TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BEI, BCT, BAM, BIE, BAG, BAS	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH 402)*

- ✓ 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 point of suspension & oscillation of bar pendulum & show that they are interchangeable. Also show that the time period will be minimum, when these points are equidistance from centre of gravity.

   Or,

   What is damped oscillation? Develop a relation for damped frequency in LCR oscillation. Hence discuss the underdamped, overdamped and critically damped oscillations.

2. In an oscillation, the amplitude drops to 1/e of its original amplitude in 50sec. Find the relaxation time. Also, obtain the time required to drop the amplitude to $1/e^2$ of the original amplitude.

3. The reverberation time for an empty hall is 1.5 sec. With 500 audiences present in the hall, the reverberation time falls to 1.4 secs. Find the number of persons present in the hall if the reverberation time falls to 1.312 sec.

4. A coaxial lens system placed in air has two lens of focal length 36cm & 12cm separated by a distance 24cm. Find the position of the cardinal points.

5. What is Newton's Ring? How can it be used to determine the refractive index of the liquid?

   Or,

   Discuss the similarities & difference of Young's double slit interference & single slit diffraction. Interrelate the discussion to explain the formation of spectra by diffraction in a single slit.

6. Show the intensity in the first and second order in a single slit diffraction reduced approximately to 4.5% and 1.6% of its central maxima.

7. Two polarizing sheets are placed together with their transmission axes crossed. A third sheet is inserted between them with its transmission axis at an angle of 45° with respect to each of the other axes. Find the fraction of incident unpolarised light intensity transmitted by the combination.

8. What is the fiber optics? Discuss the physics behind the optical fiber transmission. Derive an expression for acceptance angle of an optical fiber.

9. Define electric quadrupole and quadrupole moment. Hence, determine the expression for electric field intensity due to the quadrupole at axial line.

   Or,

   State and prove the Gauss's law in electrostatics. Apply this law to determine the electric field intensity at a point inside the uniformly charged non conducting solid sphere.

10. A parallel plate capacitor each of area $100cm^2$ has potential difference of 50V and capacitance 100pF, if a mica of dielectric constant 5.4 is inserted between plate, find the magnitude of
    a) Electric field intensity
    b) Displacement vector
    c) Polarization vector
11. Define Faraday's laws of electromagnetic induction and Lenz's law. Obtain an expression for self inductance of toroid.
12. If the carrier density of intrinsic Germanium at 300K is $2.29\times10^{13}/cm^3$. Calculate the resistivity at the same temperature given that electron & hole mobilities are $0.39m^2v^{-1}s^{-1}$ & $0.19m^2v^{-1}s^{-1}$ respectively.
13. Compare Biot-Savart law with Amper's law. Calculate the magnetic field outside & inside due to a long, straight wire of radius R carrying a steady current 'I' that is uniformly distributed through the cross-section of the wire.
14. A long solenoid of radius 2cm has 1×10^3 turns per meter and carries a sinusoidally varying current $I=5\sin100\pi t$, where I is in ampere & t is in second. Determine the magnitude of induced electric field at a radius r=1 cm & r = 3 cm from its central axis.
15. What is Displacement current? Define and derive the relation of poynting vector in electromagnetism.
16. An electron with an energy of 8eV is incident on a potential barrier which is 9.2eV high & 0.2 nm wide.
    a) what is the maximum transmission coefficient that the electron will pass through the barrier?
    b) what is the probability of transmission that the electron will pass through the barrier.

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2075 Chaitra

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Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH 402)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
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1. Define torsional pendulum. Derive an expression for its time period. Explain why the time period of the torsional pendulum remains unaffected even if the amplitude is large.

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?

2. A meter stick swings as a compound pendulum when suspended from one of its end. Calculate (a) period of the oscillations and (b) equivalent length of the simple pendulum that would have the same period.
3. Mention the conditions for good acoustics of a hall and derive an expression for reverberation time.
4. Why Newton's interference fringes are circular? Derive an expression for radius of the Newton's ring due to the transmitted light.

OR

Define dispersive and resolving power of a diffraction grating. Derive an expression for the resolving power of the grating having N slits.

5. A plane transmission grating having 5000 lines/cm is used to obtain a spectrum of light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 589 nm and 589.6 nm.
6. Calculate the specific rotation if the plane of polarization is turned through 30.5° traversing 25 cm length of 10% sugar solution.
7. Define an optical fiber and mention its types. Explain the numerical aperture and acceptance angle for the optical fiber and derive the expression to establish a relationship between them.
8. Dispersive powers for crown and flint glass lenses are 0.015 and 0.030 respectively. How can you design an achromatic contact of the lenses of focal length 50 cm?
9. What is an electric Quadrupole? Derive an expression for the electric potential at any point on the axial line at a distance 'r' from the centre of a short Quadrupole. Also, show that the electric potential at that point is inversely proportional to r^3.

OR

Discuss the modification of Gauss law due to the presence of the dielectrics and derive a relation among displacement vector, polarization vector and the electric field.

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 executes SHM between the positive charges, then derive an expression for the time period of the oscillations.

11. Calculate the mean free time and mean free path between the collisions for the free electrons in copper with number density of the electron 8.5×10^{28} m^{-3} and resistivity 1.7×10^{-8} ohm-m.($e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg and effective speed of the electron = 1.6×10^6 m/s)

12. Define the cyclotron and cyclotron frequency. show that energy of a charged particle in a cyclotron is independent to the oscillating electric field.

OR

State Ampere's law in magnetism. Calculate the magnetic field outside and inside a current carrying long straight conductor.

13. An inductance of an inductor L connected to a battery of emf ε through a resistor of resistance R. Show that the p.d. across the inductor after time t is $V_L = \varepsilon e^{-(R/L)t}$. At what time the p.d. across the inductor is equal to the p.d. across the resistor such that $i = i_0/2$.

14. What is magnetic flux density at the center of a circular coil of radius 2 cm and with 20 turns carrying current of 10 A?

15. Write Maxwell equations in differential form. State and explain the pointing vector and theorem.

16. What is the physical significance of wave function? Derive the relation of Schrodinger wave equation in time dependent form.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
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Programme	BEL, BEX, BEI, BCT, BAM, BIE, BAG, BAS	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH 402)*

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

1. Derive an expression for the time period of a physical pendulum and establish the interchangeability of the center of oscillation and suspension.

OR

Give the necessary theory of forced electromagnetic oscillation and deduce the condition for resonance amplitude in LCR series circuit with ac source.

