

NATIONAL EXAMS, DECEMBER 2008

04-BS-9, BASIC ELECTROMAGNETICS

3 Hours Duration

Notes

- 1 If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made
- 2 Candidates may use one of two calculators, the Casio or Sharp approved models This is a closed book exam
- 3 Any five questions constitute a complete paper Only the first five questions as they appear in your answer book will be marked
- 4 All questions are of equal value
- 5 Aids $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$, $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$ $e = 1.6 \times 10^{-19} \text{ C}$

- 1 A positive point charge $+4e$ is located at the centre of a square of 3×10^{-10} m sides. Negative charges $-e$ are located in the corners of the square. What is the magnitude and direction of the electric field acting on one of the negative charges?

- 2 Radii of inner and outer conductors of a coaxial line are 3 mm and 6 mm. The medium between the conductors is a dielectric of relative permittivity 2.5. The voltage between the two conductors is 10 volts, the outer conductor being negative.
 - (i) determine the charge on the outer conductor of a 1 m long section of infinite transmission line and,
 - (ii) calculate the capacitance of the section.

- 3 The uniform electron density in a long circular beam of 1 mm radius is 10^{13} per meter³. The electrons move with uniform velocity of 10^7 m/s. What are
 - (i) the total current of the beam and,
 - (ii) magnetic flux density B on the surface of the beam?

- 4 A current loop consists of two semicircles of 25 cm radius and common center located in the origin of a Cartesian coordinate system. One of the semicircles lies in the $x - y$ plane, the other in the $x - z$ plane with the junction of the two semicircles on the x axis at $x = \pm 25$ cm. A 5 ampere current circulates in the

loop Viewed from a point on the positive z-axis the current circulates clockwise
Determine the direction and magnitude of the magnetic flux density vector \vec{B} at
the center of the loop

- 5 A square loop of 10 cm sides lies in a vertical plane which rotates about a vertical axis at 3600RPM A uniform constant magnetic field of 0.5 teslas is inclined at 30° to the horizontal What is the RMS electromotive force induced in the loop?
- 6 A linearly polarized 10^4 MHz plane wave propagates in a medium of relative permittivity 9 Power density of the wave is 0.1 W/m^2 What are
(i) the RMS value of the electric field and,
(ii) the wavelength of the wave in the medium?
- 7 A 10cm x 10cm square is located in a vertical plane with two of its sides vertical and two horizontal A 5 ampere current circulates in the loop A horizontal magnetic field of 0.2 teslas is inclined at 30° to the plane of the loop What is the magnitude of the torque exerted by the magnetic field on the loop?
- 8 A parallel plate capacitor consists of metallic parallel circular plates of 5cm radius separated by a 2mm wide gap completely filled by dielectric of relative permittivity 2.5 A field of 10^6 volts/m exists inside the capacitor What is the value of electric energy stored in the capacitor?