

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Chaitra

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

Subject: - Engineering Physics (SH 452)

- ✓ 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.



- What is physical pendulum? Show that time period of physical pendulum is minimum when length of pendulum is equal to radius of gyration.

OR

Prove that LC circuit is an analog of simple harmonic motion and hence show that maximum energy in capacitor is equal to maximum energy in inductor.

- If the relaxation time of a damped harmonic oscillator is 50 sec, find the time for which (i) the amplitude falls to $\frac{1}{e}$ times the initial value and (ii) energy falls to $\frac{1}{e^2}$ times the initial value.
- What is reverberation time? Derive Sabine's relation for reverberation time.
- What are Newton's rings? Give the necessary theory for the determination of the wavelength of monochromatic light using Newton's rings method.

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.

- Two thin converging lenses of focal lengths 30 cm and 40 cm respectively are placed co-axially in air separated by a distance of 20 cm. An object is placed 40 cm in front of the first lens. Find the position and nature of the image.
- If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary and ordinary light.
- Two waves of the same frequency have amplitudes A_1 units and A_2 units. They interfere at a point where their phase difference is ϕ . What is the resultant amplitude?
- Calculate the refractive indices of the core and cladding materials of a fiber from following data. NA = 0.22 and fractional refractive index change = 0.012.
- Define electric dipole. Determine the electric field at a point along the axial line due to short dipole.

OR

At what distance along the central axis of a uniform charged plastic disc of radius 'a' is the electric field strength equal to half the value of field at the center of the surface of the disc?

- Mention the steps to calculate the capacitance of a capacitor. Derive the capacitance of a cylindrical capacitor having inner radius a and outer radius b.

11. The current density in the cylindrical wire of radius $R = 2.00$ mm is uniform across a cross section of the wire and is $J = 2.0 \times 10^5$ Am $^{-2}$. What is the current through the outer portion of the wire between radial distance $R/2$ and R ?
12. Explain Ampere's circuital law. Calculate the magnetic field inside and outside a long straight wire carrying current I .

OR

Obtain an expression for magnetic field intensity due to a circular coil carrying current at its axial point.

13. A strip of copper $200\text{ }\mu\text{m}$ thick is placed in a magnetic field 0.7 T perpendicular to the plane of the strip and a current of 20 A is setup in the strip, calculate (i) Hall voltage (ii) Hall coefficient if the number of electrons per unit volume is 8.5×10^{28} m $^{-3}$.
14. The induced magnetic field at radial distance 6 mm from the central axis of a circular parallel plate capacitor is 2×10^{-7} T. The plates have radius 3 mm. At what rate is the electric field between the plates changing?
15. What are contributions made by Maxwell to set up Maxwell's equations? Explain with suitable reasons.
16. An electron is confined to one dimensional region in which its ground state energy is 3eV . (a) What is the length of the region? (b) How much energy is required to promote the electron to its first excited state?

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1. Write down the difference between compound pendulum and torsion pendulum. Show that motion of torsion pendulum is angular harmonic in nature and hence find its time period.

OR

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

2. A meter stick swings about a pivot point at one of its end. What is the time period of oscillation? What is the distance of the pivot point from the centre of oscillation of the stick?
3. What is piezo-electric effect? How is it used for the production of ultrasonic?
4. What are Newton's rings? Give the necessary theory for the determination of the wavelength of monochromatic light using Newton's rings method.

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. Interference fringes are produced with monochromatic light falling normally on a wedge shaped film of cellophane with refractive index 1.4. The angle of the wedge is 40 seconds of an arc and the distance between the successive fringes is 0.125 cm. Calculate the wavelength of light.
6. The refractive indices for o-ray and e-ray are 1.65 and 1.55 when incident on retardation plate. Calculate the thickness such that (i) the emergent ray is plane polarized. (ii) emergent ray is elliptically polarized. (wavelength of light is 5893A°)
7. How optical fibres are classified? Discuss their characteristics features. Point out the advantages of an optical fibre communication system.
8. A thin convex lens of focal length 15cm and a thin concave lens of focal length 10cm are arranged on a common axis at a distance of 10cm apart. Find the focal length of combination and position of principle point.
9. Prove that electric field due to a short dipole at axial point is twice that at equatorial point.