2. Write down the characteristics of simple harmonic progressive wave. Derive an expression of energy of a progressive wave.
3. A spring is stretched by 5 cm when a load of 1kg is suspended to the lower and (upper end of spring is fixed). What will be the maximum velocity of object if it is pulled down further by 5cm form equilibrium position and then released?
4. Two thin lenses of focal lengths f_1 and f_2 separated by a distance d have an equivalent focal length 0.3m and both lenses are of same material. The combination of lenses satisfies the condition of achromatism and minimization of spherical aberration. Find the value of f_1 and f_2.
5. Explain the formation of Newton's ring in reflected system of monochromatic light. Prove that in reflected light diameters of the dark rings are proportional to the square root of natural numbers.

OR

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

6. A plane transmission grating of width 6 cm has 5000 lines/cm. Find the resolving power of grating for second order spectrum and the smallest wavelength difference that can be resolved for light of wavelength 5000 Å.
7. A plano-convex lens of radius 300 cm 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 0.72 cm. Calculate the wavelength of light used.
8. Differentiate between LASER and white light. Why the light in He-Ne laser is produced from Neon and not form Helium?
9. A ring shaped conductor with radius R carries a charge q uniformly distributed around it. Find the electric field intensity at an axial point of ring at distance y form the centre.

OR

Define capacitance. Give a general method to calculate capacitance of a capacitor. Find expression for the capacitance of a cylindrical capacitor.

10. An electric dipole consists of charges 10μC and -10μC separated by a distance of 1mm. What is the maximum torque experienced by the dipole if placed in the uniform electric field of intensity 400 V/cm?

11. Calculate the (i) mean free time and (ii) mean free path between collisions for the conduction electrons in copper having electron density 8.5×10^{28} /m^3 and resistivity 1.7×10^{-8} Ωm. Charge of electron 1.6×10^{-19} C, mass of electron 9.1×10^{-31} kg, effective speed of electron 1.6×10^{6} m/s.

12. Using Ampere's law, calculate the magnetic field inside, outside and on the surface of a long current carrying conductor and hence plot a graph between the magnetic field and the distance from the center of the conductor.

OR

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

13. A series circuit has 25 ohm resistance and 0.1 henry inductance. What will be initial rate of increase of current if the circuit contains a 12V steady source? What time is required for the current to attain a value of 100mA?

14. A wire of length *L* carries a current *I*. If the wire is formed into a circular coil, then the maximum torque in a given magnetic field B developed for a single turn is $\tau = \left(\frac{1}{4\pi}\right) L^2 IB$

15. Write Maxwell's equations in integral form. Convert them into differential form.

16. An electron is confined to an infinite potential well of size 8.5 nm. Calculate the ground state energy of the electron and radian frequency. Given: Plank's constant = 6.62×10^{-34} Js, mass of electron = 9.1×10^{-31} kg.

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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH402)*

- ✓ 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. Describe L.C oscillation qualitatively by using necessary circuits and graph.

OR

Define the terms sharpness of resonance and quality factor. Derive the relation of quality factor in terms of band width.

2. Define transverse wave. Develop a differential equation of the wave in a stretched string and then find the velocity of transverse wave.
3. A reverberation time of 2.3 sec is observed in a hall of volume 5500 m^3. The sound absorbing surface of the hall has an area of 750 m^2. Calculate the average absorption coefficient.
4. What are constructive and destructive interference? Prove that the path difference for constructive interference is integer multiple of λ and that for destructive interference is odd integer multiple of $\lambda/2$.

OR

How can you distinguish the plane, circularly and elliptically polarized light by using nicol prised and wave plate?

5. What is diffraction of light? Explain the dispersive power and resolving power of a diffraction grating. Derive the relation and also relate them.
6. A 30 cm long polarimeter tube containing 50 cm^3 of sugar solution produces an optical rotation 14.5° when placed on a polarimeter tube. If the specific rotation of sugar solution is 65°, calculate the quantity of sugar contained in the tube.
7. Two thin converging lenses of focal lengths 30 cm and 40 cm respectively are placed co-oxially 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.
8. What is optical fiber? Explain numerical aperture and acceptance angle. Also compare the attenuation property efficiency and cost of single mode and multimode optical fibers.
9. What is electrical dipole and dipole moment? Derive an expression of the electric field intensity at a point due to dipole at equatorial line?

10. Define the three electric vectors E,P,D and develop a relation between them.

OR

A cylindrical capacitor has radii 'a' and 'b'. Show that half the energy stored lies within the cylinder whose radius is $r = \sqrt{ab}$.

11. What will be the conductivity of sodium metal having atomic weight 22.9 and density 1.013 gm/cm^{-3}? The relaxation time of sodium metal is 3×10^{-14} sec.

12. What type of particles can be accelerated by a cyclotron? Explain the working of cyclotron and synchrotron with their differences.

OR

Differentiate between electromagnetic induction and self-induction. Develop an expression for self-inductance of a teroid.

13. Using Ampere's law, calculate the magnetic field inside, outside and on the surface of a long current carrying conductor and hence plot a graph between the magnetic field versus distance from the center of the conductor.

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

15. A radio wave transmits 25 W/m^2 of power per unit area. The flat surface area is perpendicular to the direction of propagation of the wave. Calculate the radiation pressure on it and maximum electric and magnetic field associated with the wave.

16. What are the significances of wave-function? Using the wave function derive and expression for the time dependent Schrodinger wave equation.

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14 TRIBHUVAN UNIVERSITY
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2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	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.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1) Deduce the time period of a simple harmonic vibration. Explain why a loaded bus is more comfortable than an empty bus. (3+2)

2) Explain forced oscillation with its differential equation. Write the relation for the frequency dependent amplitude and hence give a rough sketch of the resonance curve. (3+2)

Or

Calculate the average amplitude of a sinusoidal sound wave in air of a frequency of 1.5 KHz and average intensity 10-5W/cm^2, where density of air is 1.29kg/m^3. (5)

3) Give an account of bad acoustic properties of a hall and discuss the method to improve these defects. (5)

4) Explain the physical meaning of Dispersive and resolving powers of a Grating. Two spectral lines have wavelengths λ and $\lambda+\Delta\lambda$ respectively where $\Delta\lambda \ll \lambda$. Show that their angular separation $\Delta\theta$ in a grating spectrometer is $\Delta\theta = \frac{\Delta\lambda}{\sqrt{\left(\frac{d}{m}\right)^2 - \lambda^2}}$, where 'd' and 'm' are grating elements and no. of order respectively. (2+3)

