24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2067 Ashadh

Exam.	Regular/Back		
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

- ✓ 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. Show that there are four collinear points within compound pendulum having same time period. Give their physical significance.

   OR

   Derive the differential equation of damped harmonic oscillation in LCR circuit. Solving the equation find the damped frequency of the oscillation and explain its significance.

2. A uniform circular disk whose radius R is 12.6cm is suspended as a physical pendulum from a point on its rim. (a) What is its period? (b) At what radial distance $r < R$. Is there a pivot point that gives the same period?

3. Define absorption coefficient of sound. Derive a relation between reverberation time and absorption coefficient for acoustically good hall.

4. Explain how interference fringes are formed by a thin wedge shaped film, when examined by normally reflected light. How will you estimate the difference of film thickness between two points?

   OR

   Show that the intensity of second order maxima of Fraunhoffer's single slit diffraction is $\frac{2}{5\pi}$ times the intensity of central maxima.

5. In Newton's ring arrangement a source emitting two wavelengths 6×10^{-7}m and 5.9×10^{-7}m is used. It is found that n^{th} dark ring due to one wavelength coincides with $(n+1)^{th}$ dark ring due to other. Find the diameter of the n^{th} dark ring if radius of curvature of lens is 0.9m.

6. Calculate the thickness of quarter wave plate for light of wavelength 5893Å. Given refractive indices of ordinary and extraordinary ray are 1.544 and 1.553 respectively.

7. Define acceptance angle of an optical fiber. Derive the relation for Numerical Aperture (NA) of the optical fiber. Also write down its significance.

8. 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.

9. Derive an expression for the electric potential at any point on the axis of the uniformly charged disk. Extend your result to calculate electric field.

   OR

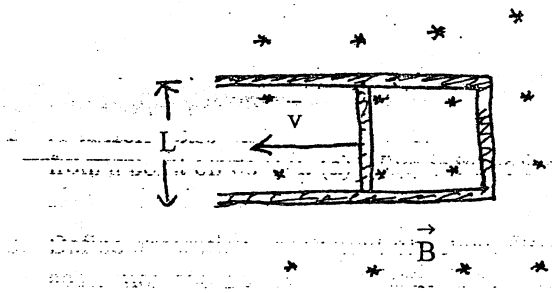
   Derive an expression for the electric field at any point on the axis of the short linear quadrupole.

10. A copper slab of thickness b is inserted into a parallel plate capacitor exactly half way between the plates. If the separation of the plate is d and the area of each plate is A, show that the change in capacitance is equal to $\frac{\epsilon_0 Ab}{(d-b)d}$.

11. What is the drift speed of the conduction electrons in a copper wire (molecular mass = 63.54 g/mol, density 8.96 g/cm^3) with radius 900 μm when it has a uniform current 17mA flowing in the wire?

12. A long straight wire of radius R carries a uniformly distributed current I. Calculate magnetic fields at any points inside and outside the wire.

13. The conducting rod shown in figure has length L and is being pulled along horizontal, frictionless conducting rails at a constant velocity $\vec{v}$. The rails are connected at one end with a metal strip. A uniform magnetic field $\vec{B}$, directed out of the page, fills the region in which the rod moves. Derive an expression for the rate of thermal energy being generated in the rod.



14. A coil has an inductance of 53 mH and a resistance of 0.35Ω. If a 12V emf is applied across the coil, how much energy is stored in the magnetic field after the current has built up to its equilibrium value? After how many time constants will half this equilibrium be stored in the magnetic field?

OR

In a certain cyclotron a proton moves in a circle of radius 0.5m. The magnitude of the magnetic field is 1.20T. What is the oscillator frequency? What is the kinetic energy of the proton in eV?

15. Define poynting vector. Prove that $\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$, where the symbols have their usual meanings.

16. An electron is trapped in an one dimensional infinite potential well of width 'a' such that

$V = \infty$ for $0 \le x$ and $x \ge a$
$V = 0$ for $0 < x < a$

Using boundary condition, prove that the total energy of the system is

$$E = \frac{\Pi^2 n^2 \hbar^2}{2ma^2}$$

Where symbols carry their usual meanings.

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