DOON UNIVERSITY, DEHRADUN

Mid Semester Examination, Second Semester, 2015-16

School of Physical Sciences

Core Physics test paper of 5 Years (Integrated) MSc Programmes

Course: PHC-151: Electricity & Magnetism (Elective)

Time Allowed: 2Hours   *Maximum Marks: 30*

Note: Attempt All Questions from Sections A, B, C.

SECTION: A   *(Marks: 1 X 6 =6)*

1. Define an ideal voltage source.
2. The dielectric constant of water is 80. Calculate its electrical permittivity.
3. By saying that the electrostatic field is conservative, we do not mean that
   (a) It is the gradient of a scalar function ($\nabla.V$) (b) Its circulation is identically zero
   (c)The work done in a closed path inside the field is zero (d) The potential difference between any two points is zero
4. Which of the following is not a source of magnetostatic fields?
   (a) current in a wire (b) A permanent magnet (c) an accelerated charge (d) a charged disk rotating at uniform speed
5. The dielectric constant of a polar dielectric (a) higher (b) smaller (d) same as that of a non polar molecule.
6. The unit of magnetic flux density is the weber. (True or False)

SECTION: B   *(Marks: 4 X 3=12)*
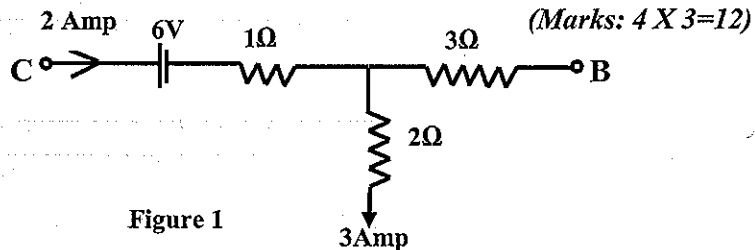
7. (a) Calculate V_{CB}

Figure 1

   (b) What is Ampere's Law? Apply the law for calculating the magnetic field for a toroid, with the direction of the magnetic field.

8. What is impedance of a series R, L and C circuit and discuss serial resonance.

OR

9. By applying Thevenin's theorem across points AB, calculate voltage across 10 Ω Resistor.
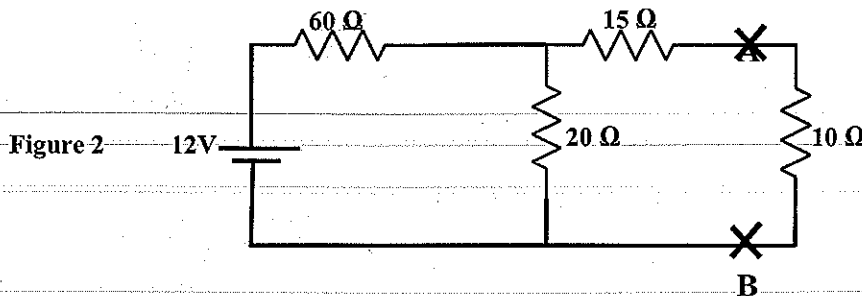

Figure 2

10. Apply uniqueness theorem for conductors. Differentiate between Poisson's and Laplace equation. How does Poisson's equation behave for a conductor?

11.   Solve the following parts:

(a) The potential of a certain charge configuration is expressed by $V = 5x + 10y^2 + 2yz$. Find the electric field intensity at (5, 2, 1).

(b) Show that the force between two charges separated by a distance is reduced by a factor $\dfrac{1}{1 + P/\varepsilon_0 E}$ due to presence of a dielectric.

(c) A test charge $q = 3.2 \times 10^{-19}$ C is moving with linear velocity $\vec{v} = (2i + 2j)$ m/s in a combined electric and magnetic field of intensity $E = (3i + 6j + k)$ N/C and $\vec{B} = (2j + 3k)$ T, respectively. Calculate the force experience by the test charge.

(d) Explain the method of images briefly. A point charge $+q$ is placed in front of an infinite conducting plane connected to earth. Determine the electrical potential at any point near the conducting plane using method of images.

(e) Explain the behaviour of a dielectric material when it is placed in a uniform electric field between the two plates of a capacitor.