Or

In newton's ring experiment, "Central spot is dark in reflected system" and "Fringes get closer as the no. of order increased" explain. Is it possible to make central spot bright in reflected system? If so how? (3+2)

5) A soap film $5*10^{-5}$ cm thick is viewed at an angle of 35° to the normal. Find the wavelength of the visible light which will be absent from the reflected light. (5)

6) Light of wavelength 580nm falls on a calcite crystal of certain thickness. The emerging light is circularly polarized. What must be the thickness of such crystal? (5)

7) Calculate the focal length of combination of two thin lenses of focal length f_1 and f_2 separated by a distance'd'. Find the position of two principal points. (5)

8) Trace the ray diagram that shows the propagation of light through the step and graded index optical fiber. Write the importance of self-focusing in an optical fiber. (3+2)

9) Charge of uniform density $\rho=3.2\mu C/m^2$ fills a non-conducting solid sphere of radius of 5.0 cm. What is the magnitude of the electric field a) at 3.5 cm b) 8.0 cm from the sphere's center (5)

Or

Two large parallel plates are separated by a distance of 5cm. The plates have equal but opposite charges that create an electric field in the region between the plates. An alpha particle ($q= 3.2*10^{-19}$ C, $m= 6.68*10^{-27}$kg) is released from the positively charged plate, and it strikes the negatively charged plate $2*10^{-6}$ sec later. Assuming that the electric field between plates is uniform and perpendicular to the plates, what is the strength of electric field? (5)

10) Calculate the potential at a point due to a uniform line of charge of length L at a distance D from its one end which lies in the perpendicular line. (5)

11) Explain how electric energy is stored in a capacitor and derive an expression for energy density of electric field. (2+3)

12) Explain super conductivity and its types with examples. Write the difference(s) between super conductor and perfect conductor. (3+2)

13) If a test charge revolves round a circular path of radius 8.5cm where the magnetic field increases at steady rate 0.13T/s, calculate the magnitude of induced electric field at a point 12.5 cm? (5)

14) Derive expression for inductances of a solenoid and toroid. Then show that inductance is the property of the coil. (5)

Or

What is Hall Effect? Write its importance. Show that the hall coefficient $R_H = -1/ne$, where the symbols have their own meanings. (1+1+3)

15) The Sun delivers about $10^3 W/m^2$ of energy to the earth's surface through EM radiation calculate a) the total power incident on a roof of dimensions 8m *20 m. b) Radiation pressure and force exerted on the roof, assuming roof is perfect absorber. (2+3)

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 20nm, calculate the percentage transmission of the beam through the barrier. (5)

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24 TRIBHUVAN UNIVERSITY
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2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BAME, BCT,BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	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.*
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1. Define compound pendulum. Show that the motion of torsional pendulum follows angular SHM. Use it to find modulus of rigidity of a given wire.

OR

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

2. If the relaxation time of a damped harmonic oscillator is 50 sec, find the time in which the amplitude falls to $\frac{1}{e^3}$ times the initial value and energy of the system falls to $\frac{1}{e^4}$ of its initial value.
3. A room has dimensions of 6×4×5m. Find (a) the mean free path of the sound wave in the room (b) the number of reflections per second made by sound wave with the walls of the room. (Given, velocity of sound in air is $330ms^{-1}$)
4. Write down the conditions for interference of light? Give the necessary theory for the interference in thin film due to reflected light.

OR

Describe how will you produce linearly, circularly and elliptically polarized light. Explain with mathematical calculation.

5. A grating with 250 grooves/mm is used with an incandensent light source. Assume visible spectrum to range in wavelength from 400 to 700 nm. In how many orders can one see the entire visible spectrum?
6. Newton's rings formed by sodium light viewed normally. What is the order of dark ring which will have double the diameter of 50^{th} ring?
7. What do you mean by population inversion and pumping? Describe the working of He-Ne laser with the help of energy level diagram.
8. What is chromatic Aberration? Show that a single lens is always accompanied with such aberration. Discuss in brief how can we minimize chromatic Aberration in the combination of lenses.
9. Derive an expression for the electric potential at a point P at an axial distance x from center of the ring of radius 'a' and linear charge density λ. Hence develop the expression for electric field intensity at the same point.

OR

Prove that the electric field due to a short dipole at a point on axial line is twice that on the equatorial line.

10. Charge of uniform volume density $\rho = 3.2\ \mu C/m^3$ fills a non conducting solid sphere of radius 5 cm. What is the magnitude of the electric field 3 cm from the sphere's center?

11. A parallel plate capacitor has a capacitance of 100 μF, a plate area of 100 cm^2 and a mica dielectric. At 50 volts potential difference calculate (a) E in the mica (b) the free charge on the plates and (c) the induced surface charge. [Dielectric constant for mica, k = 5.4]

12. What will be the conductivity of sodium metal having electron density $2.5\times10^{28}\ m^{-3}$ and relaxation time 3×10^{-14}sec?

13. Derive an expression for Hall Voltage. How do you differentiate the type of charge carrier from the result of Hall experiment? What is Hall resistance?

OR

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

14. A parallel plate capacitor with circular plates is being charged by varying electric filed of 1.5×10^{12} V/m-s. Calculate the induced magnetic field if the diameter of the plate is 110 mm and displacement current of this condition.

15. Write Maxwell equations in differential form in free space. Derive electromagnetic wave equations in vacuum. Find their plane wave solutions.

16. Write down Schrodinger time dependent and time independent wave equations. Prove that the energy levels are quantized when the electron is confined in an infinite potential well of width 'a'.

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24 TRIBHUVAN UNIVERSITY
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Subject: - Engineering Physics *(SH402)*

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

OR

Define SHM. Derive the expression for energy of SHM. Show that the KE and PE of simple harmonically oscillating object changes with time however the total energy is invariant.

2. What is LC oscillation? Derive the differential equation of free oscillation and compare its solution with mass spring system.
3. What is piezoelectric effect? Describe the construction of a piezoelectric oscillator for the production of ultrasonic waves.
4. Explain how interference fringes are formed by a thin wedge shaped film examining by normally reflected light. Derive a relation for the fringe width on such system of interference fringes.

OR

What is double refraction? Explain how would you use the phenomenon to produce linear polarized light and circularly polarized light.

