Q2 (a) Find the expression for Electric field due to line charge.

Answer Page Number 37 of Text Book I

Q2 (b) In the region of free space that includes the volume, $2 < x, y, z < 3$,

$$D = \frac{2}{z^2}\left(yza_x + xza_y - 2xya_z\right)C/m^2 .$$

(i) Evaluate the volume integral side of the divergence theorem for the volume defined here.

(ii) Evaluate the surface integral side for the corresponding closed surface.

Answer Page Number 79 of Text Book I

Q3 (a) Derive an expression for calculating the capacitance of a parallel-plate capacitor.

Answer Page Number 150-151 of Text Book I

Q3 (b) A non uniform electric field is given by E= yi+xj+zk. Determine the work expended in carrying a charge of 2 column from B (1, 0, 1) to A (0.8, 0.6, 1) along the shorter path of circle x2+ y² =1, z=1.

Answer Page Number 150-151 of Text Book I

Q4 (a) Show that the capacitance varies inversely as the square root of the voltage.

Answer Page Number 186-187 of Text Book I

Q4 (b) Using the Laplace equation, find the capacitance per unit length of a capacitor formed by two concentric circular cylinders of radius a and b (a< b)

Answer

The Laplace‘s equation in cylindrical coordinates is

$$\frac{1}{y}\left(+ \frac{dv}{dy}\right) = 0.......................................(0)$$

Or

$$\frac{t}{dt}\left(+\frac{dv}{dt}\right)=0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Integrals, we get

$$+\frac{dv}{dt}=A \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$\frac{dv}{dt}=\frac{A}{t}$$

Integrate again , we get

$$\mathrm{V = A\ln t + B} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$$\mathrm{Act\ l = a, V = V_0}$$

$$l=b \qquad \mathrm{V = 0} \qquad\qquad \mathrm{b > a}$$

$$\therefore \mathrm{V = V_0 \frac{\ln\ b/t}{\ln b/a}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

$$As \qquad \mathrm{E = -\nabla V}$$

$$\therefore \mathrm{E = \frac{V_0}{t}.\frac{1}{\ln\ b/a}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

$$D/p=a\frac{Evo}{a\ln b/a} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

$$=\frac{EV_0\,2\pi aL}{a\ln b/a} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

$$C=\frac{2\pi\in L}{\ln b/a} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

Capacitince per unit length

$$\mathrm{C}=\frac{2\pi\in}{\mathrm{lnb/a}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)\,Ans.$$

Q5 (a) The magnetic vector potential in spherical coordinates is given by A=10r $\sin\theta\ I_\theta$. Find the flux density at $\left(2,\frac{\pi}{2},0\right)$.where I_θ is unit vector in the direction of θ.

Answer Page Number 218 of Textbook I

Q5 (b) Calculate curl H at origin, where

H= 2y i – ($x^2+z^2)j+3yk$

Answer

$Given A = 10r\sin\phi I\phi$

$$flux \text{ detecting } B = \nabla X A = \begin{vmatrix} \frac{I_r}{r^2} & \frac{I\phi}{r\sin\phi} & \frac{I\phi}{r} \\ \frac{t}{tr} & \frac{r}{r\phi} & \frac{r}{r\phi}0 \\ 0 & 10r\sin\phi & 0 \end{vmatrix}$$

$$= \frac{t}{tr}(10\,r\sin\phi).\frac{I\phi}{r} = \frac{10\sin\phi}{r} I\phi$$

$$B \text{ at} \left(2, \frac{\pi}{2}, 0\right) = \frac{10}{2}.\sin\frac{\pi}{2} = 5\,I\varphi$$

Q6 (a) Calculate the force between two linear, parallel, long conductors carrying currents in opposite direction.

Answer

$$f = I(de \times B)..............(1)$$

Force on conductor 2 due to current in conductor 1 is
Df =I'(de ×B)…………….(2)

Where de is element of conductor 2 . and B- field due event I.

$$\frac{\mu o I}{2\pi R}.........................(3)$$

B= *putine.g*................(2)

$$df = I^1 \times \frac{\mu o I}{2\pi R_1} = I^1 \times \frac{\mu o I}{2\pi R_1}\int_0^l dl = \frac{II^1 \mu o l}{2\pi R_1}$$

This face well act towards right:
Force on conductor 1 due to current I' in conductor 2 will be same due to symmetry but it will act towards left.

