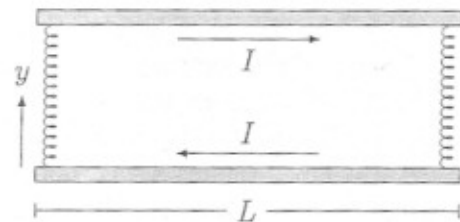


Allowed material: writing implements and a graphical calculator. You are not allowed to use any other material. There are some formulas and constant tabulated in last page of the exam. In your answers, justify the formulas you use and introduce the meaning of the symbols within these formulas.

It is important that you at least try every question. Good luck!

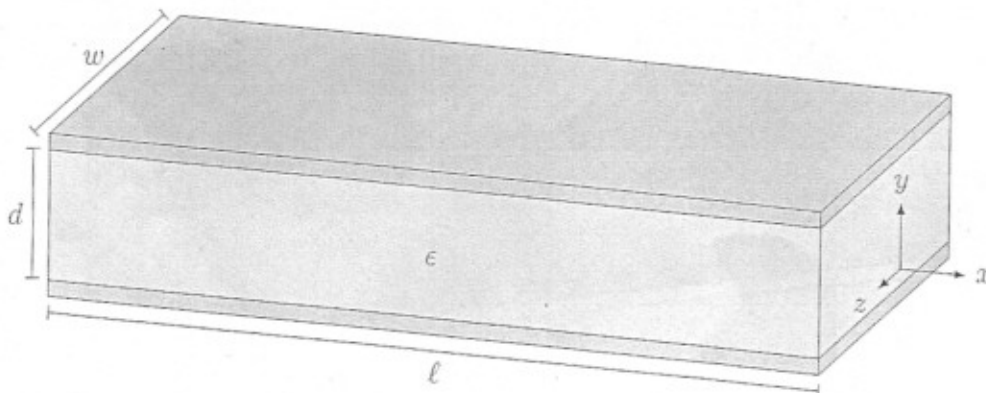
- Define the following terms using at most about 30 words. Answering using only formulas is, however, not sufficient. a) plane wave b) displacement current c) electric potential d) inductance e) electric current f) ohmic material
- Answer the following questions shortly, but precisely. Use figures and diagrams to support your answer as necessary. Answering using only figures will not, however, yield full credit.
 - When current flows in a thin helical conductor, it compresses. Explain why.
 - Explain how Faraday's cage works.

- Two conductors (length L) are connected with light conducting springs (spring constant k). When current I is applied on the circuit, the springs stretch. Determine the distance between the conductors in equilibrium. Assume that the springs stretch only in the y -direction and the spring constant is large enough to keep the distance between the conductors at lot less than L .



Problem 3.

- Consider transferring energy as electromagnetic waves. Assume that energy is transferred as a beam with cross-sectional area A . Find the smallest beam area when the power we want to transfer is 5×10^8 W which corresponds roughly the power transferred in high-voltage transmission lines. The threshold electric field for breakdown in air is 3×10^6 V m⁻¹.
- An insulating block (permittivity ϵ) is placed between the plates of a parallel-plate capacitor. The block fills the entire volume of the capacitor (length ℓ , width w , thickness d). The capacitor plates are then charged to have charges Q and $-Q$, respectively, after which the voltage source is disconnected so that from here on, the charge remains constant. Now, the insulator is drawn away from the capacitor. Determine the work required remove the insulator.



Problem 5.

Write CLEARLY in each paper your name, student number, degree programme, the code of the study module, and the date of the exam. Please solve each problem on its own page.