Quiz # 06

Chapter # 25 (Capacitance)

Topics Included:

- Capacitance
- Parallel Plate Capacitor
- Cylindrical & Spehrical Capacitors
- Capacitors in Parallel & Series
- Numerical Problems.

National University of Computer and Emerging Sciences

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QUIZ 6 — 25F-0755

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Semester 01 Class BCS-1B Section 1B

CLO 3	*Calculate electric fields, capacitance, and electric forces by applying the principles of electrostatics.*

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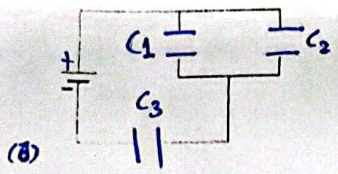
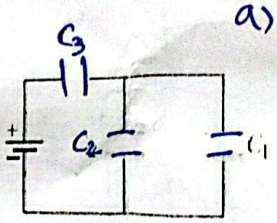
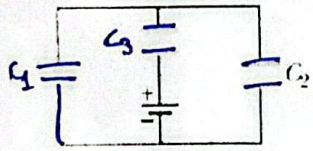
Q1. Rank the equivalent capacitances of the four circuits shown in following figure, greatest first. [4 Marks]



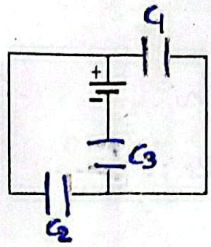
(a)



(b)



(c)



(d)

a) ⇒ $C_1 + C_2$

$$\frac{1}{C_1+C_2} + \frac{1}{C_3} = \frac{C_3+C_1+C_2}{C_1C_3+C_2C_3} \rightarrow a$$

b ⇒ $C_1 + C_2$

$$\frac{1}{C_1+C_2} + \frac{1}{C_3} = \frac{C_3+C_1+C_2}{C_1C_3+C_2C_3} \rightarrow b$$

c ⇒

d ⇒

Result / Answer:

$$C_c > C_b > C_d > C_a \rightarrow c > b > d > a$$

Q2. A solid, cylindrical conductor of radius a and charge Q is coaxial with a cylindrical shell of negligible thickness, radius b, and charge -Q. Find the capacitance of this cylindrical capacitor if its length is L. [6 Marks]

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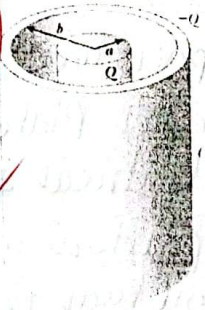

① Assume charge q.

② Electric field by Gauss law:

$$\phi_E = \frac{q_{enclosed}}{\varepsilon_0}$$

$$\oint \vec{E}\cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

$$E \oint dA = \frac{q}{\varepsilon_0} \quad (\because \cos 0^\circ = 1)$$

$$EA = \frac{q}{\varepsilon_0}$$

$$E = \frac{q}{A\varepsilon_0}$$

$$E = \frac{q}{2\pi r L \varepsilon_0} \quad (\because A = 2\pi r L)$$

③ now using potential gradient.

$$V = -\int_{-}^{+} \vec{E}\cdot d\vec{s}$$

$$V = -\int_{-}^{+} E\,ds \cos 180^\circ$$

$$V = \int_{-}^{+} E\,ds \quad (\because \cos 180^\circ = -1)$$

$$V = \int_{-}^{+} E\,ds$$

$$V = \int_{-}^{+} \frac{q}{2\pi r L \varepsilon_0}(-dr) \quad (\because ds = -dr)$$

$$V = \frac{-q}{2\pi L \varepsilon_0}\int_{-}^{+} \frac{1}{r}\,dr$$

$$V = \frac{-q}{2\pi L \varepsilon_0} \ln r \Big|_b^a$$