03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs,

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. How forced E-M oscillation is set up? Write the differential equation with its solution of such oscillation. And hence discuss about resonance curve and significance of Quality factor. [1+2+2]
2. A mass of 1 kg is suspended from a spring of spring constant 25N/m. If the undamped frequency is $\frac{2}{\sqrt{3}}$ times the damped frequency, what will be the damping factor? [5]
3. At t = 0; the displacement x(0) of the block in linear oscillator is -8.50 c.m. The Block's velocity v(0) then is -0.920 m/s and its acceleration a(0) is 47 m/s^2. Find
   a) Angular frequency b) Phase constant [2.5+2.5]
4. How Newton's Rings are differ from Haidinger fringes? Derive an expression for the diameter of bright rings in transmitted light. How can you obtain central fringe dark in this system? [1+3+1]

   OR

   Define diffraction of light. Show that the intensity of first maxima is 1/22 of the central maxima. [1+4]
5. Show that fringe width of wedge shaped film is constant for a given wedge angle. [5]
6. A Quarter wave plate is meant for $\lambda_0 = 5.893 \times 10^{-5}$ cm. what phase retardation ϕ will show for $\lambda = 4.358 \times 10^{-5}$ cm? (Neglect changes of μ_0 and μ_e with λ) [5]
7. Define cardinal points of a coaxial lens system. Find the equivalent focal length for the combination of two coaxial thin lens of focal length 'f_1' and 'f_2' separated by a distance'd'. [2+3]
8. Discuss the significance of numerical aperture (NA). How does it depend on refractive index of cladding and core? [2+3]
9. How Gauss law is superior than Columb's law? Show that the electric field on the axis of a uniformly charged disk is equal to the electric field near an infinite plane of charge in limiting case. [1+4]
10. Show that the motion of an electron constrained to move along the axis of a thin non conducting ring of radius 'a' uniformly and positively charged with linear charge density λ is simple harmonic if it is displaced a small distance 'x' along the axis (x<<a) and released. Hence find the oscillating frequency. [5]

    OR

    A capacitor of capacitance C is discharged through a resistor of resistance R. After how many time constants is the stored energy $\frac{1}{4}$ of its initial value? [5]

11. Prove that the capacitance of a concentric spherical capacitor of radii a and b is $C = 4\pi\varepsilon_0[b^2/(b-a)]$. If outer plate is charged positively and inner sphere is earthed. [5]

12. A copper wire has cross-sectional area 3.31×10^{-6} m^2 and carries a current of 10 A. What is the drift speed of the electrons? (Density of copper = 8.95 gm cm^{-3}, Avogadro's number $N_A = 6.02 \times 10^{23}$ mol^{-1}, molar mass of copper = 64 gm) [5]

13. A circular parallel plate capacitor of area 154 cm^2 is being charged has a uniform current density of a displacement current, having a magnitude 20 A/m^2. Calculate (a) the magnitude of magnetic field at the distance r = 50 mm about the central axis between the plates. (b) dE/dt in this region [2.5+2.5]

14. With necessary circuit and graph, derive an expression for rise and fall of current in LR circuit. Hence explain the inductive time constant for this circuit. [2+3]

OR

What is cyclotron? Show that the maximum energy of the ion in cyclotron is directly proportional to the square of the frequency. [1+4]

15. Sunlight strikes the earth outside its atmosphere with an intensity of 2 Cal/cm^2-min. Calculate the magnitude of electric and magnetic fields. [5]

16. Using Schrodinger wave equation, calculate the values of the energy of a particle in an one-dimensional infinitely deep potential well. Indicate graphically the first three wave function for such a particle. [3+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Derive the resonance condition in an LCR circuit. Briefly explain the quality factor and hence show the quality factor will be higher if the band width of the circuit is lower.
2. What is Ultrasound? How these waves are produced? Write the fields of major application of Ultrasound.
3. Show that the wave equation of a transverse wave in a string is

   $\frac{d^2y}{dx^2} = \frac{1}{v^2}\frac{d^2y}{dt^2}$, where $v = \sqrt{\frac{F}{\mu}}$, where μ = mass per unit length

4. Explain how Newton's rings are formed and describe the method for the determinations of refractive index of liquid using Newton's ring formula.

   OR

   Discuss Fraunhofer diffraction due to a single slit. Draw a curve indicating distribution of intensity of diffraction patterns. Is there any fundamental difference between interference and diffraction? Give the reasons.
5. What is double Refraction? Explain how Nicol prism can be used as polariser and analyser?
6. A diffraction grating has 4000 lines per cm and is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum for the wavelength 500nm.
7. Write down the characteristics of LASER and its use in holography. How semi conductor laser is produced?
8. It is desired to make a converging achromatic lens of mean focal length 30 cm by using two lenses of materials A and B. If the dispersive powers of A and B are in the ratio 1:2. Find the local length of each lens.
9. Define electric flux. Determine electric field due to an infinite line of change.

   OR

   What is dielectric constant? Prove the relation $\vec{D} = \varepsilon_0 \vec{E} + \vec{P}$, Where symbols carry their usual meanings.
10. Two tiny conducting balls of identical mass **m** and charge **q** hang from non conducting thread each of length L. Derive and expression for the equilibrium separation **'x'** between the balls assuming that the separation angle to be small.

    OR

    What is a damped em oscillations? Which factor in the circuit is responsible to produce such a motion? Derive a differential equation for this motion and write its solution. What will be the remedy of such motion to make it smooth?

11. A parallel plate capacitor contains two dielectric slabs (of equal dimensions) of dielectrics K_1 and K_2 as shown in figure below (i) Find the capacitance in each case if A is the area of each plate. (ii) If $K_1 = 2$ and $K_2 = 3$, what will be the ratio of the capacitance in two cases.

12. A p.d. of 1V is applied to a 30.5 m length of copper wire (diameter 0.02 inch). Calculate (i) The current (ii) Current density (iii) The electric field strength (Given, Resistivity of copper is $1.7\times10^{-8}\Omega m$).

13. Discuss the Hall Effect. Derive (i) Hall voltage (ii) Hall coefficient and (iii) Hall resistance. Explain that the Hall resistance leads to the quantum Hall effect.

14. Derive an expression for the magnetic flux density inside a long solenid, carrying current I, at a point nearits center.

OR

Derive an expression for growth and decay of current in inductance and resistance circuit. Also explain the decay current in LR circut.

15. Prove that charge conservation theorem with the help of maxwell's equation of electromagnetism.

16. Using the uncertainly principle, calculate the minimum uncertainty in velocity when an electron is confined to a box having a length 1nm. Given, $m = 9.1\times10^{-31}$ Kg, $h = 6.6 \times 10^{-34}$Js.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Define centers of suspension and oscillation of compound pendulum and show that they are interchangeable. What length of the pendulum has its maximum time period?

OR

Derive a differential equation for LC oscillation. Show that the maximum value of electric and magnetic energies stored in LC circuit is equal.

2. What are basic conditions for acoustics of buildings? Derive Sabine's reverberation formula and also write its two importances.
3. A rod vibrating at 12Hz generates harmonics waves with amplitude of 1.5 mm in a string of linear mass density 2gm/m. If the tension in the string is 15N, what is the average power supplied by the source.
4. Explain the circular nature of the Newton's interference fringes. Show that square of radius of the nth bright fringe of Newton's ring due to the reflected light is proportional to 2n-1.

OR

Show that coherent light waves represented by equation $Ex = E_1 \sin(wt+\delta)$
$Ey = E_2 \sin wt$
Give rise generally to an elliptically polorised wave that can become linearly and circularly polorised wave under special condition.

5. What is the highest order spectrum which may be seen with monochromatic light of wavelength 600 nm by means of a diffraction grating with 4500 Lines/cm.
6. Write the physical significance of dispersive and resolving power of grating. Also establish the relation between them.
7. What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels? Write a method for getting He-Ne Laser.
8. Two thin lens of focal length f_1 and f_2 separated by a distance d have equivalent focal length 50 cm. The combination satisfies the conditions for no chromatic aberration and minimum spherical aberration. Find the value of f_1, f_2 and d. Assume that both the lens are the same material.
9. What is quadruple? Derive an expression of the electric field intensity at a point due to quadruple at axial line?

