Exchange Program: Mechanical engineering and system design

Course catalog proposal – Spring semester (February – June)

		Level**	Lectures	Tutorials	Practical works	ECTS
Mechanics	*Fluid Mechanics 1 (MF1)*	Bachelor / Undergraduate	12 h*	10 h	4 h	3
	Fluid Mechanics 2 (MF2)	Bachelor / Undergraduate	10 h*	8 h	6 h	3
	Solid Dynamics (DSO)	Master / Graduate	12 h*	10 h	3 h	3
Mechanics (Master)	*Finite Elements (EF)*	Master / Graduate	12 h	12 h	18 h	3
	Material Engineering (GMA)	Master / Graduate	8 h	8 h	6 h	2
Engineering science	*Sensors (CAPT)*	Bachelor / Undergraduate	8 h	8 h		2
	Supervisory control (SUP)	Bachelor / Undergraduate	2 h*	4 h	12 h	2
	Motor Control (CMOT)	Master / Graduate	12 h	10 h		2
	Discrete event systems (MSS)	Master / Graduate	8 h*	8 h	4 h	2
Projects* **	*Project: Design of Mechanical Elements*	Bachelor / Undergraduate		10 h	40 h	3
	Project: System design and manufacturing	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

Fluid Mechanics 1 Lectures: 12 h; Tutorials: 10 h; Practical works: 4 h Teacher: Mrs. Gaëlle BERTON (gaelle.berton@univ-tours.fr) Code in schedules: **MF1**	Prerequisites: no prerequisite is necessary. Course objective: To know the basic properties of fluids and flows. To be able to simplify the fundamental equations. Course description: - To understand the basic concepts of fluid statics: fundamental law and application to pressure measurement - To apply the concepts of perfect fluid dynamics Course evaluation: course grade will be based on a midterm exams, final exam and practical evaluation.
Fluid Mechanics 2 Lectures: 10 h; Tutorials: 8 h; Practical works: 4 h Teacher: Mrs. Gaëlle BERTON (gaelle.berton@univ-tours.fr) Code in schedules: **MF2**	Prerequisites: Fluid Mechanics 1 course Course objectives: - 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, similitude Course evaluation: course grade will be based on a midterm exams, final exam and practical evaluation
Solid Dynamics Lectures: 12 h; Tutorials: 10 h; Practical works: 3 h Teacher: Mr. Florian LACROIX (florian.lacroix@univ-tours.fr) Code in schedules: **DSO**	Prerequisites: Static mechanic, mathematical tools Course objective: 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 description: - 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 - Linearization – Stability. Course evaluation: course grade will be based on midterm exams and a final exam.
Finite Elements Lectures: 12 h; Tutorials: 12 h; Practical works: 18 h Teacher: Mr. Florent CHALON (florent.chalon@univ-tours.fr) Code in schedules: **EF**	Prerequisites: Continuum mechanics, Applied mathematics. Course objective: 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 continuous 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 practical. Course description: - General aspects of the finite element method for isoparametric elements in linear case - Application of the virtual work theorem - Interpolation functions definitions - Numerical integration methods Course evaluation: course grade will be based on practical exams, and final exam.
Material Engineering Lectures: 8 h; Tutorials: 8 h; Practical works: 6 h Teacher: Mrs. Caroline RICHARD (caroline.richard@univ-tours.fr) Code in schedules: **GMA**	Prerequisites: - Skills about structure and crystalline microstructures, phases diagrams, chemical bonds, main mechanical properties - Base about material sciences. Course objective: Understanding the relationships between microstructure and mechanical properties, knowledge of the main manufacturing processes, management of specifications for the best choice of a material. Course description: Base culture of the behavior of materials – Second part. A particular attention is placed on the relationship between the mechanical properties and the microstructure of materials and manufacturing process: 1. Metals and alloys, ceramics, polymers

	2. Thermal treatments, surface treatments 3. Environmental effects (Temperature, wear, corrosion) A bibliographic review enhances understanding of the different criteria of the choice of a material versus the development of technical and operational specifications Course evaluation: course grade will be based on midterm exams, and final exam.
Sensors Lectures: 8 h; Tutorials: 8 h Teacher: Mr. Matthieu LESCIEUX (matthieu.lescieux@univ-tours.fr) Code in schedules: **CAPT**	Prerequisites: Basic knowledge in linear algebra, physics and electrical engineering. Course objectives: - the ability to understand the operation of sensors. - the ability to read sensor's datasheet. - the ability to evaluate uncertainties attached to measurement. - the ability to calibrate and specify metrological characteristics of a custom sensor. - the ability to associate a relevant conditioner. Course description: The aim of this course is to give relevant elements in choosing sensors. It covers: - Sensor fundamentals: physical principles and metrological characteristics, - The evaluation of uncertainties attached to any measurement and how do they propagate. - The study of the main classes of signal conditioning circuits. A specific focus is given to strain measurement, at the base of the operation of force, torque and pressure sensors. Course evaluation: course grade will be based on a final exam.
Supervisory Control Lectures: 2 h; Tutorials: 4 h; Practical works: 12 h Teacher: Mr. Jean-Paul CHEMLA (jean-paul.chemla@univ-tours.fr) Code in schedules: **SUP**	Prerequisites: basic knowledge about PLC and networks. Course objective: Understand how a human machine interface (HMI) interacts with the control part of a process. Course description: The course deals with industrial networks, OPC systems and Scada softwares. The main part of this course is small project (practical work) creating a HMI for an automated machine. This HMI can be an industrial touch screen or an iPad.

	Course evaluation: course grade will be based on the evaluation of the project.
Motor Control Lectures: 12 h; Tutorials: 10 h Teacher: Mr. Ambroise SCHELLMANNS (ambroise.schellmanns@univ-tours.fr) Code in schedules: **CMOT**	Prerequisites: basic knowledge about motors and electronics. Course objective: understand the principle of the AC and DC motor control. Course description: - Principles of the different types of motors - Analysis of the mechanical properties (torque, speed) - Principle of electric power converters - Speed control of motors Course evaluation: course grade will be based on midterm exams, and final exam.
Discrete Event Systems Lectures: 8 h; Tutorials: 8 h; Practical works: 4 h Teachers: Mr. Jean-Paul CHEMLA & Mrs. Bénédicte GASNIER (jean-paul.chemla@univ-tours.fr) (benedicte.gasnier@univ-tours.fr) Code in schedules: **MSS**	Prerequisites: Basic knowledge about linear algebra and probability. Course objective: Discrete event systems like workshops can be analyzed either by using analytical models or using simulation software. Course description: - Petri nets - Markov chains - Simulation software Course evaluation: course grade will be based on lab activities and final exam.
Project: Design of Mechanical Elements Teacher : Mr. Guénhaël LE QUILLIEC (guenhael.lequilliec@univ-tours.fr)	Prerequisites: Basic knowledge about technical drawing, mechanical element selection and CAD. Course objective: Be able to design a mechanical system. Course description: - This work is realized as a pair - Design the system on a CAD Software (Catia) - Select and size the mechanical elements of the system - Technical drawings and detail all data needed for manufacturing - Cost estimation - Remark: no manufacturing nor FE simulations are considered in this project. Course evaluation: Report, oral defense and final exam.

Project: System design and manufacturing 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.
Graduate Project	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.
Master Project	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.