



DPP-1429
M. Sc. (Sem. II) Examination
April / May - 2016
EL-423 : Electronics
(Electromagnetic fields & Waves)

Time : 3 Hours]

[Total Marks : 70

Instructions :

(1)

<p>नीचे दशांशवैल निशानीवाणी विगतो उत्तरवडी पर अवश्य क्षभवी. Fillup strictly the details of signs on your answer book.</p> <p>Name of the Examination : M. Sc. (SEM. 2)</p> <p>Name of the Subject : EL-423 : ELECTRONICS</p> <p>Subject Code No. : 1 4 2 9 Section No. (1, 2.....): Nil</p>	<p>Seat No. : □ □ □ □ □ □</p> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; text-align: center; margin-top: 10px;">Student's Signature</div>
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- (2) Symbols used have their usual meaning.
(3) Figures to the right indicate full marks.

1 Attempt any two questions :

- (a) State and prove Gauss theorem. Use the theorem to find expressions for the field strength due to an infinite uniform flat sheet of charge. 7
- (b) State and prove uniqueness theory of electrostatics regarding electric potential. Use it to prove that the electric field inside the conductor is zero. 7
- (c) What do you mean by plasma in general ? Derive the magneto-hydrodynamical equations. 7

2 Attempt any two questions :

- (a) Explain what is meant by a dipole, a quadrupole, and an octopole and show that the electric potential due to a linear quadrupole varies inversely as the cube of the distance. 7

- (b) (i) State and prove Gauss's law for dielectrics. 4
- (ii) A long straight wire, carrying uniform line charge λ , is surrounded by rubber insulation with outer radius a . Find the electric displacement. 3
- (c) (i) Define dielectric polarization. It is, though, defined geometrically. 4
- (ii) Explain dipole interaction and find expression for the torque on a dipole in the field of the other. 3
- 3** Attempt any **two** questions :
- (a) What is Ampere's law? Show how his law can be applied to find the magnetic field due to an indefinitely long straight conductor carrying a steady current. 7
- (b) (i) Distinguish between magnetic vector potential and magnetic scalar potential. 4
- (ii) Find the magnetic field having a distance s from a long straight wire carrying a steady current using Ampere's law. 3
- (c) (i) Compare Magnetostatics and electrosatics. 4
- (ii) Obtain the equation of continuity involving charge and current densities. Express it in a covariant form. 3
- 4** Attempt any **two** questions :
- (a) State Maxwell's equation for the electromagnetic field and obtain the wave equation for E and B in homogenous isotropic lossy materials. 7
- (b) (i) What do you mean by Gauge transformation ? Explain what is gauge freedom ? 4
- (ii) Find the phase velocity and the magnitude of the attenuation constant of plane waves at a frequency 10 GHz in polyethylene, given,
 $\epsilon_r = 2.3$, $\sigma = 2.56 \times 10^{-4}$ mho/meter and
 $\mu = \mu_0 = 4\pi \times 10^{-7}$ henry/meter. 3

- (c) (i) What is Skin depth δ ? What factors does it depend on? Derive an expression for δ for a medium of finite conductivity σ . 4
- (ii) Find the Skin depth δ for low frequency radio waves of wave length 3×10^8 meter in sea water the electrical conductivity $\sigma = 4$ ohm/meter. 3
- 5** Attempt any **two** questions :
- (a) Explain TEM, TE and TM modes of electromagnetic wave propagation. Obtain a relation between the free space wavelength for a rectangular wave guide. 7
- (b) (i) Discuss and deduce the retarded potential. 4
- (ii) A rectangular wave guide has dimension 2.5 cm and 5 cm. Determine guide wavelength λ , phase velocity and phase constant at a wavelength of 4.5 cm for dominant mode. 3
- (c) (i) Distinguish between the radiation by antenna and antenna arrays. 4
- (ii) What is physical meaning of radiation Resistance? Obtain its value for a dipole antenna and justify selection of $\lambda/2$ antenna on this basis. 3
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