University of Tlemcen
Faculty of Sciences
1st Year LMD-M and MI

Academic Year 2023/2024
Saturday 25/05/2024
Duration : 01 h 30mn

Final Exam of Electricity

(Calculatrice autorisée)

Course questions: (6pts)

1- A metal sphere (**S**) of radius **R** and very thin thickness is initially isolated. A point charge +q is approached to a distance **(2R)** from the center of sphere **S**. A new state of equilibrium is established. Show that the sphere becomes negatively charged when (**S**) is connected to earth. Calculate this charge.

2- Consider a capacitor formed by two parallel planes (armatures) with the same surface area S, separated by a distance **e**. One carries a positive density charge **(+σ)**, while the other carries a negative density charge **(-σ).** Knowing that the electric field created by a plane charged on the surface by a surface density **σ**, is given by $\mathbf{E=\sigma/2\varepsilon_0}$.

- Give the expression for the electric field between the two armatures.
- Deduce the expression for its capacitance

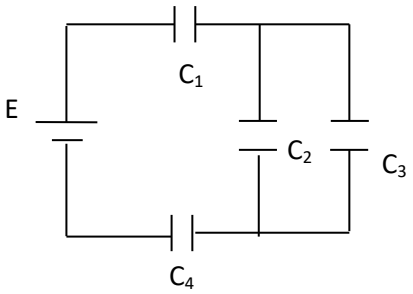
3- What does the current density **J** represent, and what is its relationship to the dielectric conductivity **σ** and the electric field **E**?

4- Write the form of the elementary electric field $\overrightarrow{dE}$ in the case of a linear charge distribution.

Exercise 1: (06 pts)

Consider the capacitor array shown in the following figure:

1- Determine the equivalent capacitance of the circuit.
2- Calculate the electrical charge carried by each capacitor.
3- Calculate the voltage across the armatures of each capacitor of the circuit.
4- Calculate the energy stored by capacitor C_1.



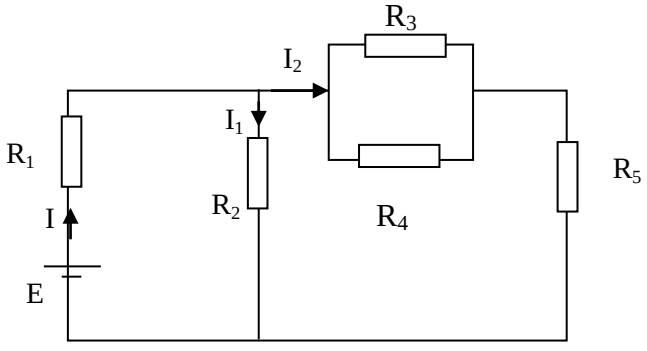
We give : C_1 =2 µF; C_2 = 4 µF; C_3=10 µF; C_4=7 µF and E =12V

Exercise 2: (08 pts)

Consider the following circuit.

1- Calculate the value of the current I using Kirchhoff's two laws.
2- Find the value of I, using the equivalent resistance Req of the circuit.
3- Find the currents flowing through resistors R_3 and R_4.
4- Calculate the total power P_T dissipated by equivalent circuit resistance, and calculate the power P supplied by source E. Conclude.

We give : R_1=2Ω, R_2=20Ω, R_3=12Ω, R_4=6Ω, R_5=16Ω and E=24 V



Good luck