OR

Derive an expression for the electric field intensity at a point on the axis of a positively charged plastic ring. Also locate the point where the field is maximum.

10. Mention the steps to calculate the capacitance of a capacitor. Derive the capacitance per unit length of a cylindrical capacitor having inner radius a and outer radius b.

11. A copper wire of cross-sectional area $5 \times 10^{-6} \text{ m}^2$ carries a steady current of 50A. Assuming one free electron per atoms, calculate (i) Free electron density and (ii) average drift velocity. Given, Density of copper = $8.9 \times 10^3 \text{ kgm}^{-3}$, Molar mass of copper = 64gm and Avogadro's number = $6.02 \times 10^{23} \text{ mole}^{-1}$.
12. Compare Ampere's law with Biot-Savart's law. Calculate the magnetic field inside and outside a long straight wire carrying current I using Ampere's law.

OR

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

13. A strip of copper 150 μm thick is placed in a magnetic field of strength 0.65T perpendicular to the plane of strip and a current of 23A is set up in the strip. Calculate the Hall voltage and Hall coefficient if the electron density is $8.5 \times 10^{28} \text{ m}^{-3}$.
14. The induced magnetic field at radial distance 6mm from the central axis of a circular parallel plate capacitor is $2 \times 10^{-7} \text{ T}$. The plates have radius 3mm. At what rate is the electric field between the plates changing?
15. Using Maxwell's equations show that the speed of electromagnetic waves in a medium is given by $v = \frac{c}{\sqrt{\epsilon_r \mu_r}}$, where symbols have their usual meanings.
16. The Position and momentum of a 1 kev electron are simultaneously determined. If its position is located to within 1A° . What is the % of uncertainty in its momentum?

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 2076 Baisakh

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

Subject: - Engineering Physics (SH 452)

- ✓ 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. Give a theory of forced vibration and write the condition for amplitude resonance. Also include a note on sharpness of resonance. [3+1]
2. A 0.5 kg body oscillates in SHM on a spring that, when extended 2mm from its equilibrium position, has an 8N restoring force. What are the angular frequency of oscillation and the capacitance of an LC circuit with the same period if Inductor is 5 H? [3+1]
3. Distinguish between the particle velocity and wave velocity. Show that the function $y = AS \sin kx \cos \omega t$ satisfies the wave equation. [2+1]
4. Light containing two wavelengths λ_1 and λ_2 falls normally on a plano-convex lens of radius of curvature R resting on a glass plate. If the n^{th} dark ring due to λ_1 coincides with $(n-1)^{\text{th}}$ dark ring due to λ_2 , prove that the radius of the n^{th} ring of λ_1 is $\sqrt{\frac{\lambda_1 \lambda_2 R}{(\lambda_1 - \lambda_2)}}$. [2+1]

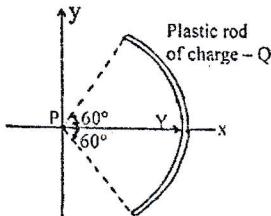
OR

Discuss the Fraunhofer diffraction pattern at a double slit and explain the condition for diffraction maxima and minima.

5. Light of wavelength 624nm is incident perpendicularly on a soap film ($\mu = 1.33$) suspended in air. What are the non-zero a) least and b) second least thickness of the film for which the reflections from the film undergo fully constructive interference? [2.5+2]
6. What is Nicol Prism? How is it constructed? Write some of its applications. [1+3]
7. Explain Chromatic Aberration with suitable sketches? Show that longitudinal chromatic aberration is equal to $\omega \times f$, when object is at infinite, where symbols have their usual meanings. [2+1]
8. What is the principle behind the functioning of an optical fibre? Point out the advantages of optical fiber communication over conventional communication system? [2+1]
9. How much work is required to turn an electric dipole 180° in a uniform electric field of magnitude 46.0 N/C if dipole moment is $3.02 \times 10^{-25} \text{ C-m}$ and the initial angle is 64° . [2+1]
10. Prove that the electric intensity at any point within the charged dielectric sphere is directly proportional to the distance of point from the Centre if the charge is uniformly distributed within the sphere. [2+1]

OR

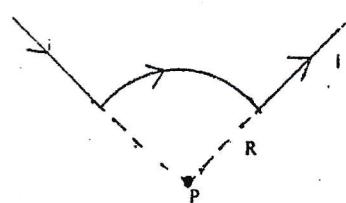
Figure below shows a plastic rod having a uniformly distributed charge - Q. The rod has been bent in a 120° circular arc of radius r. We place coordinate axes such that the axis of symmetry of the rod lies along the x axis and the origin is at the center of curvature P of the rod. In terms of Q and r, what is the electric field due to the rod at point P?



