BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: IV**
BRANCH: ECE **SESSION : SP/2019**

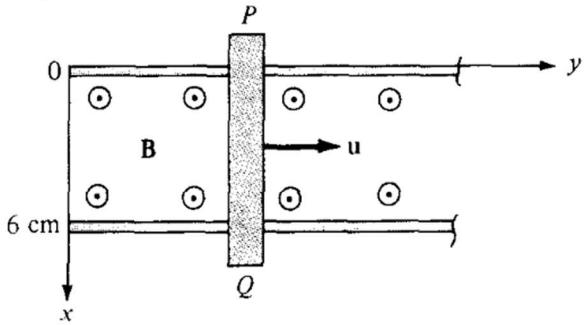
SUBJECT : EC4207 ELECTROMAGNETIC THEORY

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Differentiate between conservative and non-conservative fields considering an example of a suitable circuit. [2]

(b) A conducting bar can slide freely over two conducting rails as shown in Figure. Calculate the induced voltage in the bar, if the bar slides at a velocity $\mathbf{u} = 20\mathbf{a}_y$ m/s and $\mathbf{B} = 4\cos(10^6 t - y)\mathbf{a}_z$ mWb/m^2. [3]



Q2 (a) Justify the existence of displacement current in the context of wireless communication. [2]

(b) Why displacement currents are ignored in good conductors? The conduction current flowing through a wire with conductivity $\sigma = 2 \times 10^7$ S/m and relative permittivity $\epsilon_r = 1$ is given as $I_c = 2 \sin \omega t$ mA. If $\omega = 10^9$ rad/s, find the displacement current. [3]

Q3 (a) Write down the boundary conditions between a dielectric and a perfect conducting media. [2]

(b) In a three dimensional lossless dielectric medium, divided into region 1 ($x < 0$) and region 2 ($x > 0$), $E_1 = 1\,a_x + 2a_y + 3a_z$. Find E_2, and D_2. Given, $\epsilon_{r1} = 1$ and $\epsilon_{r2} = 2$. [3]

Q4 (a) Explain the concept of retarded potentials. Why this needs to be considered for time varying fields? [2]

(b) Let $A = A_0 \sin(\omega t - \beta z)\, a_x$ Wb/m in free space. (a) Find V and E. (b) Express ß in terms of ω, ϵ_0 and μ_0. [3]

Q5 (a) List the characteristics of a linear, homogeneous and isotropic medium. [2]

(b) Determine the magnitude of the electric field for the plane wave propagating at frequency f = 0.3 GHz in a lossless medium characterized by $\mu = \mu_0$ and $\epsilon = 9\,\epsilon_0$ if the amplitude of the magnetic field is 2 A/m. Also determine the propagation constant. [3]

Q6 (a) Why hollow tubular conductors are used instead of solid conductors in high frequency applications? [2]

(b) What is a uniform plane wave? A plane wave with a frequency of 2 MHz is incident upon a copper conductor normally. The wave has an electric field amplitude of E = 2 mV/m. Copper has $\mu_r = 1$, $\epsilon_r = 1$ and $\sigma = 5.8 \times 10^7$ S/m. Find the average power density absorbed by the copper conductor. [3]

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