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 (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. Obtain an expression for the time period of a compound pendulum and show that its time period is unaffected by the fixing of a small additional mass to it at its centre of suspension.

OR

What is electromagnetic oscillation? Derive differential equation of damped LCR oscillation and find its frequency.

2. A particle is moving with simple harmonic motion in a straight line. If it has a speed v_1 when the displacement is x_1 and speed v_2 when the displacement is x_2 then show that the amplitude of the motion is, $a = \left[\dfrac{v_2^2 x_1^2 - v_1^2 x_2^2}{v_2^2 - v_1^2}\right]^{\frac{1}{2}}$.

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

4. Two coherent sources having constant phase δ but different amplitudes A_1 and A_2 superimpose, prove that the intensity of superimposed beam is $I = A_1^2 + A_2^2 + 2A_1 A_2 \cos\delta$.

OR

Explain the phenomenon of double refraction. Describe the construction and action of Nicol prism.

5. White light is incident on a soap film at an angle $\sin^{-1}\left(\dfrac{4}{5}\right)$ and the reflected light on examination by a spectrometer shows dark bands. The consecutive dark bands correspond to wavelength 6.1×10^{-5} cm and 6.0×10^{-5} cm. If $\mu = 1.33$ for the film, calculate its thickness.

6. Light of wavelength 600nm is incident normally on a slit of width 0.1mm. Calculate the intensity at $\theta = 0.2°$.

7. Two lenses of focal lengths 8cm and 4cm are placed at a certain distance apart. Calculate the position of principal points if they form an achromatic combination.

8. An optical fiber has a NA of 0.2 and a cladding refractive index of 1.59. Determine acceptance angle for the fiber in water which has a refractive index of 1.33.

9. A ring has a charge q uniformly distributed in it. Find the expression for the electric field at any point on the axial line of the ring. Locate the point at which the field is maximum.

OR

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

10. A particle of charge $-q$ and a 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 descries a SHM with

a period $T = \left[\dfrac{\epsilon_0 \, m\pi^3 d^3}{qq_0} \right]^{\frac{1}{2}}$.

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

12. A flat silver strip of width 1.5cm and thickness 1.5mm carries a current of 150A. a magnetic field of 2.0 Tesla is applied perpendicular to the flat face of the strip. The emf developed across the width of strip is measured to be $17.9\mu V$. Estimate the number density of free electrons in the metal.

13. A straight wire segment of length l carries current I. Show that the magnetic field B produced by that segment at a displace y from it along a perpendicular bisector is $B = (\mu_0 / 2\pi y) [l/(l^2+4y^2)]$.

14. Find the inductance of a toroid having N number of turns and radius R.

OR

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

15. State and explain Maxwell's equations. Derive the continuity equation: $\vec{\nabla}.\vec{J} = \dfrac{\partial \delta}{\partial t}$.

16. Determine the total energy of a particle using Schrodinger equation, when the potential energy has value V=0 for 0<x<a, and V=$\alpha$for x≤0 and x≥a.

***