5. A diffraction grating used at normal incidence gives a line (540 nm) in a certain order superposed on the violet line (405 nm) of the next higher order. How many lines per cm are there in the grating if the angle of diffraction is 30°?
6. In Ramsden's eyepiece a coaxial lens system is used. There are two lenses in air and are of equal focal length of separated by a distance 2f/3. Find positions of the cardinal points.
7. Discuss the physical significance of numerical aperture (NA). How does it depend on refractive index of core and cladding?
8. Calculate the thickness of doubly refracting plate capable of producing a path differences of $\frac{\lambda}{4}$ between extraordinary and ordinary rays of wavelength 5890 Å. (Use $\mu_0 = 1.53$; and $\mu_e = 1.54$)
9. What is an electric dipole and dipole moment? Show that electric field for a short dipole drops inversely to cube of the distance at any point from the dipole on an axial line.

OR

What is an electric qudrupole? Calculate potential for points on the axis of the qudrupole.

10. Two point charges 6μc and -24μc are 18 cm apart in air. Locate the positions of zero potential on the line joining the charges.

11. Two capacitors having capacitance 25μF and 5μF are connected in parallel and charged with a 100V power supply. Calculate the total energy stored in the two capacitors.

12. What is superconductor? Explain critical magnetic field. Describe the characteristics of superconductor.

OR

Explain Biot-Savart law. Show that a current carrying circular coil behaves as a magnetic dipole for a large distance.

13. Explain meaning of self induction. Calculate inductance for a solenoid and Toroid.

14. Deuterons in a cyclotron describe a circle of radius 0.32 m just before emerging from dees. The frequency of the applied emf's 10 MHz. Find the flux density of the magnetic field and the energy of deuterons emerging out of the cyclotron. (mass of deuterons = 3.32×10^{-27} kg.)

15. What are Maxwell's equations? Using Maxwell equations derive electromagnetic (em) wave equation in dielectric medium. Prove that em wave travels with velocity less than velocity of light in such medium.

16. A non relativistic particle is moving three times as fast as an electron. The ratio of the de-Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the mass of the particle.

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24 TRIBHUVAN UNIVERSITY
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2072 Chaitra

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Subject: - Engineering Physics *(SH402)*

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1. Differentiate between bar pendulum and torsional pendulum. Prove that there exists four collinear points in bar pendulum.

OR

Prove that LC circuit is an analogy of simple harmonic motion and hence prove that maximum energy stored in electric field is equal to maximum energy stored in magnetic field.

2. In simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is KE and what fraction is PE? At what displacement is the energy half KE and half PE?
3. A source of sound has a frequency of 256 Hz and amplitude of 0.50 cm, calculate the energy flow across a square cm per sec. The velocity of sound in air is 330 m/s and density of air is 1.29 kg/m^3.
4. Prove that interference in thin film of reflected and transmitted light are complementary to each other.

OR

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

5. 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.
6. A 200 mm long tube and containing 48 cm^3 of sugar solution produces an optical rotation of 11° when placed in a saccharimeter. If the specific rotation of sugar solution is 66°, calculate the quantity of sugar contained in the tube in the form of a solution.
7. In a Newton's ring experiment the diameter of the 10th ring changes from 1.40 cm to 1.27 cm when a liquid is introduced between the lens and the plate. Calculate the refractive index of the liquid.
8. What is an optical fiber? Show that Numerical aperture of an optical fiber is given by the expression, $NA = \mu\sqrt{2\Delta}$, where the symbols carry their usual meanings.
9. Determine the electric field at a distance z on the central axis from the center of a charged ring. Also, find the maximum value of electric field.

OR

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

10. Over certain region of space the electric potential is $v = 15x-3x^2y+12yz^2$. Find the expression for the x, y and z components of the electric field over this region. What is the magnitude of the field at the point P that has coordinates (1, 0, -2) m?

11. Write the general methods to calculate the capacitance of a capacitor and hence determine the capacitance of a cylindrical capacitor of inner and outer radii 'a' and 'b' respectively.

12. Calculate the drift speed of electrons when 20 A current is supplied through a copper wire of cross-sectional area 1 mm^2 and electron density 10^{28} m^{-3}.

13. Determine the energy stored in an inductor. Hence, prove that the energy density in magnetic field is directly proportional to square of magnetic field.

OR

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

14. A copper strip 3.0 cm wide and 2.0 mm thick is placed in a magnetic field 1.75T. If a current of 150 A is setup in the strip, calculate (i) Hall voltage and (ii) Hall mobility if the number of electrons per unit volume is $8.4\times10^{28}m^{-3}$ and resistivity is 1.72×10^{-8} ohm-m.

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

16. A beam of electrons having energy of 3eV is incident on a potential barrier of height 4 eV. If the width of the barrier is 20 $\overset{o}{A}$, calculate the percentage transmission of the beam through the barrier.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BAME, BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	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. Write the differences between mechanical oscillation and e.m. oscillation. Set up the differential equation of damped harmonic mechanical oscillation. Obtain the relation for frequency of such oscillation. Hence explain the conditions for different types of damped oscillation

OR

Define sharpness of resonance. Derive the relation for current amplitude of forced e-m oscillation.

2. What are the measures of good acoustic building? Show that the reverberation time decrease with increase in absorbing factors in a hall.
3. Two thin lenses of focal length f1 and f2 separated by a distance having an equivalent focal length 50 cm. The combination satisfies the condition for no chromatic aberration and minimum spherical aberration. Find the separation between the two lenses if both lenses are of same materials.
4. Prove that the intensity of first maxima is 4.54% of the central maxima in Fraunhoffer's single slit diffraction.

OR

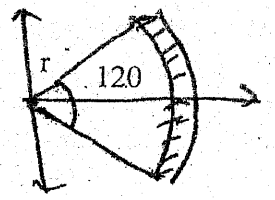
Write the physical meaning of dispersive power and resolving power of grating. Show that resolving power is directly proportional to the total number of rulings on the grating.

5. Newton's Rings arrangement is used with a source emitting two wavelength λ_1 and λ_2. It is found that the n^{th} dark ring due to λ_1 coincides with (n+1)th dark ring to λ_2. Find the diameter of n^{th} dark ring. ($\lambda_1 = 6\times10^{-5}$ cm, $\lambda_2 = 5.9\times10^{-5}$ cm radius of curvature of the lens R = 90 cm).
6. A quartz crystal has refractive indices 1.553 and 1.544. Calculate the thickness of a quarter wave plate for sodium light of wavelength 5890A°.
7. Explain the terms stimulated emission, population inversion, optical pumpling and metastable. Explain working principle of He-Nellaser.
8. A heavy circular ring of radius R oscillates in a vertical plane about a horizontal axis at a distance x from the center. Show that the time period is minimum when x = R

9. Derive the relation for potential at any point due to an electric dipole and show that no work is done in bringing a charge from infinity to dipole along the perpendicular bisector of the dipole.

