

Faculty of Economic, Social and Political Sciences



TEKN2101 Research and Technological Development

[65h] 7.5 credits

Language: French
Level: Second cycle

Aims

At the end of the class, students should be able to
Understand and converse with the technicians of the different technological domains
realise a technological application project in one of these domains

Main themes

This course is intended to provide the student with a substantial introduction to the following major technological fields :
electronics and telecommunications; energetics and environmental issues ; materials and processes; mechanics and
electro-mechanics.

It is based on a pre-required significant scientific education in physics and chemistry.

Content and teaching methods

4 technological modules (details are given below) : electronics and telecommunications ; energetics and environmental issues ; materials and processes ; mechanics and electro-mechanics.

First module: Electronics and telecommunications

Contents:

1. Electrical circuits: notion of current, voltage, energy and - principal components (R, L, C, voltage source) - Kirchhoff and Ohm law)
2. DC and transient characteristics computation
3. Semi-conductors technology : principle of the PN junction (diode), MOS transistor behaviour, basics of the integrated circuit technology
4. Analog Electronics: analysis of circuits build with operational amplifiers
5. Digital Electronics: combinational and sequential circuits
6. Propagation and modulation of signal
7. Introduction to information theory and coding
8. Architectures of networks
9. Study of the TCP/IP network

Pedagogical methods:

Oral presentations will allow students to acquire the basic concepts needed to handle the technological project in IAG22.

Concerning the study of electronic circuits, exercices will be proposed at each lecture, and main keypoints of the solution will be discussed the next week.

Examination mode:

A written examination will be organised during the examination periods: exercices with document support for the electronic circuits part, and without documents for telecommunications techniques. A global quotation will be given for the whole part of this module.

Second Module : energetics and environmental issues

Contents:

- * First law of thermodynamics : U,H, Wm
- * Second law : entropy and (T,s) diagramme
- * Ideal Gas. Thermodynamic transformations of state
- * Phase changes. Thermodynamics of vapours
- * Heat transfer
- * Fuel and combustion
- * Vapour cycles
- * Gas cycles and combined cycles (gas and vapour)
- * Context of energy production and use; renewable energies
- * Environmental challenges; phenoménoylogy

Pedagogical methods:

Presentation of a file for each theme, involving:

- formalised notes and/or copies of slides
- additional texts illustrating and enlightening the studied concepts
- a list of open questions

Examination mode:

- Each student answers a set of questions formalised in the files (individual written work)
- Ten minutes oral presentation of a text found by the students themselves.

Third Module : materials and processes

Content

- Main products of the chemical industry and sources of raw materials
- Presentation of a number of cases study in order to illustrate the main tools used by the chemical engineer: heat and mass balance, unit operations and pollution and energy problems. Among the cases studied the following are found: a metal production (steel or copper), an example of inorganic compound manufacture (sodium carbonate, sodium hydroxide and chlorine), synthesis and properties of soap and detergents, the production of synthesis gas and derived products and the production of important industrial polymers such as polyethylene, polypropylene or polyvinylchloride. -
- Classification of materials (metals, ceramics, polymers and alloys) in function of the bonding nature, influence of the type of the bonding on the matter cohesion and on some typical properties such as thermal and electrical properties and on the mechanical properties (elastic modulus, tensile strength, elastic and plastic deformation).

Pedagogical methods

Oral presentations will allow students to acquire the basic concepts needed to handle the technological project in masters.

Examination mode:

A written examination at closed book will be organised during the examination period.

Fourth Module : mechanics and electro-mechanics

Contents :

- Newtonian mechanics (basics)
- Statics : vectorial equilibrium, equilibrium equations, applications
- Resistance of materials: internal efforts, stress and strain, application to beam dimensioning
- Study of the most standard mechanisms
- Seminars on various topics:
 - Robotics
 - Mechanical vibrations
 - Vehicle dynamics, multibody dynamics
 - Human gait analysis
 - Airplane dynamics

Examination mode:

A written examination at closed book will be organised during the examination period.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Prerequisite :

This educational programme is designed for students having a significant pre-required quantitative and scientific education (physics and chemistry) such as the two first years of the " baccalauréat en ingénieur de gestion "

Evaluation :

The evaluation process is specific to each module, and was detailed in the previous point. The final note takes the four individual notes into account, and implies normally a satisfactory degree in each part.

Support :

Many modules of this course are supported by specific websites (for example on icampus): copies of course material and documents used during the lectures, additional references, exercises