11. What will be the change in the capacitance of a capacitor if a dielectric slab of thickness 'b' is inserted between the plates of a parallel plate capacitor. Take d-distance between the plates, b-thickness of the plate and K-relative permittivity. [5]
12. The resistance of a wire at 30°C is 3Ω . At what temperature will the resistance be 5Ω ? The temperature coefficient of wire is $5.66 \times 10^{-3}^{\circ}\text{C}^{-1}$. [5]
13. Describe the working principle of Cyclotron. Show that the time taken by the ion in a Dee to travel a semicircle is exactly same whatever be its radius and velocity. [2+3]
14. Explain Ampere's theorem for the case of non-steady currents. Point out one similarity and one difference between the conduction and displacement currents. [3+2]

OR

Derive the magnetic field at point P due to curved wire segment flowing current I as shown in below figure. ['R' is the radius of circle of Arc.]



15. Prove that; the relation $\frac{\partial \rho}{\partial t} = -\nabla \cdot \vec{J}$, where symbols have their usual meanings. Also write the physical meaning of this equation. [3+2]
16. A beam of electrons having energy of each 3eV is incident on a potential barrier of height 4eV. If the width of the barrier is 20A° , calculate the Reflection coefficient of the beam from the barrier. [5]

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2076 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 (SH 452)

- ✓ 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 simple harmonic motion. Show that the velocity of simple harmonic oscillator at any instant leads the displacement by a phase angle of 90° . Hence find the general expression for the velocity of a simple harmonic oscillator.

Or

Prove that LC oscillation is an analogy of spring mass system. Hence prove that maximum energy stored in the capacitor is equal to maximum energy stored in the inductor.

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. What is ultrasonic wave? Describe the piezoelectric method for producing ultrasonic waves. Mention two of its important application.
4. Dispersive powers of two different glass types are 0.0163 and 0.0243 respectively. How can you design an achromatic contact double of focal length 50cm.
5. What is interference? Discuss the interference in thin wedge shaped films and determine the fringe width for this case.

Or

Explain the dispersive power and resolving power of a diffraction grating. Deduce expressions and relate them.

6. If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary and ordinary light.
7. Two waves of the same frequency have amplitude 3 units and 4 units. They interfere at a point where their difference is 60° . What is the resultant amplitude?
8. Show that numerical aperture ($NA = \mu_1 \sqrt{2} \Delta$); where μ_1 is reflective index of core of optical fiber, Δ is fractional refractive index change.
9. A ring radius 'R' is carrying a uniform distributed charge q. Find the expression for electric field at any point on the axial line. Find the point at which electric field is maximum.

Or,

Derive an expression of electrical potential at a point P due to short dipole at a distance r from mid-point and makes an angle θ to axis of dipole. Also discuss the electric potential when $\theta=45^\circ$ and 315° .

10. Over certain region of space the electric potential is $V = 5x + 2yz^2$. What is the magnitude of the electric field at the point which has coordinates $(1, -2, 1)$ m?
11. A fully charged capacitor stores energy W_0 . How much energy remains when its charge has decrease to $\frac{1}{2}$ its original value?
12. Calculate the relaxation time for the electrons of sodium atom. The number of atoms/cm³ in sodium 2.5×10^{22} , and the electrical conductivity is 1.9×10^7 mho/m.
13. Compare Ampere's law with Biot-savart's law. Obtain expression for magnetic field intensity inside and outside the long straight wire carrying current?
Or
Determine the energy stored in an inductor. Hence, prove that the energy density in magnetic field is directly proportional to the square of magnetic field.
14. A strip of copper $200\mu\text{m}$ thick is placed in a magnetic field 0.75T perpendicular to the plane of the strip and a current of 20A is setup in the strip, calculate (i) Hall voltage and (ii) Hall coefficient if the number of electrons per unit volume is $8.5 \times 10^{28} \text{ m}^{-3}$.
15. Define Poynting vector. Prove that $\vec{S} = \frac{1}{\mu} (\vec{E} \times \vec{B})$.
16. A particule of mass m is confined in one dimensional infinitely deep potential well of length l . Find the expression of energy eigen functions and eigen values of the particle.