OR

A plastic rod contains uniformly distributed Q charge. The rod has been bent in 120° circular arc of radius 'r' as shown in figure below. Prove that the electric field intensity at the center of bent rod is $E = \frac{0.83Q}{4\pi\varepsilon_0 r^2}$



10. Derive the relation for rise and fall of current in charging and discharging of capacitor through resistor. Plot graphs between current and time and explain the figures.
11. The space between two concentric conducting spherical shells of radii b = 1.70 cm and a = 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. What is Hall-effect? Derive an expression for the Hall coefficient and established the relation between mobility of charge carrier and conductivity of material of wire.

OR

Derive a relation resistivity of a conductor using microscopic view. From your result, explain why resistivity of a conductor increase with necessary with increasing temperature.

13. Explain the phenomenon of self induction. Calculate the value of inductance for (a) long solenoid and (b) Toroid.
14. What is Ampere's law? Derive the expression for magnetic flux density outside and inside a long straight conductor carrying current I.
15. Define Poynting vector. Prove that $\vec{S} = \left(\vec{E} \times \vec{B}\right)/\mu_o$, where the symbols have their usual meanings.
16. Discuss the significance of the wave function and deduce the time independent Schrodinger's wave equation.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH402)*

- ✓ 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 bar pendulum and torsional pendulum. Using a torsional pendulum, derive a relation for modulus of rigidity of the metallic wire.

OR

Compare the damped and forced LCR oscillation. Derive the differential equation of forced em-oscillation and compare it with driven mechanical oscillation

2. Show that in a bar pendulum, minimum time period is achieved if radius of gyration is equal to the distance of point of suspension or point of oscillation from center of gravity.
3. Write some features of acoustically good auditorium. Derive Sabine's formula.
4. Two thin converging lenses of focal lengths 3 cm and 4 cm respectively are placed coaxially in air separated by a distance of 2 cm. An object is placed at 4 cm in front of first lens. Locate the positions of the principal points and final image.
5. What is polarization? Derive the relation for plane, elliptical and circular polarized light.

OR

What are the coherent sources of light? How such sources develop in lab? Show that the square of diameters of the n^{th} dark ring by the reflected light of Newton's ring is directly proportional to the natural number.

6. Define acceptance angle and numerical aperture. In an optical fiber, show that Numerical Aperture (NA) = $\mu_{core}\sqrt{(2\Delta)}$, symbols have their usual meanings.
7. In a Fraunhofer Single slit diffraction, a convex lens of focal length 20 cm is placed just after a slit of width 0.6 mm. If a plane wave of wavelength 6000A° falls on slit normally, calculate the separation between the second minima on either side of central maximum.
8. Calculate the minimum no of lines per cm in a 2.5 cm wide grating which will just resolve the sodium lines 5890 $\mathring{A}$ and 5896 $\mathring{A}$ in second order spectrum.
9. 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 center. If electron is constrained to be in axial line of the same ring, show that the motion of electron is SHM.

OR

Discuss the behavior of dielectrics in a parallel plate capacitor. Based on Gauss law of electrostatic in dielectric, show that $\vec{D} = \varepsilon_0 \vec{E} + \vec{P}$, where symbols have their usual meaning.

10. The potential in a region between $x = 0m$ and $x = 6m$ is $V = a + bx^2$ where a = 10 and b = -7V/m. Determine (i) the potentials at x = 0m, 3m and 6m and (ii) the magnitude and direction of electric fields at x = 0m, 3m and 6m.

11. What are the current density and mobility? Explain the atomic view of the resistivity and show that $\rho = \{m/ne^2\tau\}$, where symbols have their usual meanings.

12. Give general method of calculating capacitance of a capacitor. Use the method to calculate the capacitance of a spherical capacitor.

13. A toroid has number of turns 1250, internal radius 52 mm, external radius 95 mm and thickness of the ring 13 mm, calculate the inductance.

OR

A solenoid having an inductance of 6.3 μH is connected in series with a 1.2 kΩ resistance. If a 14 V battery is connected across the pair, how long will it take for the current through the resistor to reach 80% of its final value?

14. Explain Hall effect. What results you can draw from Hall experiment? Obtain an expression for the Hall voltage in a current carrying specimen placed in a magnetic field.

15. State Maxwell equation in integral form. Convert them into differential form. Explain each of these equations.

16. A free particle is confined in a box of width L. Using Schrodinger wave equation find an expression for energy eigen value.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	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 is torsional pendulum? Derive the expression for the time period of oscillation for this pendulum.

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.

2. If the relaxation time of a damped harmonic oscillator is 60 sec, find the time for which (a) the amplitude falls to 1/e times the initial value and (b) energy falls to $1/e^2$ times the initial value.
3. The volume of a small hall in BICC is $900m^3$. The wall area of the hall is 150 m^2, ceiling area 90 m^2 and floor area is 95 m^2. The sound absorption coefficient for wall is 0.04, for ceiling is 0.04 and for the floor is 0.08. Calculate the average sound absorption coefficient and reverberation time.
4. What are Newton's rings? How are they different 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?

OR

Explain the dispersive electric field power and resolving power of a diffraction grating. Derive their expressions and relate them.

5. What is the principle of double refraction? Establish the relation for the production of linearly, elliptically and circularly polarized light.
6. What is stimulated emission? Explain with a suitable energy level diagram, how He-Ne laser works.
7. Two thin lenses of focal length f_1, and f_2 separated by a distance 'x' have an equivalent focal length 30 cm and both lenses are of same material. The combination satisfies the condition of achromatism and minimum spherical aberration. Find the values of f_1 and f_2.
8. Two glass plates enclosing a wedge-shaped air film touching at one edge are separated by wire of 0.03mm diameter at a distance of 15cm from the edge. Monochromatic light of wavelength 600 nm from a broad source falls normally on the film. Calculate the fringe width.
9. Define electric dipole. Determine the electric potential at any point at a distance r from the center of the dipole.

OR

Find the expression for the electric field due to a ring of charge of radius "a" at a distance "x" from the center of the charged ring.

10. Two fixed charges 1.07 μc and -3.28 μc are 61.8cm apart, where may a third charge be located so that no net force acts on it?

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

12. Calculate the drift speed of electrons when 10 A current is supplied through a copper wire of cross sectional area 1 mm^2 and electron density $8.5\times10^{28}m^{-3}$.