Force pen unit length is

$$\frac{f}{e} = \frac{\mu I I^1}{2\pi R}...........(5)$$

$if\;\; I = I^1$

$$\frac{f}{e} = \frac{\mu o I^2}{2\pi R}$$

Q6 (b) Calculate self inductances and mutual inductances between two co-axial

Answer
The mutual inductance is

$M_{12} = M_0 n_1 n_2 \pi R_1^2 = M_{21}$

$n_1 = n/d$

$and H_1 = n_1 l_1 K (0 < r < R_1)$

$= 0 \qquad \mathrm{r} > R_2$

$$\phi_{12} = \mu_0 n_1 I_1 R_1^2 and M_{12} = \mu n_1 n_2 \pi R_1^2$$
$$R_1 = 2cm, R_2 = 3cm n_1 = 5000 tuns/m, n_2 = 8000 tunns/m$$
$$\therefore M_{12} = 4\pi \times 10^{-2} \times 5000 \times 8000 \times \pi \times (0.02)^3 = 63.2 mn/m$$

$$self \text{ inductence } \mathrm{L}_1 = M_0 n_1^2 s_1 d \qquad \mathrm{s}_1 = \pi R_1^2$$

field $self$ inductence per unit length $\mathrm{L}_1 = M_0 n_1^2 s_1 = \dfrac{4\pi}{7} \times 10^{-7}.(5000)^2.22 \times (0.02)^2$

$$= 39.5 mh/m$$
$$simililarly L_2 = \mu_0 x_2^2 s_2^2$$
$$= 4\pi \times 10^{-7} \times (8000)^2 . \frac{22}{7} \times (0.03)^2$$
$$= 22.7 \text{ mH/m}$$

Q7 (a) Let $\mu = 10^{-5}$ H/m, $\in = 4 \times 10^{-9}$ F/m, $\sigma = 0$ **and** $\rho_v = 0$. **Find k (including units) so that each of the following pairs of fields satisfies Maxwell's equations:**

(i) $\overline{D} = 6\bar{a}_x - 2y\bar{a}_y + 2z\bar{a}_z \text{ nC/m}^2$, $\overline{H} = kx\bar{a}_x + 10y\bar{a}_y - 25z\bar{a}_z$ A/m

(ii) $\overline{E} = (20y - kt)\bar{a}_x$ V/m, $\overline{H} = (y + 2 \times 10^6 t)\bar{a}_z$ A/m

Answer Page Number 319 of Text Book I

Q7 (b) Explain briefly about Retarded Potentials.

Answer Page Number 321 of Text Book I

Q8 (a) Describe the following terms in connection with electro-magnetic waves:
(i) Transverse Waves (ii) Power density (iii) Wave impedance (iv) Polarization

Answer
(i) Page Number 224 of Text Book II

(ii) Power density is inversely proportional to the square of the distance from source. It is defined as radiated power per unit area. Mathematically $P=P_t / 4(3.14)\ r^2$

P_t = Transmitted Power, P= Power density at a distance from isotropic source

(iii) Wave impedance is define as $\sqrt{\frac{\mu}{\in}}$ its is shown that

(iv) Page Number 226 Textbook II

Q8 (b) Discuss the characteristics of antennas isolated from surfaces which will alter or change their radiation patterns and efficiency

Answer Page Number 258 of Text Book II

Q9 (a) Explain the radiation resistance of an antenna.

Answer Page Number 264 of Textbook II

Q9 (b) With sketch, describe the feed mechanism of a parabolic reflector

Answer Page Number 284 of Textbook II

Q9(c) Write short notes on:
(i) Horn Antenna
(ii) Helical Antenna

Answer
(i) Horn Antenna - Page Number 290 of Textbook II

(ii) Helical Antenna - Page Number 297 of Textbook II

Text Books

1. Engineering Electromagnetics, W. H. Hayt and J. A. Buck, Seventh Edition, Tata McGraw Hill, Special Indian Edition 2006.

2. Electronic Communication Systems, George Kennedy and Bernard Davis, Fourth Edition (1999), Tata McGraw Hill Publishing Company Ltd.