POLYTECH TOURS

EXCHANGE PROGRAM

2015-2016 Course Catalog

MECHANICS AND SYSTEM DESIGN

Contents

1. Introduction

Welcome to Polytech Tours' Mechanics and System Design department, part of Université Francois-Rabelais de Tours (Univ. Tours). This document provides the list and description of the English-taught courses proposed at the department for the 2015-2016 academic year. These courses are specially adapted for exchange students who decide to spend a semester or a year at our department. For further inquiries about the courses feel free to contact Pierre BARDET <bardet@univ-tours.fr>, responsible for incoming students. You can find further information about Polytech Tours at http://polytech.univ-tours.fr and instructions for abroad students at http://international.univ-tours.fr.

2. Graduate level

2.1 Fall term (September-January)

COURSES/MODULES ECTS	ECTS	HOURS
C1 - Design of mechanical elements	3	12
C2 - Solid mechanics	3	22
C3 - Mathematics for mechanics	2	10
C4 - Heat exchange processes	2	14
C5 - Polymers Mechanics	2	9
C6 - CAD : Surfaces and poles	3	16
C7 - Project : Product Design and System	10	120
C8 - French as a foreign language	5	48
TOTAL	30	251

C1 - Design of mechanical elements - 3 ECTS

Course objectives :

- Be able to design a mechanical system and to size all of its mechanisms and structural components

Course contents :

- Be able to interpret/draw any technical drawing (assembly drawing, detail drawing).
- Be able to choose the right mechanical elements of the designed system (considering its application, cost, safety and lifetime).
- Be able to size each of these elements by following the associated design rules.

C2 - Solid mechanics - 3 ECTS

Course objectives :

- Acquire the basic elements of the mechanics to analyse mechanisms to determine efforts and speed for the dimensioning of components such as pistons or bearings.

Course contents :

- Be able to interpret/draw any technical drawing (assembly drawing, detail drawing).

C3 - Mathematics for mechanics- 2 ECTS

Course objectives :

- Initiation to functions of complex variable and some applications

Course contents :

- The complex number system
- Elementary properties of Analytic Functions
- Complex integration
- Singularities of analytic functions
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C4 - Heat exchange processes - 2 ECTS

Course objectives :

- Introduce basic concepts related to the three modes of heat transfer (conduction, convection, radiation).
- Provide tools to solve heat transfer problems in simple cases without complex software.

Course contents :

- Grasp the basic fundamental concept in heat transfer
  - Conduction: Solve a 1D steady conduction problem.
  - Convection: Calculate a convection exchange coefficient in simple cases.
  - Radiation: Establish a radiative balance between black bodies separated by transparent media. Be able to understand the behaviors of a black body and a real one
- Be able to model the heat transfer behavior of systems
  - Be able to develop the balance equations for combined transfer
  - Be able to select the right boundary and initial conditions to formulate a well-posed problem

C5 - Polymers Mechanics - 2 ECTS

Course objectives :

- Have a general knowledge on reactions and industrial techniques of polymerization and know/define characteristic physicochemical aspects of these materials. Know the different polymers manufacturing techniques, as well as the main notions of physical appearance and chemistry.

Course contents :

- Microstructures of the polymeric materials
- Elaboration of some polymers
- Mechanical Behaviour of polymers
- Tests and controls
- Particularities of elastomers

C6 - Computer Aided Design - 3 ECTS

Course objectives :

- Approach the computer-aided design by problems linked to surfaces and to volumes related to these surfaces. One second approach to make COMPUTER-AIDED DESIGN is to use software both approaching the problems of definition of parameters and programming to improve performance.

Course contents :

- Beziers curves (De Casteljau's Algorithm)
- B-Splines
- Lessons and tutorials treat curves and surfaces while practicals treat more particularly the definition of parameters and programming

C7 - Project : Product Design and System - 10 ECTS

Course objectives :

- Know how to work out specifications and requirements. Participate in a group and work according to the specifications and requirements . Use of Value and functional analysis.

Course contents :

- This first part is devoted to the study of the Design requirements, specifications and functional analysis of a plan.
- The purpose for a group of students is to split the job and to use plan management.
- In comparison with the first year when plan was in most cases mechanical, this project is more global and consists in an operative part and a command part calling upon knowledge of automatism, programming and system piloting.