OR

Find the expression for the electric field intensity at a point along the center perpendicular axis of the charge disk and distance z from center. Extend this result in infinite charge disk.

10. If copper coin has mass 3.11 gm, what is the total charge on the nucleus of the atoms in the coin? Also find number of protons inside the nucleus. Molar mass (M) = 63.5 gm/mole, Avogadro number (N_A) = 6.02×10^{23} atom/mole.

11. Discuss a microscopic view of ohm's law and show that resistivity of a conductor is independent of the external electric field.

OR

State and derive Ampere's law in magnetism. Why and how Maxwell modified it?

12. A circular coil having radius **R** carries a current **I**. Calculate the magnetic flux density at an axial distance *x* from the center of the coil. Explain how the coil bahaves for a large distance point and at what condition field will be maximum?

13. Find the expression for maximum energy of a rotating particle in a cyclotron. How cyclotron is different from synchrotron?

14. An inductance **L** is connected to a battery of emf **E** through a resistor. Show that the potential different across the inductance after time *t* is $V_L = Ee^{-(R/L)t}$. At what time is the potential difference across the inductance equal to that across the resistance such that $i = i_0/2$.

15. Write Maxwell equation in differential form. Convert them into internal form. Explain he physical significance of each of them.

16. Derive Schrodinger time independent wave equation. Explain the physical significance of the wave functions.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. What is compound pendulum? Derive the expression of it's time period and discuss about the collinear points in compound pendulum.

OR

Discuss about the damped electromagnetic oscillation. Find the expression for damped frequency. Also discuss about over damping, critical damping and under damping conditions.

2. In damped harmonic motion, calculate the time in which (i) its amplitude and (ii) its energy falls to 1/e of its undamped value if the mass of the system is 0.25 gm and damping constant is 0.01 g/s?
3. Define reverberation time. Derive Sabine's formula for reverberation time.
4. Explain the formation of Newton's rings in reflected light. Prove that in reflected light the diameters of dark rings are proportional to the square roots of natural numbers.

OR

Describe how will you produce linearly, circularly and elliptically polarized light.

5. Two thin converging lenses of focal lengths 0.2m and 0.3m are placed coaxially 0.10m apart in air. An object is located 0.6m in front of the lens of smaller focal length. Find the position of the two principal points and that of image.
6. A glass wedge of angle 0.01 radian is illuminated by monochromatic light of wavelength 6000Å falling normally on it. At what distance from the edge of the wedge, will the 10^{th} fringe be observed by reflected light?
7. Define acceptance angle in optical fiber. Show that, Numerical Aperture (NA) = $\mu_1\sqrt{2\Delta}$; where μ_1 is refractive index of core of optical fiber, Δ is fractional refractive index change.
8. Light is incident normally on a grating 0.5cm wide with 2500 lines. Find the angles of diffraction for the principal maxima of the two sodium lines in the first order spectrum, λ_1 = 5890Å and λ_2 = 5896Å. Are the two lines resolved?
9. Derive an expression for the electric field and at a point P at a distance x from a circular plastic disc of radius a along its central axis. Does this expression for E reduces to an expected result for x>>a?

OR

Calculate the potential at any point due to an electric dipole. Hence, find the potential on the axial line.

10. A neutral water molecule in its vapor state has an electric dipole moment of magnitude 7.1×10^{-30} c-m. If the molecule is placed in an electric field of 2.5×10^{4} N/C, (i) what maximum torque can the field exert on it? (ii) How much work must an external agent do to turn this molecule end for end in this field?

11. Prove the capacitance of a concentric spherical capacitor of radii a and b is $C = 4\pi\epsilon 0\left[\frac{b^2}{b-a}\right]$. If outer plate is positively charged and inner sphere is earthed.

12. Differentiate between semiconductors and super conductors. Discuss about critical magnetic field in superconductors. Also prove that superconductors are diamagnetic in nature.

13. Derive the relation for rise and fall of current in LR circuit. Explain the graph between current and time and obtain inductive time constant in both cases.

OR

State Ampere's law. Find out the expression for magnetic field at a point outside, inside and on the surface of a current carrying conductor using this law.

14. What is self induction? Develop a relation for induced emf in a coil. Calculate the self-inductance of the solenoid having length *l*, number of turns N, area of cross-section A, and current I.

15. A certain plane electromagnetic wave emitted by a microwave antenna has a wavelength of 3cm and a maximum magnitude of electric field of 2×10^{-4} v/cm.

    (i) What is the frequency of the wave?
    (ii) What is the maximum magnetic field? and
    (iii) What is the maximum energy density?

16. Prove that the energy levels are quantized, when the electron is confined in an infinite potential well of width "a".

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3 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Show that motion of a disk of a torsion pendulum is angular harmonic motion. Find an expression for its angular frequency and time period of oscillation.

OR

What is em oscillation? Derive the differential equation of forced em oscillation. Hence find its resonance frequency.

2. A mass of 2 kg is suspended from a spring of spring constant 18 N/m. If the undamped frequency is $2/\sqrt{3}$ times the damped frequency, what will be the damping factor?
3. The volume of a hall is 475 m^3, the area of the wall is 200 m^2, areas of the floor and ceiling each is 100 cm^2. If absorption coefficients of the wall, ceiling and floor are 0.03, 0.04 and 0.05 respectively, find the reverberation time for the hall.
4. Is it necessary that the interfering waves should have equal amplitude? Derive an expression for condition of constructive and destructive interferences for reflected light in case of thin transparent film of uniform thickness.

OR

What are dispersive power and resolving power of a diffraction grating? Show that the resolving power of a grating is proportional to the number of order.

5. White light falls normally on a film of soapy water of thickness 5×10^{-5} cm and refractive index 1.33. Which wavelength in the visible region will be reflected most strongly?
6. What are retardation plates? Find out an expression to find the thickness of a retardation plate that produces elliptically polarized light.
7. Derive the expression for the equivalent focal length of two thin lenses having focal lengths f_1 and f_2 separated by a distance d. Also find the position of principal points.
8. If the numerical aperture be 0.2441 and refractive index of core be 1.50, calculate the refractive index of the cladding and acceptance angle in an optical fiber.
9. What is quadrupole moment? Is it vector quantity? Derive an expression of electric field intensity due to linear quadrupole at axial line.

OR

What is electric flux? Is it scalar quantity? Use Gauss's law to find the electric field strength outside and inside of uniformly charge distributed conducting sphere of radius R.

10. If a parallel plate capacitor is to be designed to operate in an environment of fluctuating temperature, prove that the rate of change of capacitance C with temperature T is given by $\frac{dC}{dT} = C\left[\frac{1}{A}\frac{dA}{dT} - \frac{1}{x}\frac{dx}{dT}\right]$, where symbol carries its usual meaning.

11. The super conducting state of a lead specimen has critical temperature 6.2 K at zero magnetic field and the critical field is 6.4×10^4 A/m at 0 K. Estimate the critical field at 5K.

12. An inductance L is connected to battery of emf E through a reisistance. Show that the inductor affects the growth of current $i = i_0\left(1 - e^{-\left(\frac{Rt}{L}\right)}\right)$. At which condition it reduces to $0.63i_0$.

OR

Derive an expression for energy stored in magnetic field. Show that the magnetic energy density is directly proportional to the square of magnetic field.

13. A copper strip 2 cm wide and 1 mm thick is placed in magnetic field 1.5T. If a current of 200A is setup in the strip, calculate (a) Hall voltage (b) Hall mobility of the number of elections per unit volume is 8.4×10^{28} m^{-3} and resistivity is 1.72×10^{-8} ohm-m.

14. A parallel plate capacitor with circular plates is being charged by varying electric field of 1.5×10^{12} $Vm^{-1}s^{-1}$. Evaluate the induced magnetic field if the radius of the plate is 55 mm and displacement current.

15. Write down the Maxwell's equations in free space and in dielectric medium. With the help of Maxwell's equations, derive charge conservation theorem.

16. An electron is confined in an one dimensional infinite potential well of width *l*, the potential energy is $V(x) = \begin{cases} 0 & 0 \le x \le l \\ \infty & x < 0 \text{ and } x > l \end{cases}$. Find the eigenfunctions $\Psi_n(x) = A\sin\left(\frac{n\pi x}{l}\right)$ and energy eigenvalues $E_n = \frac{n^2\pi^2h^2}{2ml^2}$.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between linear and angular harmonic motion. Prove that three exits four collinear point in a bar pendulum.