03 TRIBHUVAN UNIVERSITY
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 2075 Bhadra

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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 cm. The Block's velocity $v(0)$ then is -0.920 m/s and its acceleration $a(0)$ is 47 m/s². 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 ($x \ll a$) 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 $C = 4\pi\epsilon_0[b^2/(b-a)]$. If outer plate is charged positively and inner sphere is earthed. [5]
12. A copper wire has cross-sectional area $3.31 \times 10^{-6} \text{ m}^2$ 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 $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$, 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 $r = 50 \text{ mm}$ 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/cm²-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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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

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

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 charge.

OR

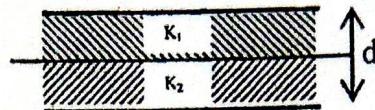
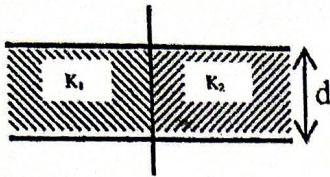
What is dielectric constant? Prove the relation $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$, Where symbols carry their usual meanings.

10. Two tiny conducting balls of identical mass m and charge q hang from non conducting thread each of length L . Derive an 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 $1.7 \times 10^{-8} \Omega\text{m}$).

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 solenoid, carrying current I , at a point near its center.

OR

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

15. Prove that charge conservation theorem with the help of Maxwell's equation of electromagnetism.
16. Using the uncertainty principle, calculate the minimum uncertainty in velocity when an electron is confined to a box having a length 1nm. Given, $m = 9.1 \times 10^{-31} \text{ Kg}$, $\hbar = 6.6 \times 10^{-34} \text{ Js}$.

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- 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.

- What are basic conditions for acoustics of buildings? Derive Sabine's reverberation formula and also write its two importances.
- 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.
- 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 $Ex = E_1 \sin(\omega t + \delta)$

$$Ey = E_2 \sin \omega t$$

Give rise generally to an elliptically polarised wave that can become linearly and circularly polarised wave under special condition.

- 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.
- Write the physical significance of dispersive and resolving power of grating. Also establish the relation between them.
- What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels? Write a method for getting He-Ne Laser.
- 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 of the same material.
- What is quadrupole? Derive an expression of the electric field intensity at a point due to quadrupole 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 behaves 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 difference across the inductance after time t is $V_L = E e^{-(R/L)t}$. 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 the 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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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 $5 \times 10^{-5} \text{ cm}$ 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 resistance. 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 if 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⁻¹s⁻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 $V(x) = \begin{cases} 0 & 0 \leq x \leq l \\ \infty & x < 0 \text{ and } x > l \end{cases}$. Find the eigenfunctions $\Psi_n(x) = A \sin\left(\frac{n\pi x}{l}\right)$ and energy eigenvalues $E_n = \frac{n^2 \pi^2 h^2}{2ml^2}$.

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 10th 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, $\lambda_1 = 5890\text{\AA}$ and $\lambda_2 = 5896\text{\AA}$. 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 $x \gg a$?

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".

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. Prove that the motion of a torsion pendulum is angular simple harmonic motion and determine it's time period. Explain how can you determine the moment of inertia of irregular shaped body by using such pendulum?

OR

Define forced electromagnetic oscillation and derive it's differential equation. Also derive the expression for resonant frequency.

2. 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. A source of sound has a frequency 512 Hz and amplitude of 0.50 cm. Calculate the energy flow across a square of unit area per sec. The velocity of sound in air is 332m/s and density of air is 1.29 kg/m^3 .
4. What are the conditions for obtaining good sustained interference pattern? Discuss the formation of interference fringes with monochromatic light in a thin wedge-shaped film in reflected light. Obtain the expression for fringe width.