FFL French as a foreign language - 5 ECTS

The French as a foreign language lessons are taught at the University Center for Teaching French to International Students (http://international.univ-tours.fr/cuefee). After taking a placement test, the student joins other international students to take lessons that will help them develop listening, speaking, reading and writing skills in French.

2.2 Spring term (January-June)

COURSES/MODULES ECTS	ECTS	HOURS
C1 - Fluid mechanics	3	13
C2 - Sensors	2	8
C3 - Supervisory Control	2	16
C4 - Dynamics of Solid	2	13
C5 - Finite Element Methods	4	30
C6 - Optimization	2	14
C7 - Project : Product Design and System	10	120
C8 - French as a foreign language	5	48
TOTAL	30	262

C1 - Fluid mechanics - 3 ECTS

Course :

- To know the basic properties of fluids and flows. To be able to simplify the fundamental equations.

Course contents :

- To understand the basic concepts of fluid statics : fundamental law and application to pressure measurement
- To apply the concepts of perfect fluid dynamics
- To have the knowledge of conservative equations of real fluids
- to be able to simplify and to solve these equations in simple cases (such as Couette or Poiseuille flows)
- To solve hydraulic problems : head loss, choice of pump

C2 - Sensors - 2 ECTS

Course objectives :

- The overall goal of this course is to familiarize students to different elements that have to be taken into account to make a measurement

Course contents :

- Sensors fundamental and general characteristics : sensitivity, accuracy, non linearity, resolution, etc...
- Sensing Physical principles.
- The uncertainty attached to any measurement.
- How to electronically condition the sensor and process the signal.
- A focus is on sensors and conditioners of forces, torque and temperature.

Requirements:

Basic knowledge in physics and electronics.

C3 - Supervisory Control - 2 ECTS

Course objectives :

- Know how to create a supervisory control of an automated system

Course contents :

- After a presentation of the usefulness of the networks in the context of industrial production, this lesson gives a short guideline of main industrial networks: CAN, ASI, Profibus, Modbus, Ethernet. In the second part, the course shows how to implement a human machine interface (HMI) connected to an automated system with shared variables between a PLC and the HMI.

Requirements:

Basic knowledge about PLC

C4 - Dynamics of Solid - 2 ECTS

Course objectives :

- Acquire the understanding of the solid inertia phenomenon. Know how to write equations of a solid movement using either general theorems or virtual work principles or Lagrangian equations. Know how to calculate link efforts via the Lagrangian formulation

Course contents :

- Mathematical recalls (vector calculus, notions on torsors, vector derivation)

- Solid Kinematics (notion of solid rigid; torsor kinematics; particular movements: translation, rotation; field of acceleration; composition of movements; kinematics of contact between two solids)
- Mass Geometry - Kinetics (mass; inertia center; inertia tensor; Huyghens Theorem; kinetic and dynamic torsors; Koenig theorem; kinetic energy)
- Systems Dynamics (fundamental principle; result and dynamic instant theorems)
- Introduction to analytical mechanics: Lagrange formalism (D'Alembert principle and virtual job; virtual speed compatible with holonomic and non-holonomic links; virtual job developed by mechanical actions; virtual job developed by the acceleration quantities; general form of the first equations of Lagrange Integrals)
- Equilibrium - Linearisation – Stability

C5 - Finite Element Methods - 4 ECTS

Course objectives :

- This lesson introduces in a theoretical way the finite element method. This method is aimed at defining tools allowing to determine the mechanical fields within continous media of complex geometry not amenable to analytical approach. In order to do that, a space discretisation of the studied mechanical problem is accomplished. A broad part of this course requires the use of computers during practicals.

Course contents :

- General aspects of the finite element method or isoparametric in linear case
- Application of the virtual work theorem
- Interpolation functions definitions
- Numerical integration methods

C6 - Optimization - 2 ECTS

Course objectives :

- Acquire classical modelling groups, aided in most cases by graph theory and linear programming, as well as precise or approximative methods groups to resolve the so modelled optimization problems.

Course contents :

- Linear programming
  - o Linear programming methods
  - o Simplex Algorithm
  - o Duality
- Discrete Combinatory Optimization
  - o Graph theory notions and graph representation in computer.
  - o Minimum spanning tree problems
  - o Shortest way problems.
  - o Maximum flow problems

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