OR

Derive a relation for current floping in the circuit containing a resistor, an inductor and a capacitor in series with a sinusoidally varying emf. Find the condition for current responce.

2. A simple pendulum of length 40 cm and mass 50 gm is suspended in a car that is traveling with a constant speed 40 m/s around a circle of radius 100 m. If the pendulum undergoes small oscillations in a radial direction about its equilibrium position, what will be its frequency of oscillation?
3. Write a plane progressive wave equation for a wave propagating along the +ve x-axis. Prove the following relations:
   i) Particle velocity at a point = - (Wave velocity) X (Slope of the displacement curve at that point)
   ii) Particle acceleration at a point = (Wave speed)^2 X (Curvature of the displacement curve at that point)
4. What is chromatic aberration? Show that longitudinal chromatic aberration is equal to (i) $\omega \times f$, when object is at infinite and (ii) $\frac{\omega \times v^2}{f}$, when object is at finite. Where symbols have their usual meaning.
5. What are Newton's rings? How can you determine the refractive index of given liquid using Newton's rings experiment?

OR

Differentiate between quarter wave plate and half wave plate. Use the reference of double refraction to describe with diagram, how you distinguish positive and negative crystal.

6. What is the difference between the resolving and dispersive power of the plane transmission grating? Show that both resolving and dispersive powers are directly proportional to order of the spectrum.
7. A sugar solution in a tube of length 200 mm produces an optical rotation 13°. The solution is then diluted to (1/3) of its previous solution concentration. Find the optical rotation produced by 35 cm long tube containing the diluted solution.

8. An optical fiber has a numerical aperture (NA) of 0.22. The care has refractive index 1.60. Calculate the acceptance angle in water that has refractive index of 1.33. Also, calculate the critical angle at core cladding interface.

9. Define electric dipole. Charges of an electric dipole are replaced by identical charges; find the electric field and potential at a point on its axial line.

OR

Derive a relation for electric field at a point on the axis of a positively charged plastic ring. Show that if an electron is constrained within the axis of ring, motion of electron will be SHM.

10. If a disk of radius 2.5 cm has a surface charge density of 8.6 $\mu C/m^2$ on its upper surface. What is the electric field (i) at a surface of the disk and (ii) at a point on the central axis at a distance 15 cm from the disk?

11. A parallel plate capacitor whose capacitance C is 13.5pF is charged by a battery to a potential difference V = 12.5 V between its plates. The charging battery is now disconnected and a porcelain slab (k = 6.50) is supplied between the plates. (a) What is the potential energy of the capacitor before the slab is inserted (b) What is the potential energy of the capacitor –slab device after the slab is inserted?

12. A copper wire of cross-section area $3\times10^{-6}m^2$ carries a steady current of 60A. Assuming one electron per atom. Calculate (i) free electron density and (ii) average drift velocity. Given, Density of Cu = $8.9\times10^{3}kg/m^3$, Molar mass of Cu = 64 and Avogadro's Number = 6.02×10^{23}/mole.

13. Determine the energy stored in an inductor. Also, determine the energy density in magnetic field.

OR

Obtain an expression for magnetic field intensity due to a circular coil carrying current at its axial point. Compare the result with that due to short bar magnet.

14. Suppose a cyclotron is operated at an oscillator frequency of 15 MHz and has a dee of radius 55 cm (i) What is the resulting kinetic energy of deuteron? (ii) What is the magnetic field needed for deuteron to be accelerated in the cyclotron? Given: mass of the deuteron = 3.34×10^{-27}kg.

15. Write Maxwell's equations for non conducting medium. Using these equations determine the electromagnetic wave equation in terms of magnetic field for a non conducting and an-isotropic medium having finite permittivity (μ) and finite permeability (ε). Hence prove that the velocity of electromagnetic wave is equal to velocity of light in free space.

16. What is the physical meaning of wave function? Derive the Schrodinger time independent wave equation.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Develop and solve the differential equation of damped harmonic oscillator subjected to a sinusoidal force. Then obtain expression for its maximum amplitude and quality factor. [5]

OR

Obtain an expression for current in a driven LCR circuit and discuss how the current leads or lags the applied voltage in phase:

a) When the net reactance in circuit is inductive and
b) When the reactance in circuit is equal to resistance. Illustrate it with the help of a figure.

2. A circuit has L = 2 mH, C = 1.6 μF and R = 1.5 Ω. (a) After what time t will the amplitude of charge oscillations drop to one half of its initial value. (b) To how many periods of oscillations does this correspond? [5]

3. Calculate the reverberation time for a hall of volume 1400 m^3, which has seating capacity of 110 persons with full capacity of audience and when audience are occupying only cushioned seats. The relevant data for the hall are: [5]

SN	Surface	Area (m^2)	Coefficient of absorption
1	Plastered Wall	98	0.03
2	Plastered Ceiling	144	0.04
3	Wooden Door	15	0.06
4	Cushioned Chairs	88	1.00
5	Audience	150	4.70

4. Prove that the condition for achromatism for the combination of two lenses of focal length f_1 and f_2 having dispersive power w_1 and w_2 placed at a separation x is [5]

$$\frac{w_1}{f_1}+\frac{w_2}{f_2}=\frac{x}{f_1 f_2}(w_1+w_2)$$

Also prove that the separation between the lenses is equal to the focal length if $f_1 = f_2$.

5. In He-Ne laser, the lasing action is due to Ne gas. Then what is the role of the gas in it? Explain how the He-Ne laser works with a suitable energy level diagram on the basis of four level scheme for its action. [5]

6. Two sources of intensities 4I and I are used in an interference experiment. Obtain the intensities at points where the waves from two sources superimpose with a phase difference of (a) 0 (b) $\frac{\Pi}{2}$ (c) Π. [5]

OR

Explain the dispersive and resolving power of a diffraction grating. Prove that the ratio of dispersive power to resolving power is equal to the ratio of half width of peak and wavelength of incident light.

7. Derive the necessary formula for linearly, circularly and elliptically polarized light when light is emerged out of the doubly refraction crystal. [5]

8. What are Newton's rings? Derive the relation for the diameter of bright rings. What is the difference between the rings observed by reflected light and by transmitted light? Explain how does the pattern appear when white light is used? [5]

9. Define electric displacement vector. Develop a relation between electric displacement vector, electric field and polarization. Also prove that induced charge in dielectric is always less than free charge. [5]

OR

A dielectric sphere of radius R is charged uniformly. Obtain expressions for electric field intensity (a) outside (b) at the surface and (c) inside the sphere.

10. To similar balls each of mass m are hung from silk threads of length l and carry similar charges q. Assume that the angle made by each thread with vertical, θ is small. Show that $x = \left(\frac{q^2 l}{2\pi \epsilon_0 mg}\right)^{\frac{1}{3}}$, where is separation between the balls. Also calculate the charge q on the hung mass if l = 1.2 m, m = 20 g and x = 3 cm. [5]

11. The parallel plates in a capacitor, with a plate area of 8.5 cm^2 and air filled separation of 3 mm are charged by a 6 V battery. They are then disconnected from the battery and pulled apart to a separation of 8 mm. Neglecting fringing, find (a) the potential difference between the plates (b) the initial energy stored and (c) final energy stored. [5]

OR

A capacitor discharges through a resistor R. (a) After how many times constant (τ_c) does it charge fall to one half of its original value? (b) After how many time constants does the stored energy drop to half of its initial value?

