Total No. of Questions—8] [Total No. of Printed Pages—4

BE-I/11(A)

236179

(New Course)

ENGINEERING PHYSICS—COURSE NO. BSC-102

Time Allowed—3 *Hours* *Maximum Marks*—100

Note : Attempt *five* questions in all, selecting at least *two* questions from each section. Each question carries **20** marks. Use of scientific calculator is allowed.

Section A

1. (*a*) Derive the equation of continuity $\nabla . \vec{J} + \frac{\partial P}{\partial t} = 0$. How does it lead to the concept of displacement current ? Explain its significance in Maxwell's equations of electromagentism. Show that it has dimensions of conventional current. 12

   (*b*) An electromagnetic wave propagates through a medium having relative permittivity 4 and relative permeability 1. Find the velocity of the wave. 8

2. (*a*) Explain the physical significance of a wave-function. Discuss the conditions and limitations, a wavefunction must obey. Derive time independent Schrödinger's wave equation and express it for a free particle also. 12

[*Turn over*

(*b*) Prove uncertainty relation for energy and time from position momentum uncertainty relation. 8

3. (*a*) Distinguish between free, damped and forced oscillations. Deduce the differential equation of a forced harmonic oscillator and find its solution. Discuss its different cases. 12

(*b*) Show that the ratio of the energy lost per cycle to the energy stored in the damped oscillator is $\frac{2\pi}{Q}$, where Q is the quality factor. 8

4. (*a*) Explain what is meant by the divergence of a vector field $\vec{A}$. Derive expression for Div $\vec{A}$ in Cartesian co-ordinates. Discuss its physical significance. 12

(*b*) Find the probability that a particle trapped in a box of width 'L' can be found between 0.1 L and 0.2 L for the ground and the first excited states. 8

Section B

5. (*a*) Describe drift and diffusion currents and derive Einstein's relation for a P-N junction. 12

(*b*) The resistivity of a doped silicon material is 9×10^{-3} Ωm. The Hall co-efficient is 3.6×10^{-4} m^3/C. Assume single carrier conduction, find the mobility and density of charge carriers. 8

6. (*a*) Differentiate between Fresnel and Fraunhofer's class of diffraction. Prove and explain the rectilinear propagation of light by using the concept of Fresnel's half period zones. 12

(*b*) Calculate the thickness of a doubly refracting crystal required to introduce a path difference of $\frac{\lambda}{2}$ between O and E rays when $\lambda = 6000$ Å, $\mu_o = 1.65$ and $\mu_E = 1.48$. 8

7. (*a*) Differentiate between :

(*i*) Laser and Ordinary light

(*ii*) Holography and Photography

Explain the principle of Holography. How is hologram produced and how is the image reconstructed from it. Discuss some of its applications. 12

(*b*) A glass clad fibre is made with core glass of refractive index 1.5 and the cladding is doped to give a fractional index difference of 0.0005. Find :

(*i*) Cladding index and

(*ii*) Numerical aperture. 8

8. (*a*) Obtain expressions for charge densities in *n*-type and P-type semiconductors. Give an expression for the mobility of a charge carrier. 10

(*b*) Describe the construction of a Nicol prism. Explain how it can be used as a polariser and as an analyzer. 10