OR

What do you understand by plane polarized and circularly polarized light? Describe how you will produce circularly polarized light and distinguish it from unpolarized light.

5. When oil is introduced into the space between the lens and the plate in Newton's arrangement, the radius of 8th dark ring decreases from 1.8 mm to 1.64 mm. What is the refractive index of the oil? Assume the refractive index of glass is greater than that of oil.
6. A grating of width 2.8 cm has 6000 lines. What is the minimum difference in wavelength that can be resolved in second order at 550 nm?
7. What is meant by the cardinal points of a lens? Derive the formula for equivalent focal length of two thin lenses place coaxially in air and separated by finite distance.
8. Define acceptance angle of an optical fiber. Derive the relation for numerical aperture (NA) of the optical fiber. Also write down it's significance.
9. Derive an expression of electric potential at point P due to dipole at a distance r from the mid-point and makes an angle θ to axis dipole. Also discuss the electric potential when $\theta = 0^\circ$, $\theta = 90^\circ$ and $\theta = 180^\circ$

OR

What is Gaussian Surface? Derive an expression for electric field intensity due to the non-conducting spherically symmetric charge distribution of radius R at a point (a) Outside (b) Inside the sphere by applying Gauss's Law.

10. Two small, positively charged spheres have a combined charge of 5.0×10^{-5} C. If each sphere is repelled from other by an electrostatic force of 1.0 N when the spheres are 2.0 m apart, what is the charge on the sphere with the smaller charge?
11. The space between two concentric conducting spherical shells of radii $b = 1.70$ cm and $a = 1.20$ cm is filled with a substance of dielectric constant $k = 23.5$. A potential difference $V = 73$ V is applied across the inner and outer shells. Determine (a) the capacitance of the device (b) the free charge q on the inner shell.
12. Give the method of Biot and Savart Law to calculate the magnetic field due to current carrying conductor. Calculate the magnetic field on the axis of circular loop at distance x from the center of the circular coil of radius R carrying current I .

OR

What type of particles can be accelerated by a cyclotron? Explain the working of a cyclotron. Write an expression for its frequency.

13. Define self induction. Derive the expressions for self inductance of a toroid.
14. Calculate the (a) mean free time and (b) mean free path between collisions for the conduction electron in copper having electron density $8.4 \times 10^{22} \text{ cm}^{-3}$ and resistivity $1.7 \times 10^{-8} \Omega \text{m}$. Charge of electron = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} Kg, effective speed of electron $1.6 \times 10^6 \text{ m/s}$.
15. The maximum electric field 10 m from an isotropic point source of light is 2 V/m. What are (a) the maximum value of the magnetic field and (b) the average intensity of the light there? (c) what is the power of the source?
16. Describe the physical significance of the wave function. Derive an expression for three dimensional time independent schrodinger wave equation.



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 All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between linear and angular harmonic motion. Prove that there exists four collinear points in a bar pendulum.

OR

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

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 core 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

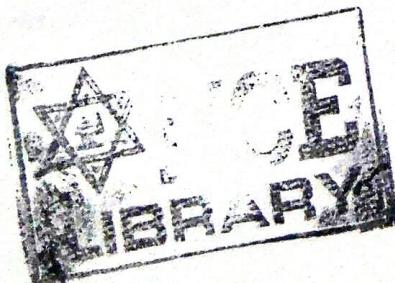
Derive a relation for electric field at a point on the axis of a positively charged plastic ring. Show that if an electron is constrained within the axis of ring, motion of electron will be SHM.

10. If a disk of radius 2.5 cm has a surface charge density of $8.6 \mu\text{C/m}^2$ 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 $V = 12.5 \text{ V}$ 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 $3 \times 10^{-6}\text{m}^2$ 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 = $8.9 \times 10^3 \text{kg/m}^3$, Molar mass of Cu = 64 and Avogadro's Number = $6.02 \times 10^{23}/\text{mole}$.
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 = $3.34 \times 10^{-27}\text{kg}$.
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.