12. What is Biot-Savart law? Derive an expression for flux density due to a current carrying circular loop at its axial point. [5]

13. If a parallel plate capacitor with circular plate be charged, prove that the induced magnetic field at a distance r in the region between the plates be [5]

$$B = \frac{1}{2}\mu_0 \epsilon_0 r \frac{dE}{dt} \text{ for } r \leq R \text{ and}$$

$$B = \frac{1}{2}\frac{\mu_0 \epsilon_0 R^2}{2r}\frac{dE}{dt} \text{ for } r \geq R$$

14. In a Hall-effect experiment, a current of 3A sent lengthwise through a conductor 1 cm wide, 4 cm long and 1 μm thick, produces a transverse Hall voltage of 10 μV, when a magnetic field of 1.5 T is passed perpendicularly through the thickness of the conductor. Calculate (a) drift velocity of the charge carriers and (b) the number density of charge carriers. [5]

15. Define poynting vector and develop an expression of it interms of electric and magnetic fields. Using the poynting vector calculate the maximum electric and magnetic fields for sun-light if the solar constant is 1.4 KW/m^2. [5]

16. A beam of electrons having energy of each 3 eV is incident on a potential barrier of finite height 4 eV. If the width of the barrier is 20 A°, calculate the percentage transmission of the beam through the barrier. [5]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	**Regular**		
Level	BE	**Full Marks**	80
Programme	BCE, BGE, BME	**Pass Marks**	32
Year / Part	I / II	**Time**	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Derive a relation to determine the radius of gyration of a compound pendulum. Why determination of the acceleration due to gravity is more accurate from a compound pendulum than a simple pendulum?

   OR

   Define the quality factor (Q). Derive a relation of quality factor (Q) from the damped harmonic motion and show that the quality factor (Q) is inversely proportional to damping constant (b).

2. An oscillatory motion of a body is represented by $y = ae^{i\omega t}$ where y is displacement in time t, a is its amplitude and ω is angular frequency. Show that the motion is simple harmonic.

3. What is Ultrasound? How these waves are produced? Differentiate such waves from ordinary sound wave.

4. Why colours are observed when soap bubble is exposed to sunlight? Show that the consecutive bright or dark fringes are observed when the thickness of the film increases by $\frac{\lambda}{2}$ in an inclined plane.

   OR

   What is plane diffraction grating? How is it used to find the wavelength of a monochromatic light experimentally?

5. What is an optical fiber? How is it made? Write down the main differences between step index and graded index multimode optical fibers with well diagrams.

6. A 200 mm long glass tube is filled with a solution of sugar, containing 15 gm of sugar in 100 ml of water. The plane of polarized light, passing through this solution, is rotated through 25°17′. Find the specific rotation of sugar.

7. Two thin converging lenses of focal lengths 0.2 m and 0.3 m are placed coaxially 0.1 m apart in air. An object is located 0.6 m in front of the lens of smaller focal length. Find the position of principal points and that of image.

8. What is double refraction? Show that a beam of plane polarized light is converted into elliptically polarized light when it passes through a quarter-wave plate.

9. Obtain an expression for electric field at an axial distance x from the centre of the flat circular disc of radius R that carries a uniform surface charge density σ. Extend your result to calculate potential at a distance x.

OR

A thin ring made of plastic of radius R is uniformly charged with linear charge density λ. Calculate the electric field intensity at any point at an axial distance Y from the centre. If electron is constrained to be in axial line of the same ring, show that the motion of electron is simple harmonic.

10. A copper strip 2.5 cm wide and 1.5 mm thick is placed in magnetic field with B = 2.5 T perpendicular to the plane of the strip and away from the reader. If a current of 250 A is set up in the strip, what Hall potential difference appears across the strip? Charge density is copper = $8.4 \times 10^{28}/m^3$.

11. Compare Ampere's law with Biot Savart law. Obtain expressions for magnetic field intensity inside and outside the long straight wire carrying current.

12. A spherical drop of water carrying a charge of 30 pC has a potential of 500 V at its surface (with V = 0 at infinity). (a) What is the radius of the drop? (b) If two such drops of the same charge and radius combine to form a single spherical drop, what is the potential at the surface of the new drop?

13. Calculate the displacement current between the capacitor plates of area 1.5×10^{-2} m^2 and rate of electric field change is 1.5×10^{12} V/ms. Also find the value of displacement current.

14. Obtain expressions for growth and decay of charges in the RC circuits. Explain how you will measure experimentally the capacitance of the given capacitor.

15. Write down Maxwell equation in integral form with their physical meanings. Convert these equations into differential form.

16. An electron is confined to an infinite height box of size 0.1 nm. Calculate the ground state energy of the electron. How this electron can be put to the third energy level?

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH452)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. A uniform circular disc of radius R oscillates in a vertical plane about a horizontal axis. Show that disc will oscillate with the minimum time period when the distance of the axis of rotation from the center is $\frac{R}{\sqrt{2}}$

   OR

   In the progressive wave show that the potential energy and kinetic energy of every particle will change with time but the average energy per unit volume remains constant.

2. A 2μF capacitor is charged up to 50 Volt. The battery is disconnected and 50mH is connected across the capacitor so that the LC oscillation occurs. Calculate the maximum value of the current in the circuit.

3. Show that the least possible distance between an object and its real image in a convex lens is four times the focal length of the lens.

4. What is path difference and phase difference in interference? Explain why we have to make a compensation in path difference in interference of light in parallel film in reflected system. Hence find out the condition for obtaining maxima in interference in this film by reflected light.

   OR

   What is Nicol Prism? How is it constructed? Discuss some of it applications.

5. A diffraction grating used at normal distance gives a green line λ=5400A° in a certain order superimposed on the violet line λ=4500A° of the next higher order. If the angle of diffraction is 10°, how many lines are there per centimeter in the grating?

6. What are Resolving Power and dispersive power of a diffraction grating? Show that the resolving power of a grating depends on the order and no of rulings of grating.

7. Calculate the reverbation time in a hall measuring 40*10*20* ft with the following parameters. (i) 7500 sq.ft of plaster, α_1=0.03 (ii) 400 sq.ft of glass, α_2=0.025 (iii) 6000sq.ft.of wood and floor etc, α_3=0.06 (iv) 600 seats α_4=0.03 and (v) audience of 500 persons, α_5=4.0 person.

8. What do you mean by Numerical Aperture and acceptance angle? Show that Numerical Apeture (NA) is proportional to square root of fractional refractive index change.

9. Derive an expression for the electric field intensity at any point in the axial line of a ring of charge q. From your result show that electric field is maximum at $x = \frac{a}{\sqrt{2}}$, where a is the radius of the ring.

OR

A capacitor of capacitance C is charged through a resistor obtains an expression for charging current. Show the variation of current with time. How will you use this information to calculate capacitance C.

10. What will be the force per unit area with which plates of parallel plate capacitor attract each other if they are separated by 1mm and maintained at 100 V potential difference and electric constant of the medium in unity.

11. Obtain Ohm's law in term of $\vec{J} = \sigma \vec{E}$, Explain why and how resistance of a conductor varies with temperature. Based on this information explain superconductor. Give at least two characteristics of superconductors.

12. Compare Ampere's law with Biot-Savart's law. Which is more useful for calculating B for a current carrying conductor. Calculate the magnetic field inside and outside a long straight wire carrying current I.

OR

State Faraday's law of Electromagnetic induction. Show that in electromagnetic induction the mechanical energy is converted into electric and finally in to heat energy.

13. A solenoid having an inductance of 6.3μH is connected in series with 1.2 KΩ resistor. (i) If a 14V battery is connected across the pair, how long will it take for the current to reach 80% of its equilibrium value? (ii) What is the current through the resistor at time $t=\tau_L$

14. What is Hall effect? Obtain an expression for Hall resistance. Show in a graph how hall resistance varies with magnetic field.

15. Calculate the magnitude of the poyniting vector and the amplitude of the electric and magnetic fields at a distance of 10 cm from a radio station which is radiating power of 10^5 watt uniformly over a hemisphere with radio station as center.

16. Consider an electron of mass m is confined in an one dimensional infinite potential well of width *l* such that
$V = \infty for\ 0 \leq x\ and\ x \geq l$
$V = 0 for\ 0 < x < l$

Show that inside the well electron can only have the discrete energy values.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics *(SH402)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. What are drawbacks of simple pendulum? Show that the period of torsion oscillations remain unaffected even if the amplitude be large, provided that the elastic limit of the suspension wire is not exceeded.

OR

In simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is kinetic energy and what fraction is potential energy? At what displacement is half kinetic energy and half potential energy?