13. State Biot-Savart law. Derive an expression for the magnetic flux density at a distance "x" on the axis of circular coil of radius "a" carrying current I.

OR

Derive an expression for rise and fall of current in LR circuit. Hence explain the inductive time constant of this circuit.

14. A particular cyclotron is designed with Dees of radius R = 75cm and with magnets that can provide a field of 1.5T. (a) To what frequency should the oscillator be set if deuterons are to be accelerated? (b) What is the maximum energy of deuterons that can be obtained?

(Mass of deuterons is 3.32×10^{-27}kg)

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

16. A football of 500 gm is confined between two impenetrable walls of Dasharath Rangashala that can be treated as a box of length 100m. Calculate the minimum speed of the ball.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	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. Derive a relation to find the moment of inertia of a rigid body about an axis passing through its center of gravity using the torsional pendulum.

OR

What is resonance? Formulate the differential equation of forced electromagnetic oscillation. Then determine the expression for resonant frequency.

2. A string has a linear density of 625 gm/m and is stretched with a tension 50N. A wave, whose frequency and amplitude are 160Hz and 10mm respectively, is travelling along the string. At what average rate is the wave transporting energy along the string?
3. Why is it important to study the reverberation time, before the construction of a Cinema Hall? Derive a relation for reverberation time based on absorption coefficient, volume and surface area of the hall.
4. What happens to the energy when waves perfectly cancel to each other in interference? Derive the relations for thin film interference by reflected light.

OR

Show that the diameters of the Newton's rings when two surfaces of radii R1 and R2 are placed in contact are related by the relation $(1/R_1)+(1/R_2) = (4n\lambda/d^2_n)$, where n is the integer number of the fringes.

5. A grating with 250 grooves/mm is used with an incandescent light source. Assume the visible spectrum to range in wavelength from 400 to 700 nm. In how many orders can one see the entire visible spectrum?
6. Define the polarization of light. Write its importance in different optical instruments. Derive the relation for the thickness of quarter wave plate and half wave plate.
7. Two thin converging lenses of focal length 3cm and 4cm respectively are placed coaxially in air and separated by distance of 2cm. An object is placed 4cm in front of the first lens. Find the position of the nature of the image and its lateral magnification.
8. A glass-clad fiber is made with a core glass of refractive index 1.55 and the cladding is doped to give a fractional index difference of 5.5×10^{-4}. Determine (i) Cladding index (ii) the critical internal reflection angle (iii) the external critical acceptance angle and (iv) numerical aperture (NA).
9. 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 SHM with a period.

$$T = \sqrt{\frac{\epsilon_0 \, m \prod^3 d^3}{q q_0}}$$

OR

Calculate electric field at any point is axial distance due to a dipole and a quadrapole. What conclusion you can draw from your results.

10. Charges ave uniformly distributed through out the volume of an infinitely large cylinder of radius 'a'. Show that the electric field at a distance 'r' from the cylinder axis r < a is given by $E = \frac{\rho r}{2\varepsilon_0}$ where ρ is the volume charge density.

11. A cylindrical capacitor has radii a and b. Show that half the stored electric potential energy lies within a cylinder whose radius is $r = \sqrt{ab}$

12. Explain Hall Effect. Derive a relation for hall resistance. From this relation explain the meaning of quantization of hall resistance.

13. The current density in a cylindrical wire of radius R = 2 mm and uniform cross-sectional area is given by $J = 2 \times 10^5$ Am^2. What is the current through the outer portion of the wire between radial distances R/2 and R?

14. Explain the phenomenon of "self-induction". Find an expression for the self-induction of a toroid having N numbers of turns, radius r and carrying current i.

OR

State Ampere's law. Find the exprerssions for magnetic field outside and inside the long straight wire by using this law.

15. Write down the Maxwell's equations for non conducting Find the equation of propagation of plane electromagnetic wave for E-field and B-field for such medium. Show that electromagnetic wave travels with velocity less than velocity of light in such medium.

16. Derive schodinger time independent wave equation. 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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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH402)*

- ✓ 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 an expression for the time period of a physical Pendulum and establish the interchangeability of the center of oscillation and suspension
2. Give the necessary theory of forced vibration and deduce the condition for resonance amplitude.

OR

Show that the fractional change in frequency of damped oscillation is $1/8Q^2$ where Q is quality factor.

3. The reverberation time for an empty hall is 1.5 sec. With 500 audiences present in the hall, the reverberation time falls to 1.4 sec. Find the number of persons present in the hall if the reverberation time falls down to 1.312 sec.
4. What is interference? Explain the intensity distribution in interference with mathematical treatment.

OR

Show that the intensity of second primary maxima is 1.62% of central maxima in Fraunhoffer's single slit diffraction.

5. A beam of plane polarized light is converted into circularly polarized light by passing it through a crystal slice of thickness 3×10^{-5} m. Calculate the difference in the refractive indices of the two rays inside the crystal. Wavelength of light is 600nm.
6. What are active medium population inversion and optical pumping? Give the importance in the study of LASER. Write a method for getting He-Ne LASER.
7. Write the physical meaning of dispersive power and resolving power of plane transmission grating. Show that the product of the total number of ruling and the order of the spectrum gives the resolving power of the plane transmission grating.
8. Two thin identical convex lenses of focal length 8 cm and each are coaxial and 4 cm apart. Find the principal points and the position of object for which image is formed at infinity.
9. What is electric quadrupole? Calculate the electric potential of a linear quadrupole of separation 2z at an axial distance R from its center.

OR

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

10. A cylindrical resistor of radius 6 mm and length 2.5 cm is made of material that has a resistivity of 4×10^{-5} Ω.m. What are (i) The magnitude of the current density and (ii) the potential difference when the energy dissipation rate in the resistor is 2 Watt?

11. A solenoid 2.6 m long and 1.3 cm in diameter carries a current of 9A. The magnetic field inside the solenoid is 20mT. Find the length of the wire forming the solenoid.

12. Compare the methods of Biot and Savart Law and Ampere's Law to calculate magnetic fields due to current carrying conductor. Calculate magnetic field at an axial distance "x" from the center of the circular coil carrying current.

13. In a Hall experiment, a current of 25A is passed through a long foil of silver, which is 0.1 mm thick and 3 m long. Calculate the Hall voltage produces across the width by a flux of 1.4 Wb/m^2. If the conduction of silver is 6.8×10^7 mho/m, estimate the mobility of the electrons in silver.

