

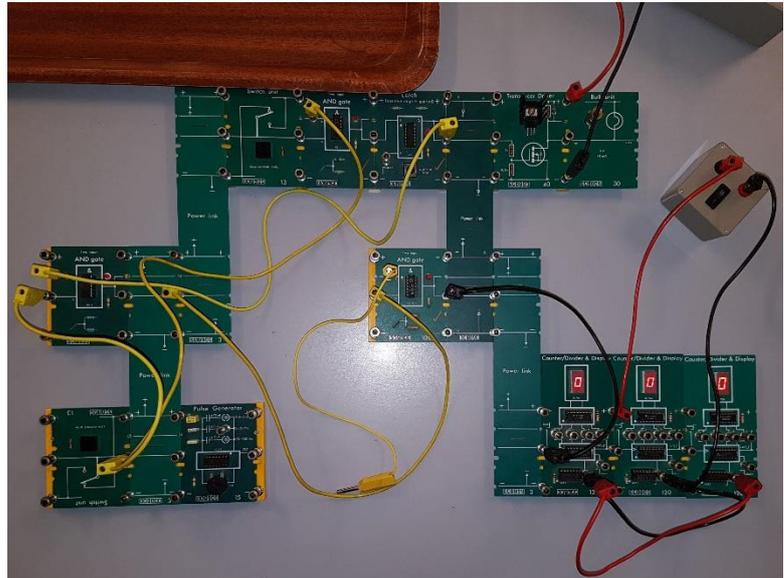
MICROELECTRONICS optional course (S6 and S7, 2 periods per week)

Objectives

Microelectronics course is a practical and enjoyable way of learning and improving logical skills.

Contents

This course has a high practical content with considerable "hands on" experience for the student more especially later in the sixth and in the seventh years.



Fundamental properties of **LOGIC GATES** and their later inclusion in circuits provide "logical solutions" for everyday practical problems e.g. a washing machine filling with water, then heating the water and finally the washing cycle beginning. Another simple example could be the activation of a burglar alarm when for example a window or door is opened or a light beam broken or pressure is exerted on a hidden sensor under a carpet. The possibility of making any gate out of Nand or Nor gates is verified so that a logic circuit with various gate types may always be reduced to a single gate type . Further simplification of logic expressions is studied using the laws of Boolean Algebra. The entire first semester is given over to the above topics. In the second semester a large part of the course will be given to practice with basic **ARDUINO** components. A personal project will conclude this chapter. Tthere follows a detailed study of sequential logic, starting with basic RS flip-flops , both negative and positive edge triggered versions investigated from cross coupled NAND and NOR gates respectively. Applications such as debouncing a switch are investigated Thereafter a extension to D-type and T-type flip-flops allows an appreciation of the function mechanism of shift registers (latches) and counters.



In the second year of this course (Year 7) , logic systems (with low current requirements) are used to drive **TRANSISTORS** and relays via various physical sensors e.g. light , temperature , humidity sensors.

This allows devices with much larger current requirements to be operated -an example could be to design a circuit which will automatically switch on the heating in a greenhouse at night if the temperature falls below a certain value ; a much more demanding simulation and one which provides a stimulating challenge is for a circuit which will simulate a car windscreen wiper with time variable intermittent wipe. The windscreen wipe starts automatically when it starts raining. In all of the simulations, the Unilab Alpha system is adopted. This makes circuit construction much easier. Initially the various Input boards (physical sensors such as heat , light humidity) , then processor units (transistors , latches , delays and counters) , and finally output units (motors , buzzers , lights and solenoids) are individually studied and the relevant operating parameters entered in look up tables. **ARDUINO** will be again a useful tool to practice with the components described above. These look up tables then provide the essential starting point for the design and subsequent construction of the simulation circuits. Subsequently analogue as well as digital systems are also studied. Of paramount importance in this respect is the **OPERATIONAL AMPLIFIER** which is investigated in detail; its function in automatic control situations e.g. not simply switching on a light automatically when it gets dark but making the light get brighter as it gets darker. Other examples include position control and servomechanisms.

Instruments and method

Activities in class are performed singularly or in team. 90% of the course is practical. The school provides all necessary hardware. The students have the possibility to bring their own PCs in order to continue their Arduino projects at home. This is not mandatory.

Marks

A mark will be determined by activities and projects developed during the semester. Students will be evaluated on all topics.

B mark will be determined with 2 tests (on paper and/or practical) per semester composed by questions on all topics.

Level required

No specific Electronics skills are required. Informatics skills and Physics skills, as well as **enthusiasm**, are welcome!

Please contact Mr. Vis for any further info.