2. Derive a differential equation of LC oscillation. With the solution of this equation, show that the maximum value of electric and magnetic energies stored in LC circuits is equal.
3. How much acoustic power enters the window of area $1.58m^2$, through the sound wave (standard intensity level $10^{-16}W/cm^2$)? The window opens on a street where the street noise results in an intensity level at the window of 60dB.
4. Explain circle of least confusion. Show that the diameter of a circle of least confusion is independent of the focal length of a lens.
5. A glass clad fibre is made with core glass of refractive index 1.5 and cladding is doped to give a fractional index difference of 0.005. Find (i) the cladding index (ii) The critical internal reflection angle (iii) The external critical acceptance angle (iv) Numerical aperture (v) Acceptance angle.
6. A parallel beam of light(λ=5890Å) is incident on a thin glass plate (μ = 1.5) such that the angle of refraction is 60°. Calculate the smallest thickness of the plate which will appear dark by reflection.
7. How are Newton's Rings formed? How is the ring diameter and film thickness related? How can Newton's rings experiment be used to determine refractive index of a liquid?

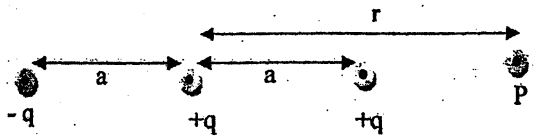
OR

What is double refraction? How can we experimentally distinguish between plane polarized, circularly polarized and elliptically polarized light?

8. Assume that the limits of the visible spectrum are arbitrary chosen as 430nm and 680nm. Calculate the no. of rulings per millimeter of a grating that will spread the first-order spectrum through an angle of 20°
9. Define an electric dipole. How does a dipole behave in electric field? Obtain the conditions for maximum torque and maximum potential energy in an electric field.

OR

For the charge configuration of the figure, show that V(r) at a point P on the line assuming $r >> a$ is given by $V = \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r} + \frac{2qa}{r^2}\right)$.



10. A long cylindrical conductor has length 1m and is surrounded by a co-axial cylindrical conducting shell with inner radius double that of long cylindrical conductor. Calculate the capacitance for this capacitor assuming that there is vacuum in space between cylinders.

11. Charges of uniform volume density $3.2\mu C/m^3$ fill a non conducting solid sphere of radius 5cm. What is the magnitude of the electric field at (a) 3.5cm (b) 8cm from the centre of the sphere?

12. What are superconductors? How they differ from perfect conductors? Give basic properties and uses of superconductors.

13. Derive the relation for rise and fall of current in LR circuit. Plot a graph between current and time and explain the graph.

OR

In a Hall-effect experiment, a current of 3A sent length wise through a conductor 1 cm wide, 4cm long and 10μm thick produces a transverse (across the width) Hall potential differences of 10μV, when a magnetic field of 1.5T is passes perpendicularly through the thickness of conductor. From these data, find: (a) The drift velocity of the charge carrier and (b) The number density of charge carrier.

14. A particular cyclotron is designed with dees of radius R = 75cm and with magnets that can provide a field of 1.5T. (i) To what frequency should be oscillator be set if deuterons are to be accelerated? (ii) What is the maximum energy of deuterons that can be obtained? Given mass of the deuteron is 3.34×10^{-27}kg.

15. Define Poynting vector. Prove that $\vec{S} = \frac{1}{\mu_0}\left(\vec{E}\times\vec{B}\right)$.

16. Prove that the energy levels are quantized, when the electron is confined in an infinite potential well of width a.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	**Regular**		
Level	BE	**Full Marks**	80
Programme	BCE, BME	**Pass Marks**	32
Year / Part	I / II	**Time**	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. What is forced oscillation? Derive differential equation for forced oscillation and show that amplitude at resonance is inversely proportional to damping constant of medium.

OR

Derive the differential equation for damped LCR oscillation. Obtain an expression for current and frequency of oscillation.

2. Prove that if a transverse wave is traveling along a stretched string, the slope at any point of the string is numerically equal to the ratio of the particle speed to the wave speed at that point.
3. The volume of a room is $600m^3$, wall area of room is $220m^2$, the floor and ceiling area each is $120m^2$. If average absorption coefficient for walls is 0.03, for ceiling is 0.80 and for floor is 0.06, calculate average absorption coefficient and reverberation time.
4. Two thin lenses of power P_1 and P_2 are separated by a distance d. Find an expression to show that equivalent power of the combination is given as $P = P_1 + P_2 - dP_1P_2$.
5. Explain the formation of Newton's ring in reflected light. Prove that, in reflected light the diameter of the dark rings are proportional to the square root of natural numbers and diameter of bright rings are proportional to the square root of odd numbers.

OR

Write down the physical meanings of dispersive power and resolving power of plane transmission gratting. Show that both resolving and dispersive power have proportional relation with the order of spectrum.

6. A 200mm long tube containing $48cm^3$ of sugar solution produces an optical rotation of 11° when placed in a polarimeter. If specific rotation of sugar solution is 66°, calculate quantity of sugar contained in the form of solution.
7. Light is incident normally on a gratting 0.5cm wide with 2500 lines. Find the angles of diffraction for the principal maxima of the two sodium lines in the first order spectrum, $\lambda_1 = 5890A°$ and $\lambda_2 = 5896A°$. Are the two lines resolved?
8. What is principle of laser? Discuss how population inversion is carried out? With the help of energy level diagram, explain how He-Ne laser works.

9. A thin non conducting rod of finite length l carries a total charge q spread uniformly along it. Show that the electric field at any point at a distance y above from the centre of rod is $E = \frac{q}{4\pi \epsilon_0 y} \frac{1}{\sqrt{l^2 + 4y^2}}$. Extend this result for infinite length.

OR

Find the potential at any point at an angle θ at a distance r from the centre of the short dipole. What result do you obtain if the point is along axial line?

10. A capacitor is made of two concentric spherical plates of radii a and b of inner and outer spheres respectively. If outer plate is positively charged and inner sphere is earthed, prove that the capacitance of such capacitor is given as, $C = 4\pi\varepsilon_0 \left[\frac{b^2}{b-a}\right]$.

11. Calculate the relaxation time for the electrons of sodium atom. The number of atoms per cm^3 in sodium is 2.5×10^{22}, and the electrical conductivity is 1.9×10^7 s/m.

12. List and explain methods to calculate magnetic field due to a current carrying conductor. Derive an expression for the magnetic field on the axial line of a long solenoid carrying current.

OR

What is self inductance? Calculate the inductance of a circular Toroid. From your result, show that inductance is a property of a coil and depends on permeability and shape and size of the coil.

13. Suppose a cyclotron is operated at an oscillator frequency of 12MHz and has a dee of radius 53cm.
    a) What is the magnitude of the magnetic field needed for deuteron to be accelerated in the cyclotron?
    b) What is the resulting kinetic energy of the deuteron? Given: mass of deuteron = 3.34×10^{-27}kg.

14. What must be the magnitude of a uniform electric field if it is to have the same energy density that passed by a 0.50T magnetic field?

15. What is poynting vector? Show that the intensity of an electromagnetic wave equals the average magnetic energy density times the speed of light.

16. A particle is moving in one dimensional potential well of infinite height and width a. find the expression for energy of the particle.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Mangsir

Exam.	**Regular / Back**		
Level	BE	**Full Marks**	80
Programme	BCE, BME	**Pass Marks**	32
Year / Part	I / II	**Time**	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. What is a torsional pendulum? Obtain an expression for its time period and explain why, unlike a simple or a compound pendulum the time period in this case remains unaffected even if the amplitude be large?

   OR

   Derive the differential equation of the forced oscillation of LCR circuit with ac source and find the expression for the current amplitude.

2. A meter stick suspended from one end swings as a physical pendulum (a) what is the period of oscillation (b) what would be the length of the simple pendulum that would have the same period.

3. Calculate the minimum intensity of audiability in watts per square cm from a note of 1000 Hz if the amplitude of vibration is 10^{-9}cm. Given density of air is 0.0013 gm/cc and velocity of sound in air is 340 m/s.

4. What is diffraction of light? Discuss the intensity distribution with special reference to diffraction of light in a single slit.

   OR

   Define circle of least confusion and show that $d = \frac{1}{2} WD$,

   Where

   d = diameter of circle of least confusion
   W = dispersive power
   D = diameter of lens aperture

5. A plano-convex lens of radius 300cm is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 8^{th} dark ring in the transmitted system is 0.72cm. Calculate the wavelength of light used.

6. What is double refraction? Using the concept of double refraction show that the plane polarized and circularly polarized light are the special cases of elliptically polarized light.