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 $L = 1.2 \text{ mH}$, $C = 1.6 \mu\text{F}$ and $R = 1.5 \Omega$. (a) After what time t will the amplitude of the 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

$$x = \left(\frac{q^2 l}{2\pi \epsilon_0 mg} \right)^{\frac{1}{3}}, \text{ where } x \text{ is separation between the balls. Also calculate the charge } q \text{ on the hung mass if } l = 1.2 \text{ m, } m = 20 \text{ g and } x = 3 \text{ cm.}$$

[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 $1 \mu\text{m}$ thick, produces a transverse Hall voltage of $10 \mu\text{V}$, 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 in terms 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 \AA , calculate the percentage transmission of the beam through the barrier. [5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BQE, 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 physical pendulum and derive its formula of time period. Also differentiate mechanical oscillations and electromagnetic oscillations.
2. The speed of transverse wave on a string is 170 m/s when the string tension is 120 N. To what value must the tension be changed to raise the wave speed to 180 m/s?
3. The volume of a room is 980 m³. The wall area of the room is 150 m², ceiling area 95 m² and floor area is 90 m². The average sound absorption coefficients for wall ceiling and floor are respectively 0.03, 0.8 and 0.06. Derive Sabine's relations in acoustics and calculate reverberation time using above data.
4. What are coaxial optical system and cardinal points? State their properties and show their positions in a diagram. Illustrate the use of these points in the formation of an image by a lens system.
5. Explain why population inversion is required for laser operation, and explain how population inversion is achieved in a four-level laser.
6. Derive an expression for nth dark ring of reflected system in Newton ring experiment. Also show that central of the Newton's ring is dark.

OR

Discuss and derive the necessary formula of the intensity distribution in the diffraction pattern due to single slit.

7. In a double-slit experiment, the distance between slits is 5 mm and the slits are 1 m from the screen. Two interference patterns can be seen on the screen: one due to light of wavelength 480 nm, and the other due to light of wavelength 600 nm. What is the separation on the screen between the third-order bright fringes of two interference patterns?
8. A beam of polarized light is sent into a system of two polarizing sheets. Relative to the polarization direction of that incident light, the polarizing directions of the sheets are at angle Θ for the first sheet and 90° for the second sheet. If 0.1 of the incident intensity is transmitted by the two sheets, what is Θ ?
9. Find an expression for the electric potential due to ring of charge of radius "a" at a distance "x" from the centre of the ring. Extend your result to calculate the electric field intensity at that point.

10. A particle of charge $-q$ and mass m is placed midway between two equal positive charges q_0 of separation d . If the negative charge $-q$ is displaced in perpendicular direction to the line joining them and released. Show that the particle describes a simple harmonic motion and calculate its frequency of oscillation.

11. Give general method of calculating capacitance of a capacitor. Use the method to calculate capacitance of a spherical and a cylindrical capacitor.

OR

A capacitor discharges through a resistor R . (a) After how many time constants (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 Hall Effect? Obtain an expression for the Hall resistance "R" in a conductor placed in a magnetic field "B". What conclusions can be drawn by Hall-effect measurements?

13. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter 1 mm. Conductor B is a hollow tube of outside diameter 2 mm and inside diameter 1 mm. What is the resistance ratio R_A/R_B measured between their ends?

14. What is inductance? In what factors do it depends? Calculate the inductance of a solenoid and a toroid.

OR

A solenoid 1.3 m long and 2.6 cm in diameter carries a current of 18 A. The magnetic field inside the solenoid is 23 mT. Find the length of the wire forming the solenoid. Also calculate the inductance of the solenoid.

15. 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 \AA , calculate the percentage transmission of the beam through the barrier.

16. Write and explain Maxwell equations in integral form. Convert them into differential form.

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 $25^\circ 17'$. 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 $B = 2.5 \text{ T}$ 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 $= 8.4 \times 10^{28}/\text{m}^3$.

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 $1.5 \times 10^{-2} \text{ m}^2$ and rate of electric field change is $1.5 \times 10^{12} \text{ V/ms}$. 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?

Exam. Level	BE	New Back (2066 & Later Batch) 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 $2\mu F$ capacitor is charged up to 50 Volt. The battery is disconnected and $50mH$ is connected across the capacitor so that the L.C 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 compensation in path difference in interference of light in parallel light in reflected systems. 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 its applications.

