18U406 (Pages: 3) Name: ……

Reg. No……..

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2020

(CUCBCSS-UG)

(Regular/Supplementary/Improvement)

CC15U PH4 B04 - ELECTRODYNAMICS - I

(Physics - Core Course)

(2015 Admission onwards)

Time: Three Hours Maximum: 80 Marks

Section A

Answer ***all*** questions. Each question carries 1 mark.

1. The flux through any surface enclosing the charge is given by ……
2. The normal derivative of electric potential is ……across a boundary.
3. If a conductor is placed in an electric field $\boldsymbol{E}$ with charge density $\boldsymbol{\rho}$, the net charge density inside the conductor will be ……
4. According to Laplace's equation the extreme values of $\boldsymbol{V}$ occur at ……
5. In an external electric field, if the dipoles are pointing along the direction of the field, the material is said to be ……
6. The average electric field inside a dielectric sphere of polarization $\boldsymbol{P}$ is ……
7. The direction of magnetic field due to an infinite straight thin current carrying wire can be found using …… law
8. Divergence of vector potential $\boldsymbol{A}$ is ……
9. The atoms or molecules with odd number of electrons are normally …… materials.
10. The magnetization path traced out by the ferromagnet on the application and removal of magnetic field is called ……

(10 x 1 = 10 Marks)

Section B

Answer ***all*** questions. Each question carries 2 marks.

11. Explain the need of placing an apparatus inside a grounded Faraday cage.
12. What is the significance of the method of images in electrostatic problems?
13. Define induced surface charge.
14. Write done the linear relationship between $\boldsymbol{P}$ and $\boldsymbol{E}$ for an asymmetric molecule.
15. Explain the work done by magnetic forces.
16. Distinguish between electrostatic and magnetostatic fields.

17. Derive an expression for magnetic force (in terms of current) on a current carrying wire.

(7 x 2 = 14 Marks)

Section C

Answer any ***five*** questions. Each question carries 4 marks.

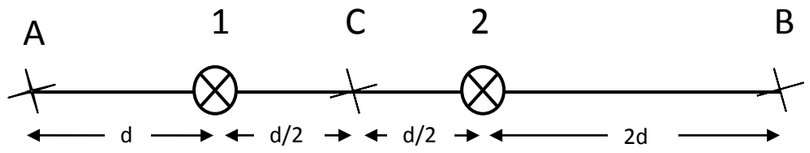
18. Discuss the advantages of electrostatic potential formulation.
19. Derive an expression for the electrostatic pressure on the surface of a conductor with surface charge density $\boldsymbol{\sigma}$.
20. State and explain the uniqueness theorem.
21. Explain the significance of Laplace's equation and its solution in two dimensions.
22. What do you understand by susceptibility and susceptibility tensor?
23. From Biot-Savart law, derive the divergence and curl of magnetic field.
24. Explain the effect of magnetic field on atomic orbits.

(5 x 4 = 20 Marks)

Section D

Answer any ***four*** questions. Each question carries 4 marks.

25. Particle 1 of charge $\boldsymbol{q_1}$ = 1.00 pC and particle 2 of charge $\boldsymbol{q_2}$ = - 2.00 pC are fixed at a distance $\boldsymbol{d}$ = 5.00 cm apart. In unit vector notation, what is the net electric field at points A, B, C in the given figure and sketch the electric field lines.



26. A disk has radius $\boldsymbol{R}$ = 2.20 cm. Its surface charge density is 1.5 x 10^{-6} C/m^2 from $\boldsymbol{r}$ = 0 to $\boldsymbol{r}$ = $\boldsymbol{R}$/2 and 8.00 x 10^{-7} C/m^2 from $\boldsymbol{r}$ = $\boldsymbol{R}$/2 to $\boldsymbol{r}$ = $\boldsymbol{R}$. What is the total charge on the disc?
27. A coaxial cable used in a transmission line has an inner radius of 0.10 mm and an outer radius of 0.6 mm. Calculate the capacitance per meter of the cable, if the space between the conductors is filled with polystyrene (ε_r = 2.5).
28. A neutral water molecule in its vapor state has an electric dipole moment of 6.2 x 10^{-30} Cm. How far apart are the molecules centers of positive and negative charge? Calculate the maximum torque that an electric field of 1.5 x 10^4 N/C can exert on it?
29. A straight horizontal length of copper wire, of linear density 46.6 g/m, has a current $\boldsymbol{I}$ = 28 A through it. What are the magnitude and direction of the minimum magnetic field $\boldsymbol{B}$ needed to suspend the wire, i.e. to balance the gravitational force on it?
30. A square loop of edge length 2 cm carries a current 1 A. Calculate the magnitude of the magnetic field produced at a point 5 cm, on the central perpendicular axis of the loop from its center.
31. A paramagnet in the form of a cylindrical rod has a length of 5.00 cm and a diameter of 1.00 cm. It has a uniform magnetization of 5.3 x 10^3 A/m. What is its magnetic dipole moment?

(4 x 4 = 16 Marks)

Section E

Answer any ***two*** questions. Each question carries 10 marks.

32. Derive the expression for energy of a point and continuous charge distributions and evaluate the energy of a uniformly charged spherical shell of total charge $\boldsymbol{q}$ and radius $\boldsymbol{R}$.
33. Derive the expression for the work done by the battery, connected to the capacitor, to maintain the capacitor at fixed potential.
34. Derive the expression for magnetic field at a distance $\boldsymbol{z}$ vertically above a infinitely straight current carrying conductor and evaluate the nature and direction of force acting per unit length between two such conductors kept at a distance $\boldsymbol{R}$ apart.
35. Define magnetization. Derive the expression for magnetic field due to a magnetized object and explain the physical interpretations of bound charges and bound currents.

(2 x 10 = 20 Marks)

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