7. Two similar thin convex lenses of focal length 10cm each are placed co-axially 5cm apart. Find the equivalent focal length and the position of principal points. Also find the position of the object for which the image is formed at infinity.

8. What is an optical fibre? Discuss its types. Derive the relation for Numerical Aperture (NA) in an optical fibre.

9. Find the electric field at a distance x above the centre of the flat circular disc of radius R which carries a uniform surface charge density σ. Extend your result in the limit $R \to \infty$.

OR

Show that the electric field due to a short dipole at a point on the axial line is twice as that of a point on the equaterial line.

10. Differentiate between polar and non-polar dielectrics. Using Gauss's law in dielectrics establish relation of electric field with displacement vector and polarization vector. Hence obtain the relation for free and induced charge in the dielectric.

11. What is the average time between collisions of free electrons in a copper wire? (At. wt. = 63 g/mol, density = 9 gm/cc and resistivity = 1.7×10^{-8} Ωm, NA = 6.02×10^{23} mo^{-1})

12. A spherical drop of water carrying a charge of 3 μC has a potential of 500V at its surface. What is the radius of drop? If two such drops of same charge and radius are combined, what is potential of the single new drop formed?

13. A variable field of 10^{12} V/m.s is applied to a parallel plate capacitor with circular plates of diameter 10cm. Calculate (a) induced magnetic field and (b) displacement current.

14. A circular coil having radius R carries a current I. Calculate the magnetic flux density at an axial distance x from the centre of the coil. Explain how the coil behaves for a large distance point and at what condition field will be maximum?

OR

Show that the energy per unit volume in electric field and magnetic field are proportional to the square of their fields.

15. Derive the Schrodinger time independent wave equation. What is the physical significance of wave functions?

16. Using Maxwell equations in free space, derive electromagnetic wave equations for $\vec{E}$ and $\vec{B}$. Write its plane wave solution.

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'01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Chaitra

Exam.	New Back (2066 Batch Only)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. Derive a relation for the time period of a compound pendulum and compare it with that of simple pendulum to locate the centre of oscillation.

OR

Obtain differential equation for forced oscillation. Write its solution. Explain the statement "quality factor (Q) is a measure of the sharpness of resonance in the case of a driven oscillator".

2. Derive a relation for speed of transverse wave in a stretched string and show that the average rate of energy transfer is $\frac{1}{2}\mu\omega^2A^2$, Where the symbols are having usual meanings.

3. Write down the requirements for a good acoustic hall and derive a relation for reverberation time.

4. Explain chromatic aberration. Show that the longitudinal chromatic aberration is equal to the product of dispersive power and mean focal length of a lens.

OR

Define the term "optical activity". Derive a relation for the specific rotation of any optically active substance. Also write down its applications.

5. A glass clad fiber is made with the core glass of refractive index 1.5 and the cladding is doped to give a fractional index change of 0.0005. Determine
   a) the cladding index,
   b) the acceptance angle and
   c) the numerical aperture.

6. Newton's rings are observed in reflected light of wavelength 5900Å. The diameter of 10^{th} dark ring is 50mm. Find the radius of curvature of lens and thickness of air film.

7. In a grating the sodium doublet (5890Å, 5896Å) is viewed in third order at 30° to the normal and is resolved. Determine the grating element and the total width of the rulings.

8. Calculate the thickness of (i) a quarter wave plate and (ii) a half wave plate given that $\mu_E = 1.553$, $\mu_0 = 1.544$ and $\lambda = 5\times10^{-5}$cm.

9. What is electric Quadrapole? Finding an expression for electric potential at any point on an axial line at a distance 'r' from centre of short Quadrapole, show that electric field at that point is inversely proportional to r^3.

OR

A ring of radius 'R' is carrying a uniformly distributed charge 'q'. Find an expression for electric field at any point on the axial line. Locate the point at which electric field is maximum.

10. A parallel plate capacitor each of area $100cm^2$ has a p.d of 50V and capacitance of 100×10^{-4} μF. If a mica of dielectric constant is inserted between plates find the magnitude of

    a) Electric field in mica
    b) Displacement vector
    c) Polarization vector

11. Compare the methods of Biot Savart law and Ampere's law to calculate magnetic fields due to current carrying conductor. Calculate magnetic field at an axial distance 'r' from the centre of the circular coil carrying current.

12. A current of 1.2×10^{-10}A exists in a copper wire (At. wt. = 63 and density = 9gm/cc) whose diameter is 2.5mm. Assuming current to be uniform, calculate:

    a) Current density
    b) Electrical conductivity
    c) Mobility of electrons

13. What is cyclotron? Find an expression to show that maximum kinetic energy of charge particles coming out of dees of cyclotron is directly proportional to square of frequency of oscillator

    OR

    What is Hall-effect? Derive an expression for Hall coefficient and establish the relation with mobility of charge carrier and conductivity of material of wire.

14. A proton with speed of 3×10^5 m/s orbits just outside a charged sphere of radius 1cm. What is the charge on the sphere?

15. Write Maxwell equations in integral form. Convert them in differential form. Explain each equations.

16. A free particle is confined in a box of width L. Find an expression for energy eigen value to show that the particle can have only discrete energy and momentum.

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Six** questions selecting **One** each from **Group A & D** and **Two** each from **Group B & C**.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

Group A

1. a) Define physical pendulum. Show that the radius of gyration is equal to distance from centre of suspension to centre of gravity of a compound pendulum, when time period is minimum. [1+5]

   b) A solid sphere of mass 5/2 kg and diameter 2/7 m is suspended on a thin metallic wire. Find the period of angular oscillation if the torque constant of the wire is 6×10^{-3} Nm/rad. [4]

   c) What are particle velocity and wave velocity? Find the relation between them. [3]

2. a) Differentiate between reverberation and echo. Derive a relation for the reverberation time with reference to acoustically fit hall. [6]

   b) A mass of 6 kg stretches a spring 0.3m from its equilibrium position. The mass is removed and another body of mass 1.0 kg is hanged from the spring. What would be the period of oscillation if the spring is now stretched and released? [3]

   c) The relaxation time for a damped harmonic oscillator is 50 seconds. Determine the time in which the amplitude and energy of oscillator falls to 1/e times of its initial value. [4]

Group B

3. a) What are coherent sources of light? Why it is essential to generate coherent sources to observe the interference? Show that there is zero energy at dark fringes of interference phenomena. [1+1+3]

   b) Differentiate between curvature of field and distortion. Also draw neat and clean diagram of such aberrations. [2.5+2.5]

   c) In a plane transmission grating the angle of diffraction for second order maxima for wavelength 5×10^{-5} cm is 30°. Calculate the number of lines in one cm of the grating surface. [4]

4. a) Explain the phenomenon of double refraction in uniaxial crystal. What are quarter wave and half wave plates? [6]

   b) Discuss the propagation mechanisms of light waves in optical fiber. [4]

   c) Distance between two slits is 0.1mm and the width of the fringes formed on the screen is 5mm. If the distance between the screen and the slit is one meter, what would be the wavelength of light used? [4]

5. a) Discuss the essential requirements for producing laser action. Describe a Ne-Ne laser. [5]

b) Two thin convex lenses having focal lengths 6cm and 2cm are co-axial and separated by a distance of 4cm. Calculate the combined focal length and the positions of the principal planes. [5]

c) A 20cm long tube containing sugar solution rotates the plane of polarization by 11°. If the specific rotation of sugar is 66°, calculate the strength of the solution. [4]

Group C

6. a) Define dielectric strength. Derive a relation for the capacitance of a spherical capacitor consisting of two concentric spherical shell of radii y and z, (with z > y). [1+5]

b) If a copper wire is stretched to make it 2.5% longer than its original length, what is the percentage change in resistance? [4]

c) List industrial uses and hazard of high intensity electrostatic field. Explain in detail, one of the uses. [3]

7. a) Explain resistivity. Obtain the expression for resistivity in terms of mean free path. [5]

b) State Biot-Savarts law. Use it to determine the magnetic field of a narrow circular coil along its axis. [5]

c) The current in a LR circuit builds up to one third of its steady state value in 5 sec. What is the inductive time constant? [3]

