National University of Computer and Emerging Sciences

Lahore Campus

Applied Physics (NS1001)

Date: 30-05-2025

Course Instructors:

Hufsa & Faizan

Final Exam: BS (CS), BS(SE) & BS(DS)

Total Time (Hrs): 3

Total Marks: 80

Total Questions: 4

Roll No _____ Section _____ Student Signature _____

Instructions: **Attempt all questions.**

Solve Questions 1-4 in the answer booklet. Solve questions in sequence.

Constants: k (coulomb's constant) = 8.99×10^{9} Nm^2/C^2 and $\varepsilon_o = 8.854\times10^{-12}$ C^2/Nm^2, proton mass = 1.67×10^{-27} kg, electron/proton charge= 1.6×10^{-19} C, $\mu_o = 4\pi\times10^{-7}$ T.m/A

CLO # 03 (Statement: Apply laws of electrostatics for different applications of electric charge/field distributions)

Question 1 [Total Marks: 20]

Q1(a): Consider a spherical capacitor formed by two coaxial spheres of radii 'a' and 'b'. Each plate contains a charge of magnitude 'q'. Apply Gauss's law and calculate a mathematical expression of its capacitance. Also, draw its illustration. **(5+5=10 marks)**

Q1(b): A 100 pF capacitor is charged to a potential difference of 50 V, and the charging battery is disconnected. The capacitor is then connected in parallel with a second (initially uncharged) capacitor. If the potential difference across the first capacitor drops to 35 V, what is the capacitance of this second capacitor? **(5 marks)**

Q1(c) In the figure, the battery has a P.D. of V=10V, and the five capacitors each have a capacitance of 10 microfarad. Calculate the charge on capacitor 2. **(5 marks)**

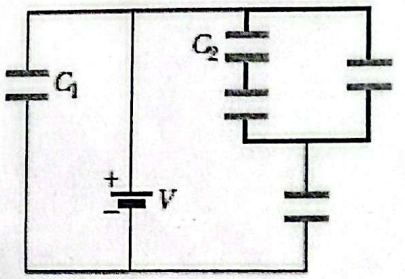

Figure 1

CLO # 03 (Statement: Apply laws of electrostatics for different applications of electric charge/field distributions)

Question 2 [Total Marks: 20]

Q2(a): The current density through a cross section varies with radial distance r as $J = ar^2$, where $a = 3.0 \times 10^{11}$ A/m^4 and r is in meters. What is the current through the outer portion of the wire between radial distances $R/2$ and R (Fig. 2) (**10 marks**)

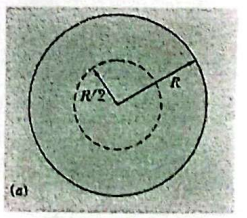

Figure2

Q2(b): Derive a formula that shows a relationship between current density and the drift speed of charged particles. Also, draw its illustration. **(5+5 =10 marks)**

CLO # 04 (Statement: Explain the interaction between electric & magnetic fields with different applications)

Question 3 [Total Marks: 20]

Q3(a): A strip of copper carrying a current '***i***' and is immersed in a magnetic field. A potential which is called 'Hall Potential' (***V***) will be developed with the electric field across the strip of width '***d***', and thickness '***l***'. Calculate a formula for finding the number of charge carriers per unit volume '***n***', representing Hall potential, magnetic field, thickness, and current. Draw an illustration of Hall's effect and represent 'developed potential'. **(5+5=10 marks)**

Q3(b): A straight, horizontal length of copper wire has a current i = 28 A through it. What are the magnitude and direction of the minimum magnetic field ***B*** needed to suspend the wire—that is, to balance the gravitational force on it? The linear density (mass per unit length) of the wire is 46.6 g/m. **(10 marks)**

CLO # 04 (Statement: Explain the interaction between electric & magnetic fields with different applications)

Question 4 [Total Marks: 20]

Q4(a): Apply Ampere's law to find out magnetic field inside a long straight wire carrying current "***i***". Use integrations for the Amperian loop. Draw an illustration as well. **(5+5=10 marks)**

Q4(b): **Figure *3*** shows the cross section of a long conducting cylinder with inner radius ***a* = 2.0 cm** and outer radius ***b* = 4.0 cm**. The cylinder carries a current out of the page, and the magnitude of the current density in the cross section is given by $J = cr^2$, with c = 3.0 × 106 A/m^4 and r in meters. What is the magnetic field ***B*** at the dot in the Figure, which is at radius r = 3.0 cm from the central axis of the cylinder? **(10 marks)**

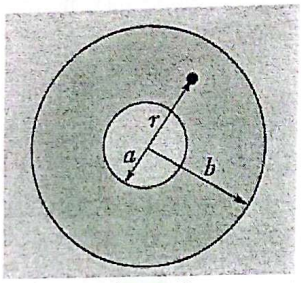

Figure 3