[Total No. of Questions - 5] [Total No. of Printed Pages - 3]
(2123)

1403

B. Tech 5th Semester Examination

Electromagnetic Field Theory (O.S.)

EC-5002

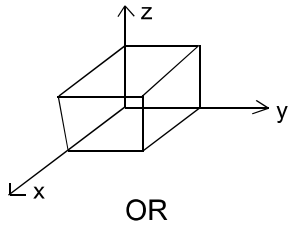
Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Candidates are required to attempt five questions in all. Selecting one question from each of the sections A, B, C & D. Section E is compulsory.

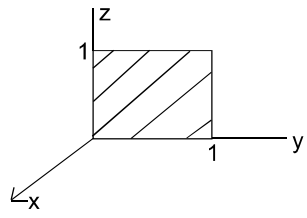
SECTION - A

1. Check the divergence theorem using the function $\vec{V} = y^2\,\hat{i} + (2xy + z^2)j + (2yz)\hat{k}$ and the unit cube situated at the origin. **(20)**



OR

Test Stoke's theorem for the function $\vec{V} = (2xz + 3yz)\,\hat{j} + (4yz^2)\,\hat{k}$, using the square surface shown in figure. **(20)**



SECTION - B

2. In free space, Let Q_1 = 10nC be at $P_1(0, -4, 0)$ and Q_2 = 20nC be at $P_2(0, 0, 4)$. (i) Find $\vec{E}$ at the origin (ii) where should a 30 nC point charge be located so that $\vec{E}$ = 0 at the origin? **(10×2=20)**

OR

(a) State and explain the ampere's circuital law for steady currents. Mention its applications and limitations. **(10)**

(b) Find the magnetic field intensity at centre of a square loop conductor of side L carrying a current of I amps. **(10)**

SECTION - C

3. (a) State the maxwell's correction to the Ampere's law for the steady currents and derive this correction from the equation of continuity. **(10)**

(b) Using the Gauss law, ohm law and equation of continuity, show that the charge density ρ that existed within a conductor decreases to 1/e times its initial value in a time ε/σ. What is the value of this time for copper? **(10)**

OR

(a) Differentiate the Poynting theorem from the complex Poynting theorem. Give a proof for the complex Poynting theorem. **(10)**

(b) A 50V voltage generator at 20 MHz is connected to the plates of an air dielectric parallel plate capacitor with plate area 2.8 cm^2 and separation distance 0.2 mm. Find the maximum value of displacement current density and displacement current. **(10)**

SECTION - D

4. (a) Derive the transmission line equations in time domain and phasor domain. **(10)**

(b) A transmission line of length 70 m is terminated in a impedance of $Z_r = 125 + j\,48$. If the frequency is 3 MHz and the characteristics impedance is 230 Ω, find the sending impedance. **(10)**

OR

(a) Derive an expression for the input impedance of a lossless line which is terminated by (i) a load Z_L (ii) an open circuit. **(10)**

(b) A telephone line has R = 10 Ω/km, L = 0.0037 H/km, C = 0.0083 μF/km and G = 0.4×10^{-6} $\mho$/km. Determine Z_0, α and β at 1 KHz. **(10)**

SECTION - E

5. (i) Write down the relation for spherical to cylindrical transformation.

(ii) Write the expression for divergence in spherical coordinates.

(iii) Define surface charge density.

(iv) What is electric flux?

(v) Write the relation of energy density in electrostatic field $\vec{E}$.

(vi) Find the capacitance between two concentric spherical shells.

(vii) Write the expression for energy stored in the magnetic field.

(viii) Write the Ampere's circuital law in integral form.

(ix) What is the Faraday's law of induction?

(x) Define the standing wave ratio. **(2×10=20)**