8. a) State the Ampere's circuital law. Derive the relation for the self induction of a toroid. [5]

b) Two particles of equal charges of $2.0 \times 10^{-7} C$ but opposite signs are held 15cm apart. what are the magnitudes and directions of $\vec{E}$ at a point midway between them? [4]

c) A copper strip 2cm wide and 1mm thick is placed in a magnetic field with B = 1.5T. If a current of 200A is setup in the strip, what Hall p.d. appears across the strip? (Given: $n = 8.4 \times 10^{28}$ per m^3) [4]

Group D

9. a) What is displacement current? Also write its significance. [3]

b) Derive a differential equation for LC oscillation with initial charge Q_0. Derive an expression for the frequency of the oscillation, then relate it with spring-mass system. [6]

c) A 10 Henry coil has a resistance of 180Ω What size of capacitor must be put in series with it if the combination is to resonant when connected to 60 Hz outlet? [4]

10. a) With the help of Maxwell's equations prove the relation $C = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$, where symbols carry their usual meanings. [4]

b) Prove the continuity relation $\vec{\nabla} . \vec{J} + \frac{\partial \rho}{\partial t} = 0$. [4]

c) The maximum electric field at a distance of 20m from an isotropic point light source is 4.0 v/m. Calculate (i) the maximum value of the magnetic field and (ii) the average intensity of light there. [5]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Magh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Six questions selecting One each from Group A & D and Two each from Group B & C.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

Group A

1. a) What is torsional pendulum? Show that motion of a disc of a torsional pendulum is harmonic. Find its time period. Describe how will you determine modulus of rigidity of a thin metallic wire which supports the disc. [7]
   b) The amplitude of a lightly damped oscillator decreases by 3% during each cycle. What fraction of the energy of the oscillator is lost in each full oscillation? [3]
   c) A source of sound has a frequency 2.56 Hz and amplitude of 0.25cm. Calculate the flow of energy across a square centimeter in one second if the velocity of second in air is 340 m/s and the density of air is 0.00129 gm/cc. [3]
2. a) What is reverberation? Derive the reverberation time and explain how it depends on absorption coefficient of the medium. Discuss the significance of this formula with reference to the acoustics of a building. [7]
   b) Derive an expression for velocity of a wave in a stretched string. [3]
   c) Two sounds differ in sound level by 1.00 dB. What is the ratio of the greater intensity to the smaller intensity? [3]

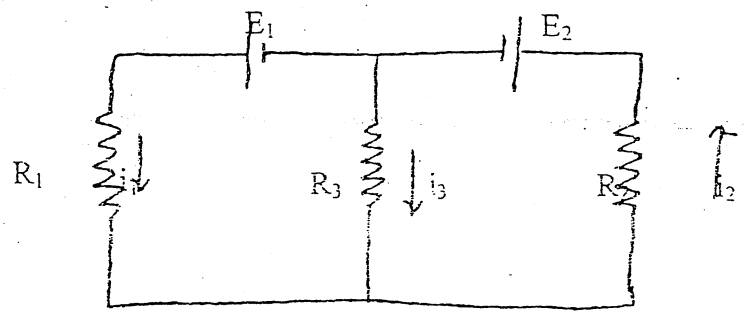
Group B

3. a) What is an optical fiber? Explain the physics behind its functioning. Trace the ray diagram that shows the propagation of light through the step index and graded index optical fibres. [7]
   b) Define cardinal points and locate these points within the lens. [3]
   c) A dielectric slab of thickness 'b' is inserted between the plates of a parallel-plate capacitor of plate separation 'd'. Show that the capacitance is then given by $C = \frac{K \epsilon_0 A}{Kd - b(K-1)}$, where the symbols have their usual meanings. [4]
4. a) Explain the phenomenon of interference of light. Give the theory of the Newton's ring. How fringes can be used to find the wavelength of light. [6]
   b) Light is incident normally on a gratting of total ruled width 5×10^{-3}m with 2500 lines in a cell. Find the angular separation of the sodium lines in the first order spectrum. Wavelengths of lines are 589nm and 589.6nm. Can they be seen distinctly? [4]
   c) What is astigmatism? What is the cause of it and how can it be reduced to a minimum? [4]
5. a) Write down the physical meanings of dispersive power and resolving power of plane transmission grating. Show that both resolving and dispersive power have proportional relation with the order of the spectrum. [7]
   b) A quarter wave plate is 12.5 μm thick. Calculate the wavelength for which it acts as a quarter wave plate. The difference in the principal refractive indices is 0.01. [3]
   c) Find the specific rotation of a given sample of sugar solution if the plane of polarization is turned through 26.4°. The length of the tube containing 20% sugar solution is 20cm. [4]

Group C

6. a) A thin ring made of plastic of radius R is uniformly charged with linear charge density λ. Calculate the electric field at any point at an axial distance Y from the center. If electron is constrained to be in axial line of the same ring, show that motion of electron is simple harmonic. Find frequency of oscillation. Mention any assumptions you made. [7]

b) In the given figure, find the currents i_1, i_2, i_3 if $E_1 = 1.5V$, $E_2 = 3V$, $R_1 = R_3 = 2\Omega$ and $R_2 = 4\Omega$. [3]



c) A copper strip 2cm wide and 1mm thick is placed in a magnetic field with B = 1.5 T perpendicular to the plane of the strip and away from the reader. If a current of 200A is set up in the strip, what Hall potential difference appears across the strip? Charge density of copper = $8.4 \times 10^{28}/m^3$) [3]

7. a) Define electric dipole. Find an expression for electric potential at any point in space due to dipole of length 2a. Could you extend this relation to calculate electric field intensity? If so, how? [5]

b) What is the drift velocity of a copper wire having diameter 0.25cm carrying current of 10A? Given density of copper = 9 gm/cm^3; and molar mass of the copper is 64 gm/mole. [4]

c) What is the magnetic energy density at the centre of the circulating electron in the hydrogen atom? Assume that the electron circulates around the nucleus in a path of radius 5.1×10^{-11}m at a frequency of 6.8×10^{15} rev/sec. [4]

8. a) Differentiate between Biot-Savart law and Ampere's law in calculating magnetic field of a current carrying conductor. Calculate the magnetic field on the axial line of a long straight solenoid carrying current. [7]

b) A capacitor of capacitance C is charged through the resistor R. Calculate the time at which the potential across the resistor is equal to the potential across the capacitor. [4]

c) Calculate the capacitance of the earth, viewed as a spherical conductor of radius 6400km. [3]

Group D

9. a) What is electromagnetic oscillation? Derive a differential equation for free em oscillation. Find the time period of oscillation. How frequency will be changed if there is resistance in the circuit? [7]

b) Why and how Maxwell modified Ampere's law in magnetism? [3]

c) Calculate the magnitudes of electric and magnetic field vectors associated with e-m waves emitted from a source 35 km away if its power of emission is 30 kW. [3]

10. a) Write Maxwell's equation in integral form and the laws in which these equations are based. Convert them into differential form. [6]

b) Derive electromagnetic wave equations in free space. Give their plane wave solution. Based on these solutions prove that $\frac{E}{B} = C$. [4]

c) In a LC circuit, what value of charge, expressed in terms of the maximum charge, is present on the capacitor when the energy is shared equally between the electric and magnetic field? [3]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Chaitra

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Six questions selecting at least One from Group A & D and Two from Group B & C.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

Group A

1. a) What is a compound pendulum? Deduce the expression for the time period of a compound pendulum and formulate the equivalent length of the simple pendulum. [1+6]

   b) Calculate the change in intensity level when the intensity of sound increases 100 times the original intensity. [3]

   c) A line source emits a cylindrical expanding wave. Assuming the medium absorbs no energy, find how the amplitude and intensity of the wave depend on the distance from the source. [3]

2. a) Explain the term "wave motion". Show that for a plane progressive wave, on the average, half the energy is kinetic and half potential. [1+5]

   b) A lecture hall with a volume of $4500m^3$ is found to have a reverberation time of 1.5 sec. What is the total absorbing power of all the surfaces in the hall? If the area of the sound absorbing surface is $1600m^2$, calculate the average absorption coefficient. [3]

   c) A string 2.72m long has a mass of 263 gm. The tension in the string is 36.1N. What must be the frequency of travelling waves of amplitude 7.7mm in order that the average transmitted power be 85.5W? [4]

