipated during lightning ?

   d) If work 100joule must de done to move electric charge of 4c from a place where potential is −10 volt to another place, where potential is V volt. Find the value of V.

   e) What should be capacitance of a capacitor capable of storing one jole of energy and used with a 100V d.c supply ?

   f) What is integral form of Gauss's Law in dielectric ?

   g) Write list the source of magnetic field.

   h) What is the physical significance of the current element ?

   i) Under what condition does a current loop will not rotate in the magnetic field ?

   j) $\vec{\nabla} \cdot \vec{B} = 0$, write it qualitatively.

Part-III

3. Answer any *eight* of the following :   2 × 8

a) Explain integral form of Maxwell 3rd equation.

b) Explain Displacement current density.

c) Define optical rotation.

d) Define electrostatic potential along with its unit.

e) Write down the expression for displacement vector.

f) State Biot-Savart's Law.

g) State Gauss divergence theorem.

h) If $\vec{A} + \vec{B} + \vec{C} = 0$

   prove that $\vec{A} \times \vec{B} = \vec{B} \times \vec{C} = \vec{C} \times \vec{A}$.

i) Can a magnet attract a molten iron ? Why ?

j) A coil of a few turns and radius 1 cm is placed co-axially inside another coil of 8 turns. If their mutual inductance be 3.15×10^{-7} henery, find the number turn in first coil.

Part-IV

4. a) State and Prove Gauss's theorem of electrostatics.   6

OR

b) Derive electric potential at a point outside of a uniformly charged solid sphere.

5. a) Define capacity of capacitance. Derive expression for capacitance of a Parallel Plate Capacitor. 6

OR

b) Deduce an expression for electrostatic energy of a charged sphere.

6. a) Derive magnetic induction due to a straight current carrying conductor using Biot-Savart's Law. 6

OR

b) State and explain Ampere-circuital law. Express it differential form.

7. a) Derive Maxwell's 1st and 4th equation of electromagnetic theory. 6

OR

b) Prove that electromagnetic wave are transverse in nature.

SECTION-B

[Phy-(GE-B)-II]

Part-I

1. Answer the following :   1 × 8

a) Number of cardinal points of a lens system are _____ .

b) Write the relation between intensity of wave and its amplitude.

c) In which experiment the screen and the source to study the diffraction are kept at finite distance ?

d) The emission of electrons stops below a certain minimum frequency is known as _____ .

e) The value of Compton wavelength is 0.242A⁰.

(True/Flase)

f) De-Brolie wavelength for electron when v < c is _____ .

g) Write one application of Heisenberg's uncertainity principle.

h) Write the relation between radius of the nucleu and atomic mass of the element.

Part-II

2. Answer any *eight* of the following :   1½ × 8

a) Define monochromatic aberration.

b) Write the condition for interference.

c) Light from a narrow slit posses through two parallel slit 0.4mm apart and the fringes when measured a distance of 0.40m from the slit and 0.5mm apart. Find the wavelength of light.

d) Explain Newton's ring.

e) Does sound wave suffers diffraction. Explain.

f) Explain dual nature of radiation.

g) Write limitation of Bohr's theory.

h) What are basic postulates of special theory of relativity ?

i) Explain the well behaved wave function.

j) Write two characterstics of nuclear forces.

Part-III

3. Answer any *eight* of the following :   2 × 8

a) State Huygen principle.

b) Two waves of intensity in ratio 9 : 4 superimpose to produce interference. Find ratio of maximum to minimum intensity.

c) Which condition Lorentez transformation change to Galilean transformation, Explain.

d) Explain Time dilation.

e) Explain Planck's formula for lower frequencies.

f) State Laws of photoelectric effect.

g) Explain normalisation of wave function.

h) State laws of radio activity.

i) State Ehrenfest Theorem.

j) The sodium yellow light of $= 5893 A^0$ is a doublet of $6A^0$ width. What is the minimum number of lines of a grating should have to resolve this doublet in the 3rd order spectrum.

Part-IV

4. a) Define chromatic aberation. Derive condition achromatism when two lens are in contact.   6

OR

b) Discuss formation of Newton's ring. Derive expression for nth dark and bright ring by reflected light.

5. a) Explain Compton effect. Find an expression for Compton shift. 6

OR

b) State and explain Frank Hertz experiment.

6. a) Derive schrodinger's time dependent wave equation in one dimension and three dimensions. 6

OR

b) Consider a particle incident on a potential step of height V_0 with energy E greater than V_0. Calculate the co-efficient of reflection and transmission.

7. a) Derive Lorentz transformation equation of special theory of relativity. 6

OR

b) Describe a linear accelerator to increase the velocity of a charged particle. What is its main drawback.