FACULTY OF INDUSTRIAL SCIENCES & TECHNOLOGY
MATERIAL TECHNOLOGY PROGRAMME

ELECTRICITY, MAGNETISM & OPTICS

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CH10: INDUCTANCE

1. A long solenoid with length l and cross-sectional area A is closely wound with N_1 turns of wire. A coil with N_2 turns surrounds it at its center as shown in the figure. Find the mutual inductance, M.

2. In example 9.8, suppose the current i_2 in the outer coil is $i_2 = (2.0\times10^6\ \text{A/s})t$.
   (i) At t = 3.0 μs, what is the magnetic flux through each turn of the solenoid (coil 1) due to the current in the outer coil?
   (ii) What is the induced emf in the solenoid?

3. Determine the self-inductance of a toroidal solenoid with cross-sectional area A and mean radius r, closely wound with N turns of wire. Assume that B is uniform across a cross section. If the current in the toroidal solenoid increases uniformly from 0 to 6.0 A in 3.0 μs, find the magnitude and direction of the self-induced emf.

4. The magnetic field in inside an air-filled solenoid 38.0 cm long and 2.10 cm in diameter is 0.600 T. Calculate the energy stored in this field.

5. A 10 cm long solenoid of diameter 0.40 cm is wound uniformly with 800 turns. A second coil with 50 turns is wound around the solenoid at its center. Determine the mutual inductance of combination of the two coils.

6. An air-filled toroidal solenoid has 300 turns of wire, a mean radius of 12.0 cm, and a cross-sectional area of If the current is 5.00 A, calculate:
   (i) the magnetic field in the solenoid;
   (ii) the self-inductance of the solenoid and
   (iii) the energy stored in the magnetic field.