5. A diffraction grating used at normal distance gives a green line $\lambda = 5400A^{\circ}$ in a certain order superimposed on the violet line $\lambda = 4500A^{\circ}$ 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 reverberation time in a hall measuring $40 \times 10 \times 20$ ft with the following parameters. (i) 7500 sq.ft of plaster, $\alpha_1=0.03$ (ii) 400 sq.ft of glass, $\alpha_2=0.025$ (iii) 6000sq ft of wood and floor etc, $\alpha_3=0.05$ (iv) 600 seats $\alpha_4=0.03$ and (v) audience of 500 persons, $\alpha_5=40$ person
8. What do you mean by Numerical Aperture and acceptance angle? Show that Numerical Aperture (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 is unity.

11. Obtain Ohm's law in term of $J = \sigma E$. 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 into heat energy.

13. A solenoid having an inductance of $6.3 \mu H$ is connected in series with $1.2 \text{ k}\Omega$ 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 poynting 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 hemispherical 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

$$V = \alpha \text{ for } 0 \leq x \text{ and } x > l$$

$$V = 0 \text{ for } 0 < x < l$$

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

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 ($\lambda=5890\text{\AA}$) is incident on a thin glass plate ($\mu = 1.5$) 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?

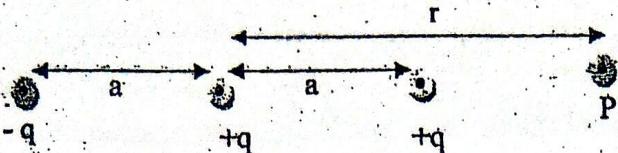
OR

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 $r \gg a$ is given by $V = \frac{1}{4\pi\epsilon_0} \left(\frac{q}{r} + \frac{2qa}{r^2} \right)$.



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 $3.2\mu\text{C}/\text{m}^3$ 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 $10\mu\text{m}$ thick produces a transverse (across the width) Hall potential differences of $10\mu\text{V}$, 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 $R = 75\text{cm}$ 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 $3.34 \times 10^{-27}\text{kg}$.

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

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

$$\Rightarrow R = 75\text{ cm}$$

$$B = 1.5\text{T}$$

$$f =$$

$$E = 2\pi^2 f^2 R m \omega$$

$$\frac{mv^2}{r} = q v B$$

$$\frac{mv}{r} = \frac{qeB}{m}$$

$$\omega r = \frac{qeB}{mr}$$

$$\omega r = \frac{B e}{m}$$

$$\therefore f = \frac{1}{2\pi} (B^2 m)$$

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 All questions.
- ✓ All 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 grating. 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 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, $\lambda_1 = 5890\text{\AA}^\circ$ and $\lambda_2 = 5896\text{\AA}^\circ$. 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, $C = 4\pi\epsilon_0 \left[\frac{b^2}{b-a} \right]$.
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 $1.9 \times 10^7 \text{ S/m}$.
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.
- What is the magnitude of the magnetic field needed for deuteron to be accelerated in the cyclotron?
 - What is the resulting kinetic energy of the deuteron? Given: mass of deuteron = $3.34 \times 10^{-27} \text{ kg}$.
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.

Exam.	New Back (2066 & Later Batch)		
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 All questions.
- ✓ All questions carry equal marks.
- ✓ $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$, $C = 3 \times 10^8 \text{ m/s}$
- ✓ Assume suitable data if necessary.

1. Define free oscillation and write two differences between compound and torsion pendulum. Show that time period of compound pendulum is minimum when $k = l$.

OR

Why the electromagnetic oscillations are always damping? Explain how can we keep the oscillations continue? Derive the differential equation of the damped em oscillation and write its solution.

2. A wave of frequency 500Hz has a phase velocity of 200m/s. (i) How far apart two points 30° out of phase? (ii) What is the phase difference between two displacement at a point at times 10^{-3} s apart?

3. Sound waves are emitted uniformly in all direction from the speaker in a large hall. Prove that the amplitude of the sound waves change with the distance r at any point from the speaker is, $a = \frac{1}{r} \sqrt{\frac{P}{2\pi\rho v \omega^2}}$. Where P is power of the sound wave moving with velocity v in the medium of density ρ and ω is the angular frequency.

