Exchange Program: Mechanical engineering and system design

Course catalog proposal – Fall semester (September – January)

		Level**	Lectures	Tutorials	Practical works	ECTS
Mechanics	*Design of Mechanical Elements (CM)*	Bachelor / Undergraduate	12 h*	12 h		3
	Solid Mechanics (MSO)	Bachelor / Undergraduate	8 h*	10 h	12 h	3
	Polymer Mechanics (MPO)	Master / Graduate	12 h	8 h	6 h	3
Mechanics (Master)	*Plasticity (PLAST)*	Master / Graduate	8 h	6 h		2
	Fatigue of Materials (FMR)	Master / Graduate	12 h	10 h	3 h	3
Engineering science	*Heat exchanges (TT)*	Master / Graduate	12 h*	8 h	6 h	3
	Reliability of devices and systems (FCS)	Master / Graduate	6 h	4 h		1
	Design of Experiments (PEX)	Master / Graduate	4 h	6 h	6 h	2
Mathematics and software tools	*CAD: surfaces and poles*	Master / Graduate	6 h*	4 h	12 h	2
	Mathematics for mechanics	Bachelor / Undergraduate	26 h*	14 h		3
Projects* **	*Project: Product and system design*	Master / Graduate	4 h	6 h	100 h	10
	Supervised Project					20
	Supervised Project					30
Language** **	*French language and French culture*			48 h		5

* The lectures are basically taught in French, with English documents
** or equivalent
*** One project is mandatory.
**** This course is mandatory. The lessons are taught at the University Center for Teaching French to International Students (Centre Universitaire d'Enseignement du Français pour Etudiants Etrangers - C.U.E.F.E.E. - http://international.univ-tours.fr/cuefee).

Course details

Design of Mechanical Elements Lectures: 12 h; Tutorials: 12 h Teacher: Mr. Guénhaël LE QUILLIEC (guenhael.lequilliec@univ-tours.fr) Code in schedules: **CM**	Prerequisites: no prerequisite is necessary Course objectives: - Be able to design a mechanical system and to size all of its mechanisms and structural components. Course description: - 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. Course evaluation: course grade will be based on midterm exams, and final exam.
Solid Mechanics Lectures: 8 h; Tutorials: 10 h ; Practical works: 12 h Teacher: Mr. Arnaud DUCHOSAL (arnaud.duchosal@univ-tours.fr) Code in schedules: **MSO**	Prerequisites: - General knowledge of mechanisms - Industrial design analysis - Knowledge of mechanical joint models Course objectives: - To be able to analyse a mechanism in order to create a bond graph. - To be able to write a static torsor of the joints in order to use it in a 2D problem - To apply static fundamental principle of static on system of rigid bodies in order to determine the efforts on the joints. - To be able to determine the kinematic unknowns and to be able to solve a 2D problem. - To apply velocity and acceleration composition laws. - To apply the velocity field and equi-projectivity - To prepare students to Dynamics of Solids and Resistance of Material courses Course evaluation: course grade will be based on a written tests and practice results.
Polymer Mechanics Lectures: 12 h; Tutorials: 8 h; Practical works: 6 h Teacher: Mr. Florian LACROIX (florian.lacroix@univ-tours.fr) Code in schedules: **MPO**	Prerequisites: continuum Mechanics, calculus and differential equations Course objectives: The essentials knowledge to master : - the understanding of polymer synthesis methods and more generally of microstructural reactions

	- knowledge of the different mechanical behaviors of its materials - the understanding of the impact of the temperature, the environment, the loading … on the mechanical behavior. - Techniques and models used to understand long-term behaviour - Tools for modeling the behavior of polymers Course evaluation: course grade will be based on midterm exams and final exam.
Plasticity Lectures: 8 h; Tutorials: 6 h Teacher: Mr. Guénhaël LE QUILLIEC (guenhael.lequilliec@univ-tours.fr) Code in schedules: **PLAST**	Prerequisites: Continuum mechanics and Strength of materials basis. Course objective: be able to understand and assess the plastic behavior of metallic materials. Course description: Understand typical one-dimensional strain-stress relationship and their corresponding idealized hardening rules. Introduction to strain and stress tensors. Introduction to yield criteria and the usual three-dimensional behavior laws. Course evaluation: course grade will be based on final exam.
Fatigue of Materials Lectures: 12 h; Tutorials: 10 h; Practical works: 3 h Teacher: Mr. Florian LACROIX (florian.lacroix@univ-tours.fr) Code in schedules: **FMR**	Prerequisites: Material science Course objectives: - To know how to determine the life of a structure in fatigue - To have notions of fatigue of materials - To know the effect of a mechanical notch on the fatigue resistance - To possess the basics of fracture mechanics - To know how to determine fracture toughness - Understanding fatigue crack propagation Course evaluation: course grade will be based on midterm exams and final exam.
Heat Exchange Lectures: 12 h; Tutorials: 8 h; Practical works: 6 h Teacher: Mrs.Gaëlle BERTON (gaelle.berton@univ-tours.fr) Code in schedules: **TT**	Prerequisites: calculus and differential equations. Course objectives: - To introduce basic concepts related to the 3 main modes of heat transfer (conduction, convection, radiation). - To provide methods and tools to solve heat transfer problems in simple cases without any complex software tool. Course description: topics include key notions in heat transfer (conduction: 1D steady state problem solving;