14. A parallel plate capacitor with circular plates is charged by current "i" (a) What is the magnitude of $\int \mathbf{B}.\mathbf{ds}$ in terms of μ_0 and i between the plates if r = (a/5) from the center? What is the magnitude of induced magnetic field for r = (a/5) in terms of displacement current?

OR

An inductance L is connected to a battery of emf E through a resistance. Show that the potential difference across the inductance after time t is $V_L = \varepsilon\, e^{\left(\frac{-R}{L}\right)t}$. At what time is the potential difference across the inductance equal to that across the resistance such that $i = \frac{i_0}{2}$.

15. Write Maxwell equations in integral form. Convert them in differential form. Explain the physical meaning of each equation.

16. Describe the physical significance of the wave function. Derive an expression of time dependent Schrodinger equation.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX ,BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	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. Distinguish between free and forced vibrations. Write the differential equation of forced oscillation. Determine the amplitude of oscillation for forced oscillation and hence explain sharpness of the resonance.

OR

Define simple harmonic motion. Show the average kinetic energy is half oft the total energy of a particle executing simple harmonic motion.

2. A 2μF capacitor is charged upto 50V. The battery is disconnected and 50mH coil is connected across the capacitor so that LC oscillation to occur. Calculate the maximum value of the current in the circuit.
3. The elastic limit of steel forming a piece of wire is equal to 2.70×10^8 Pa. What is the maximum speed at which transverse wave pulses can propagate along this wire without exceeding this stress? (density of steel = 7.89×10^3 kg/m^3)
4. What are Newton's rings? How can you use these rings to determine the refractive index of a given liquid?

OR

Discuss the phenomenon of Fraunhofer diffraction at a single slit. Show that the relative intensities of the successive maxima are $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$.....

5. Light of wavelength 6000 A falls normally on a thin wedge shaped film of refractive index 1.4, forming fringes that are 2 mm apart. Find the angle of the wedge.
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. Show that the diameter of circle of least confusion depends on the diameter of lens aperture and dispersive power of the material of the lens but is independent of the focal length of the lens.
8. An optical fiber has a numerical aperture of 0.22 and core refractive index 1.62. Determine the acceptance angle for the fiber in a liquid which has a refractive index of 1.25. Also, determine the fractional refractive index change.

9. Prove that electric field due to a short dipole at axial point is twice that at equatorial point.
10. A capacitor of capacitance C is discharging through a resistor of resistance R. After how many time constants is the stored energy 1/8 of its initial value?
11. Give a general method to calculate electric field and potential due to continuous charge distribution. Using your method, calculate electric field at an equitorial distance y due to a long charged rod having linear charge density λ.
12. Consider a circular coil of radius R carrying current I. Find the magnetic field at any point on the axis of the loop at a distance z from the center of the loop. Show that the circular current carrying coil behaves as a magnetic dipole for large distance.
13. In a Hall Effect experiment, a current of 3.2A lengthwise in a conductor 1.2 cm wide, 4.0 cm long and 9.5μm thick produces a transverse Hall voltage (across the width) of 40μV when a magnetic field of 1.4T is passed perpendicularly through the thin conductor. From this date, find (a) the drift velocity of the charge carriers and (b) the number density of charge carriers.
14. Derive an expression for growth and decay of current in LR circuit. Explain inductive time constant by sketching graph between current and time for both cases.

OR

Derive expressions for inductance of a Solenoid and Teroid. Then show that inductance is the property of the coil.

15. Write and explain Ampere's law in magnetism. How Maxwell modified it. Based on this modified equation, explain the term displacement current. Prove displacement current is equal to conduction current.
16. Explain Schrodinger's wave equation. Derive time independent Schrodinger wave equation. Use this equation to find energy for a particle in a box of infinite square well potential.

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24R TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH402)*

- ✓ 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. Point out the similarities and dissimilarities between the oscillations of bar pendulum and torsinal poendulum. Show that the radius of gyration is equal to distance from center of suspension to center of gravity of compound pendulum, when time period in minimum.
2. Derive a differential equation for LC Oscillation. Show that the maximum value of electric and magnetic energies stored in LC circuit is equal.

OR

Prove that if a transverse wave is travelling along a string, then 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 time of reverberation of an empty hall is 1.5 sec with 500 audiences present in the hall; the reverberation time falls to 1.4sec. Find the no. of persons present in the hall if the reverberation time falls down to 1.32 sec.
4. Show that the intensity of the first subsidiary maxima of Fraunhoffer's diffraction at a single slit is 4.5% of that or principal maxima.

OR

What is double diffraction? Explain how Nicol prism can be used as polarizer and analyzer?

5. In a Newton's ring experiment, the radius of curvature of the lens is 5cm and the lens diameter is 20mm. (a) How many bright rings are produced? Assume that λ=589nm (b) How many bright rings would be produced if the arrangement were immersed in water (μ=1.33)?
6. A diffraction gratting 3cm wide produces the second order at 33° with light of wavelength 600nm. What is the total number of lines on the gratting.
7. What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels?
8. What are cardinal points of an optical system? Determine the equivalent focal length of a combination of two thin lenses separated by a finite distances.
9. A ring has a charge q uniform distributed in it. Derive an expression for the electric field at any point on the axial line of the ring. Extend your result to find the potential.

OR

Write an expression for electric field at any point in the axial line of a charged ring. Using this equation, calculate the electric field at any point in the axial line of a charged disk.

10. What is the magnitude of the electric field at the point (3,2) m if the electric potential is given by $V = 2x+5xy+3y^2$ volts. What acceleration does an electron experiences in the x-direction.

11. Derive an equation $\vec{J} = \sigma \vec{E}$. Explain why resistivity of a conductor increases with increasing temperature plot a graph between R_θ (Resistance at any temperature θ) and temperature. Based on the graph, explain what are superconductor? How they differ from perfect conductor? Describe the characteristics of superconductor.

12. Derive an expression for energy stored in magnetic field. Show that the energy stored per unit volume is directly proportional to the square of the magnetic flux density. Compare this result with electric energy density.

OR

What is self induction? Define inductance of a coil. Show by calculation inductance of a coil depends on the permeability of a medium and the geometry of the coil.

13. A long circuit coil consisting of 50 turns with diameter 1.2m carries a current of 10Amp. (a) Find the magnetic field at a point along the axis 90cm from the center. (b) At what distance from the center, along the axis, the field is 1/8 greater as at the center.