Group B

3. a) What are cardinal points of an optical system? Determine the equivalent focal length of a combination of two thin lenses separated by a finite distance. Hence find the position of two principal points. [1+5+2]

   b) What is an optical fiber? How is it made? Write down the main differences between step index and graded index multimode optical fibers. [3]

   c) Calculate the thickness of (i) a quarter wave plate and (ii) a half wave plate, given that [3]

   $\mu_E = 1.553$, $\mu_0 = 1.544$ and $\lambda = 5890Å$

4. a) What are monochromatic aberrations? Explain the term spherical aberration and astigmatism and their minimization with suitable ray diagrams. [1+7]

   b) Newton's rings are formed by reflected light of wavelength 5895Å with a liquid between the plane and curved surfaces. If the diameter of the 6^{th} bright ring is 3mm and the radius of curved surface is 100cm, calculate the refractive index of the liquid. [4]

   c) Distinguish between Fraunhoffer and Fresnal diffraction. [2]

5. a) What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels? [1+4]

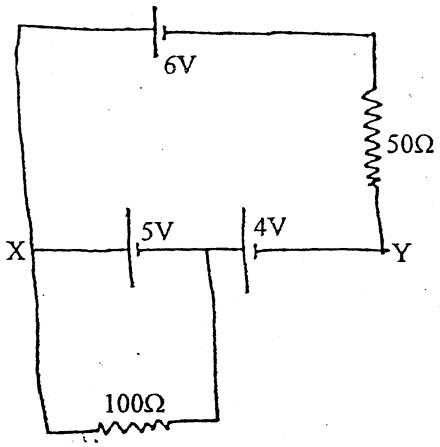
   b) Explain circle of least confusion. Show that diameter of circle of least confusion is dependent of the focal length of a lens. [5]

   c) Two thin lenses of focal lengths f_1 and f_2 separated by a distance d have an equivalent focal length 50cm. The combination satisfies the conditions for no chromatic aberration and minimum spherical aberration. Assuming both the lenses are made of same material, find the values of f_1, f_2 and d. [4]

Group C

6. a) State general form of Gauss law. Calculate potential difference between two plates of a charged cylindrical capacitor. [5]

   b) In the given circuit diagram, find the current in each resistor and potential difference between X and Y. [4]



   c) A strip of copper 150μm wide is placed in a uniform magnetic field $\vec{B}$ of magnitude 0.65T, with $\vec{B}$ perpendicular to strip. A current 23A is then sent through the strip such that a Hall potential difference V appears across the width of the strip. Calculate V. Given number of charge carriers per volume for copper is 8.47×10^{28} electron/m^3. [4]

7. a) What is dipole? Derive an expression for electric field due to dipole at the points on the (i) axis of the dipole and (ii) perpendicular bisector of dipole. [1+3+3]

   b) Show that the time constant in RC circuit is the time at which the charge in the circuit will reach a value $\frac{1}{e}$ of its final equilibrium value. [3]

   c) Two long parallel wires are 8.1cm apart. What amount of equal and antiparallel current flow in the wires if the magnetic field halfway between them is 296 μT? [3]

8. a) State and explain Faraday laws of induction. Deduce the expression for the inductance of a toroid. [1+4]

   b) State Biot-Savart law. Use it to find magnetic field at any point due to long straight current carrying conductor. [1+3]

   c) What will be the force per unit area with which plates of parallel plate capacitor attract each other if they are separated by 1mm and maintained at 100V potential difference and electric constant of the medium is unity. [4]

Group D

9. a) Explain what are Maxwell's equations. Write Maxwell's equations in free space and find the electromagnetic equations for electric and magnetic field. Also provide their plane wave solutions. [7]

   b) What is displacement current? Why Maxwell's modification is necessary is Ampere's law in magnetism? [3]

   c) You are given an inductor of 1 mH. If you are asked to make it oscillate with a frequency of 1 MHz, how can you make such an oscillating device? [3]

10. a) What are free and damped electromagnetic oscillations? Deduce the frequency of a damped electromagnetic oscillation and hence show the charge distribution with time graphically. [7]

    b) The maximum electric field at a distance 10m from an isotropic point light source is 2V/m. (i) What is the average intensity of light there (ii) What is the power of the source? [4]

    c) Show that the displacement current in a parallel plate capacitor is given by $C\frac{dv}{dt}$. [2]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Kartik

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Six** questions selecting at least **One** from **Group A and D** and **Two** from **Group B and C**.*
- ✓ ***All** questions carry equal marks.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

Group A

1. a) Differentiate between free oscillation and forced oscillation. [3]
   b) What is torsional pendulum? Find the time period for torsion pendulum. Also write its significance. [5]
   c) A spring is hung vertically and loaded with a mass of 75 grams and allowed to oscillate, calculate (i) the time period and (ii) the frequency of oscillation, when the spring is loaded with 100 grams it extends by 5cm. [5]
2. a) What are the differences between interference and beats? [3]
   b) Define absorption coefficient? Derive Sabine's reverberation formula and also explain its importance in our daily life? [6]
   c) A police man on duty detects a drop of 12 percent in the pitch of a motor car as it crosses him. If the velocity of sound is 332 m/s, calculate the speed of the car. [4]

Group B

3. a) Calculate the equivalent focal length of two thin co-axial lenses separated by a finite distance x. Also derive expressions giving the positions of the two principal points. [4+2]
   b) Write down the properties of LASER. Also explain the terms optical pumping, population inversion and stimulated emission. Write the merit and demerit of laser. [1+3+1]
   c) In Newton's rings experiment the radius of the 4^{th} and 12^{th} rings are 0.26cm and 0.37cm respectively. Find the diameter of the 24^{th} dark ring. [3]
4. a) What are the conditions for coherent sources? Explain the phenomenon of interference in thin film for reflected light. [1+5]
   b) What is optical fibre? Explain the graded index multimode optical fibre and also write the application of optical fibre in communication system as well as medical science. [4]
   c) What is the highest order spectrum, which may be seen with monochromatic light of wavelength 559nm, by means of a diffraction grating with 15000 lines/inch? [4]
5. a) State and explain the theory and resolving power of a plane transmission grating. [5]
   b) What do you mean by plane polarized light? Explain the phenomenon of double refraction in crystal. [1+4]

c) Calculate the polarizing angle for light travelling from water of refractive index 1.34 to glass of refractive index 1.52. [4]

Group C

6. a) Define the term electric dipole. Calculate the potential at a point along the axis of the quadrupole. [1+4]

   b) Explain the principle of parallel plate capacitor and determine its capacitance. [4]

   c) If a copper wire is compressed to make 0.5 percent shorter. What is the percentage change in resistance? [4]

7. a) Define the terms conductance and resistivity. Explain the atomic view of Ohm's law. Also write down the limitations of Ohms law. [6]

   b) What is difference between intrinsic and extrinsic semiconductor. Derive the relation conductivity of semiconductor. [3]

   c) Two small spheres of charge 14 micro coulomb and 35 micro coulomb placed 20cm apart. Find the location of a point between them where the field strength is zero. [4]

8. a) What is magnetic flux density? Derive an expression for magnetic flux density inside a long solenoid, carrying current I, at a point near its center. [1+4]

   b) Prove that magnetic energy density is directly proportional to the square of the magnetic flux density. [4]

   c) A copper strip 2cm wide and 1.5mm thick is placed in a magnetic field with magnetic strength 2.6 Tesla. If a current of 145A is set up in the strip, what Hall potential difference appears across the strip? The number of charges is 8.4×10^{28} per meter cube. [4]

Group D

9. a) What is meant by LC oscillation? Derive the differential equation of an LC circuit also calculate the frequency of LC oscillation.

   b) Derive the Maxwell's equations in differential form also explains their physical significance.

   c) Using Maxwell's equation prove that (E/B) = C. [3]

10. a) Define poynting vector and show that $S = (1/\mu_0)_{E \times B}$ where symbols carry their usual meanings. [5]

    b) What is displacement current? Prove that the displacement current density in a parallel capacitor can be written as $\vec{J}_d = \epsilon_0 \frac{d\vec{E}}{dt}$. [3]

    c) What should be the capacitance of a capacitor in a tuned circuit of frequency 10 MHz having an inductance of 0.01 mH? The resistance of the circuit is negligible. [4]

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