	convection: convection exchange coefficient calculation in simple cases; radiation: radiative balance definition between black bodies separated by transparent media, behaviors of black bodies and real ones), methods to model the heat transfer behavior of systems (balance equations for combined transfer, selection of right boundary and initial conditions to formulate a well-posed problem), methods to optimize the energy performances of a system. Course evaluation: course grade will be based on midterm exams, quizzes, and final exam.
Reliability of devices and systems Lectures: 6 h; Practical works: 4 h Teacher: Mr. Sébastien JACQUES (sebastien.jacques@univ-tours.fr) Code in schedules: **FCS**	Prerequisites: basic knowledge of probability and statistics. Course objective: develop the concepts, methods and tools both to evaluate and predict devices and/or systems' lifetime. Course description: topics include definitions (reliability, operating conditions and operating period, failure / failure mode / failure mechanism / failure analysis), distribution models (exponential, log-normal, Weibull), probability plotting, accelerated tests, failure mechanism and models, and failure rate prediction. Course evaluation: course grade will be based on quizzes and written tests.
Design of Experiments Lectures: 4 h; Tutorials: 6 h; Practical works: 6 h Teacher: Mr. Sébastien JACQUES (sebastien.jacques@univ-tours.fr) Code in schedules: **PEX**	Prerequisites: basic knowledge of probability and statistics, quality management, and reliability. Course objectives: - Get a better understanding of the need of a design of experiments (DoE). - Build a DoE and define the links between the inputs and the process' response(s). - Results' analysis of a DoE and evaluation of its relevance. Course description: topics include definitions (controlled inputs, discrete and continuous uncontrolled factors, process' responses, experimental range, levels), full factorial designs, relevance of the synergistic approach, impact of the effects of a full factorial design, fractional factorial designs, fractional factorial designs' development. Course evaluation: course grade will be based on quizzes and written tests.

CAD Surfaces and Poles Lectures: 6 h; Tutorials: 4 h; Practical works: 12 h Teacher: Mr. Pierre BARDET (pierre.bardet@univ-tours.fr)	Prerequisites: no prerequisite is necessary. Course objective: 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 description: - Beziers curves (De Casteljau's Algorithm) - B-Splines - Lessons and tutorials treat curves and surfaces while practical's treat more particularly the definition of parameters and programming Course evaluation: course grade will be based on lab activities and final exam.
Mathematics for mechanics Lectures: 26 h; Tutorials: 14 h Teacher: Mr. Pierre BARDET (pierre.bardet@univ-tours.fr)	Prerequisites: no prerequisite is necessary. Course objective: Initiation to functions of complex variable and some applications. Course description: - The complex number system - Elementary properties of Analytic Functions - Complex integration - Singularities of analytic functions Course evaluation: course grade will be based on a final exam.
Project: Product and system design Tutorials: 4 h; Practical works: 6 h Teacher: Mr. Arnaud DUCHOSAL (arnaud.duchosal@univ-tours.fr)	Prerequisites: Technical specification, CAD, basic functions of electronic and mechanical systems. Course objective: 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 description: - This first part is devoted to the study of the Design requirements, specifications and functional analysis of a plan. - The second part is devoted to the dimensioning calculation and in some projects to the achievement. - 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.

	Course evaluation: course grade will be based on project report and oral presentation.
Supervised Project (20 ECTS)	Prerequisites: Depends on the subject. Possible topics of projects: CAD (design) Control, acquisition Numerical methods Simulation and experiments in solid or fluid mechanics Heat transfer Robotics Other topics can be proposed by the applicant Course evaluation: project report.
Supervised Project (30 ECTS)	Prerequisites: Depends on the subject. Possible topics of projects: Cutting tools Polymers-Elastomers Nano-indentation Fatigue Signal analysis Other topics can be proposed by the applicant Course evaluation: project report and oral presentation
French as a foreign language	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.