1. A toroidal solenoid with $N = 2000$ turns has area of cross section $A = 0.400\ \text{cm}^2$ and radius $r = 9.00$ cm. Calculate the inductance while the toroidal solenoid is filled with a) air, b) ferromagnetic material having relative permeability of $K_m = 600$.

2. The average emitting power of a radio station is $1.2 \cdot 10^5$ W. Assume that the power is distributed evenly to the half-space above ground.
   a) Calculate the average absolute value of the Poynting vector $\overline{S} = \mu_0^{-1} \overline{E} \times \overline{B}$ at the distance of 10 km from the station. (3 p)
   b) Calculate the amplitude of the electric field strength by assuming that the wave is harmonic at the observation point. (3 p)

3. a) Homogenous electric field $\overline{E}$ and homogenous magnetic field $\overline{B}$ are detected in the same spot in vacuum. The energy densities of the fields are equal. Calculate E if $B = 1{,}2 \cdot 10^{-5}$ T. (3 p)
   b) Unpolarised light hits the planar surface of a glass plate at an angle of 57°. The reflected light is totally linearly polarised. What is the refractive index of the glass? Calculate also the refraction angle. (3 p)

4. Two blue LEDs ($\lambda = 470$ nm) 2.5 m apart are viewed with help of a telescope through a circular aperture ($D = 0.350$ mm) in front of the telescope. Using Rayleigh's criteria calculate the maximum distance to the light sources from the aperture if the resolution is limited by diffraction.

5. Electron is in a one-dimensional box of width L. The potential energy is zero in the box and infinity at the walls.
   a) Derivate the relation for the allowed energy states of the electron using Schrödinger equation. (4 p)
   b) Calculate the energy separation of the two lowest states, if $L = 1.5$ nm. (2 p)

Constants: mass $m = 9.11 \cdot 10^{-31}$ kg and charge $e = 1.60 \cdot 10^{-19}$ C of an electron, $c = 3.00 \cdot 10^8$ m/s, $\mu_0 = 4\pi \cdot 10^{-7}$ Tm/A, $\varepsilon_0 = 8.85 \cdot 10^{-12}$ F/m, $h = 6.63 \cdot 10^{-34}$ Js

Please write your name, student number, degree programme (EST, TLT, AUT, ...), course code and the date of the exam on each paper.