4. Define the diffraction of light. Show that the intensity of second primary maxima is 1.62% of central maxima in Fraunhofer's single slit diffraction.

5. What are Newton's rings? How are they formed? Show that the diameter of dark Newton's rings by reflected system of light are proportional to the square root of natural number.

OR

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

6. Define acceptance angle in optical fiber. Show that, Numerical Aperture (NA) = $\mu_1 \sqrt{2\Delta}$; Where μ_1 : refractive index of core of optical fiber, Δ : fractional refractive index change.

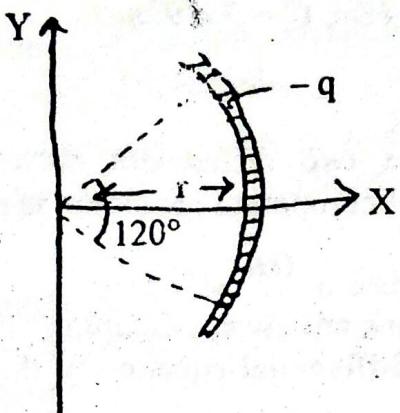
7. Two thin converging lenses of focal lengths 20cm and 40cm are placed co-axially 20cm apart. An object is located at a distance of 48cm from first lens. Find the positions of principal points and image.

8. A 200mm long tube containing 48cm³ of sugar solution produces an optical rotation of 11° when placed on a Sacchari meter. If the specific rotation of sugar solution is 66° , calculate the quantity of sugar contained in the tube in the form of solution.

9. Derive an expression for the electric field at point P at a distance 'Z' from a circular plastic disc of radius R along its central axis. Explain what will happen to the electric field if (i) $R \rightarrow \infty$, with keeping z finite and (ii) $z \rightarrow 0$; While keeping R finite.

OR

- A plastic rod contains uniformly distributed charge $-q$. The rod has been bent in 120° circular arc of radius r as shown in figure below. Prove that the electric intensity at the center of the bent rod is $E = \frac{0.83q}{4\pi\epsilon_0 r^2}$.



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 with temperature T is given by:

$$\frac{dC}{dT} = C \left[\frac{1}{A} \frac{dA}{dT} - \frac{1}{x} \frac{dx}{dT} \right]. \text{ Where symbols carry their usual meanings.}$$

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

12. Derive the relation for magnetic field on the axis of a circular loop and show that a circular current carrying coil behaves as a magnetic dipole for a larger distance.

13. What radius is needed in proton synchrotron to attain particle energy of 15 GeV, assuming that a guide field of 2.0 wb/m^3 is available? Rest mass of proton is 1.007529 AMV .

OR

- A parallel plate capacitor with circular plates is being charged by time varying electric field of $1.5 \times 10^{12} \text{ V/ms}$. Calculate the induced magnetic field if the radius of the plate is 55mm and displacement current of the system.

14. Derive the relation for rise and fall of current in LR circuit. Plot a graph betⁿ current and time and explain the figure.

15. Write Maxwell's electromagnetic wave equations in dielectric medium. Obtain electromagnetic wave equations for \vec{E} and \vec{B} in both dielectric medium and in free space. Compare velocity of electromagnetic wave in dielectric medium to free space.

16. Calculate the permitted energy levels of an electron in one dimensional potential well of width 0.2nm.

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 All questions.
- ✓ All 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 audibility 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 8th 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 $R \rightarrow \infty$.

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 equatorial 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 = $1.7 \times 10^{-8} \Omega\text{m}$, $NA = 6.02 \times 10^{23} \text{ mo}^{-1}$)
12. A spherical drop of water carrying a charge of $3 \mu\text{C}$ 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.

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

Subject: - Engineering Physics

- ✓ 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 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 $1/2 \mu v w^2 A^2$, 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 5900\AA . 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 (5890\AA , 5896\AA) 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 $\lambda = 5 \times 10^{-5} \text{ cm}$.
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 $100 \times 10^{-6} \mu\text{F}$. If a mica of dielectric constant 5.4 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 $1.2 \times 10^{-10}\text{A}$ 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 $3 \times 10^5 \text{ m/s}$ 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.
