18-12-2015

DOON UNIVERSITY, DEHRADUN

End Semester Examination, First Semester, 2015

Department of Physics, School of Physical Sciences

M.Sc. Physics 2 Years

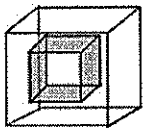
Course: PHC-403: Electromagnetic Theory

Time Allowed: 3 Hours *Maximum Marks: 30*

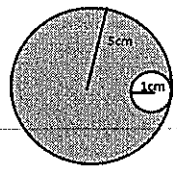
Note: Attempt All Questions from Sections A,B,C.

SECTION: A *(Marks:2 X 4 =8)*

1. A cube of side length 1 m is enclosed within a bigger cube of side length 2m having planes parallel for both the cubes with the same inversion centre. The inner cube is charge in such way: The xy-plane faces have +5 C and -5 C charges respectively, The yz-plane faces have +2 C and -2 C charges respectively and the zx-plane faces have +1 C and -1 C charges respectively.Find out the total flux of electrostatic field passing through the outer cube.



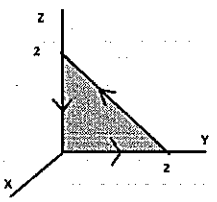
2. A disk shaped object of radius 5 cm is charged with charge density of $2/\pi$ C/m^2. The disk has a circular cavity of radius 1 cm touching its circumference as shown in the figure. Whal will be the electric field intensity and direction at the centre of the bigger disk.



3. An electron is passing through a homogeneous magnetic field of strength 50 Tesla with the velocity of 200 m/s perpendicular to the magnetic field. What will be the work done by the magnetic field in the time span of 10 seconds.
4. Write down the postulates of special theory of relativity.

SECTION: B *(Marks: 3 X 4=12)*

5. Test Stoke's theorem for the function $\vec{v} = xy\hat{i} + 2yz\hat{j} + 3zx\hat{k}$ using the triangle shaded area of the figure:



6. Express the potential in at some position **r** due to an arbitrary charge density distribution in the form of summation of the powers of r^{-n}. Hence, recognize the quadrupole term in this expansion.
7. (a) Explain the concept of susceptibility, permittivity and dielectric constants in the linear dielectric matter.
   (b) A metal sphere of radius a carries a charge Q. It is surrounded, out to radius b, by linear dielectric material of permittivity ε. Find the potential at the centre relative to the infinity.
8. Write down the differential and integral forms of the Maxwell's equations in the magnetic and polarisable media.

SECTION: C *(Marks: 5 X 2=10)*

9. Explain the behaviour of effective relative permittivity and conductivity under the wave propagation phenomenon. Compare the results for different ranges of the frequency ω.

10. (a) Construct terms of field tensor. Hence, show the relativistic transformation of electrostatic and magnetic fields and potentials.

(b) Inertial frame S' moves at constant velocity $\vec{v} = \beta c(\cos\varphi\hat{i} + \sin\varphi\hat{j})$ with respect to the frame S. Their axes are parallel to one another, and their origins coincide at t = t' = 0. Find the Lorentz transformation matrix for this case.