14. Describe the principal and working 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.

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

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 transmission coefficient of the beam through the barrier.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	All	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics *(SH 402)*

- ✓ 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. Show that the motion of torsion pendulum is angular harmonic motion. Also find its time period.

OR

Derive the differential equation of the forced oscillation of LCR circuit with an AC source and find the expression for the current amplitude. Hence explain the condition of current resonance in such circuit.

2. A 750g block oscillates on the end of a spring whose force constant, k=56N/m. The mass moves in a fluid which offers a resistive force F = -bv, where b = 0.162Ns/m. What is the period of the oscillation?

3. A room has dimensions 6m×4m×5m. Find:
   i) Mean free path of sound wave in the room
   ii) The number of reflections made persecond by the sound wave with the walls of the room. (Take velocity of sound in air= $350ms^{-1}$).

4. Define interference. Show that interference in thin film due to reflected and transmitted lights are complementary.

OR

What are Newton's rings? How can you determine the refractive index of given liquid using Newton's rings experiment?

5. Explain the dispersive and resolving power of a diffraction grating. Derive expressions and develop a relation between them.

6. A 200mm long tube containing $48cm^3$ of sugar solution produces an optical rotation of 11° when placed on a saccharimeter. If the specific rotation of sugar solution is 66°, calculate the quantity of sugar contained in the tube in the form of solution.

7. Prove that the condition for achromatism for the combination of two lenses of focal length f_1 and f_2 having dispersive power ω_1 and ω_2 placed at a separate distance x is $(\omega_1/f_1)+(\omega_2/f_2)=(x/f_1f_2)(\omega_1+\omega_2)$.

8. Differentiate between spontaneous and stimulated emission of radiation. Explain the construction and working of He-Ne laser with a suitable energy level diagram.

9. Derive an expression for the electric field 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?

10. A capacitor of capacitance 'C' is discharged through a resistor of resistance 'R'. After how many time constants is the energy stored becomes one fourth of initial value?

11. Calculate the electric field due to a uniformly charged rod of length l at a point along its long axis at a distance 'a' from its nearest end.

12. Explain the principle and working of cyclotron. Show that the time spent by the particle in a Dee is independent of its speed and radius of its circular path.

OR

Use Biot- Savart Law to calculate magnetic field on the axial line of a current carrying circular loop. Explain how the coil behaves for a large distance point.

13. A cooper strip 150μm thick is placed in a magnetic field of strength 0.65T perpendicular to the plane of the strip and current of 23Amp is set up in the strip. Calculate: (i) the Hall voltage (ii) Hall coefficient and (iii) Hall mobility, if the number of electrons per unit volume is $8.5\times10^{28}/m^3$ and resistivity is 1.72×10^{-8} Ohm-m.

14. A parallel plate capacitor with circular plates of 10cm radius is charged producing uniform displacement current of magnitude $20A/m^2$. Calculate (i) dE/dt in the region (ii) Displacement current density and (iii) Induced magnetic field.

15. Obtain an expression for energy transfer rate by electromagnetic wave. From your result show that $I \propto E^2_{rms}$. Where I is the intensity em wave and E_{rms} is root mean square value of electric field.

16. Derive the schrodinger time independent wave equation. Also what do you mean by a potential barrier?

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2068 Baishakh

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX, BCT, BEL, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	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 torsion pendulum? Describe how will you determine modules of rigidity of a thin metallic wire which supports the disc.

OR

LC oscillations are called em oscillations, why? Derive the differential equation for damped electromagnetic oscillations and find the amplitude and frequency of that oscillations.

2. Prove that if a transverse wave is travelling along a string then the slope at any point of the string is numerically equal to ratio of the particle speed to the wave speed at that point.
3. The time of reverberation of an empty hall and with 500 audience in the hall is 1.5 sec and 1.4 sec respectively. Find the reverberation time with 800 audience in the hall.
4. What are Haidengers Fringes? Describe the interference phenomena in wedge shape thin film and determine the relation of path difference.

OR

What is double refraction? Discuss, how we can recognize that the given light is plane polarized, circularly polarized, elliptically polarized or unpolarized.

5. Light is incident normally on a grating of total ruled width 5×10^{-3}m with 2500 lines in all. Find the angular separation of the sodium lines in the first order spectrum. Wavelengths of lenses are 589×10^{-9} m and 589.6×10^{-9} m. Can they be seen distinctly?
6. Plane polarized light is incident on a piece of quartz cut parallel to the axis. Find the least thickness for which the ordinary and extraordinary rays combine to form plane polarised light. Given, $\mu_0 = 1.5442$, $\mu_E = 1.5533$, $\lambda = 5 \times 10^{-5}$cm.
7. Show that the diameter of circle of least confusion depends on the diameter of lens aperture and the dispersive power of the material of the lens but is independent of the focal length of the lens.
8. Calculate the refractive indices of the core and cladding materials of a fiber from following data. Numerical Aperture (NA) = 0.22 and fractional refractive index change, $\Delta = 0.012$.

9. 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 x from the centre. Show that the motion of an electron is simple harmonic if electron is constrained to be in axial line of the same ring provided that $x << R$.

OR

If both charges of a dipole of charge Q and separation 2d are positive, show that the electric intensity at any point P at a distance r from the centre of such dipole for $r >> d$ is $E = \frac{2q}{4\pi^2 \epsilon_0 r^2}$.

10. Prove that the capacitance per unit length of a cylindrical capacitor various inversely with logarithm of ratio of external and internal radii. Obtain an expression for energy stored per unit volume in a parallel plate capacitor.

11. A copper wire of cross section area 5×10^{-6} m^2 carries a steady current of 50A. Assuming one free electrons per atom, calculate:

a) Free electron density and
b) Average drift velocity

Given: Density of copper = 8.9×10^3 Kg/m^3, Avogadro's No. 6.02×10^{23} mol^{-1}, Molar mass of copper = 64.

12. What is Ampere's law? Derive the expressions for magnetic flux density outside and inside a long straight conductor carrying a current, i.

OR

Describe cyclotron with necessary theory. Find the expression for maximum energy of a rotating particle in a cyclotron. Give limitations of cyclotron and how is it modified?

13. Find an expression of the self inductance of a toroid having N number of turns, radius r and carrying a current i.

14. 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/m.s. Also calculate displacement current density.

15. Write Maxwell's equations in integral form and explain the laws on which these equations are based. Convert them into differential form.

16. What is barrier tunneling? Discuss and write the Schrödinger wave equation in each regions. Also write the formula of transmission coefficient, T in this case.

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