ESIX-GSI – 2022 **Courses in English at ESIX-GSI**

Title	Semester Fall/Spring	ECTS
Fall semester		
II5C111I - Mathematics *<u>Course objective</u>: revisit classical mathematical techniques. Apply these techniques to engineering problems.* *<u>Prerequisites</u>: elementary calculus and methods.* *<u>Content</u>:* *Differential equations, Laplace transform, Fourier series.* *Complex functions, residue theorem. Z-transform.* *Linear algebra, vectors and matrices.* *Vector analysis and partial differential equations.* *Introduction to optimization.*	Fall -S5	3
II5C112I - Materials Science & Chemistry *<u>Course objective</u>: acquire some basic knowledge on crystallography and phase diagrams.* *<u>Prerequisites:</u> basic physics (atoms, electrons, chemical bond).* *<u>Content</u>: crystalline state, crystal structures, crystal defects, phase diagrams (constitution, domains of existence, etc.), notion of eutectic, peritectic, correlation diagram and microstructure.*	Fall – S5	3
II5C113I - General mechanics & technology *<u>Course objective</u>: understand the principles of solid-body motion. Apply these principles to engineering problems.* *<u>Prerequisites</u>: elementary physics and mathematics.* *<u>Content</u>: reference frames and point kinematics. Systems of particles, Newton's laws, kinetic energy theorem. Kinematics and dynamics of a rigid body. Interactions between rigid bodies. Technical mechanics.*	Fall – S5	5
II5C121I – Electronics part 2 : introduction to sensors. *<u>Course objective</u>: understand a part of the chain of measurements: acquire a signal (temperature, pressure, position,...) using an appropriate sensor, and amplify this signal in view of processing it.* *<u>Prerequisites:</u> mathematics (calculus & methods), physics (electricity).*	Fall – S5	3

Content: Introduction to sensors. Resistive, capacitive and inductive sensors. Analysis of optical, force, acceleration, temperature, humidity, magnetic and hall effect sensors.		
123-1 Mechanics & resistance of structures *Course objective: determine stress and strain in steel truss structure.* *Prerequisites: general mechanics.* *Content: reminders on strength of materials. Stress concentration and combined stresses. Energetic methods applied to the calculation of stress and strain in steel truss (isostatic or hyperstatic) structures.*	Fall – S9	2
II5C232I - Hazard analysis *Course objective: Get to know how to evaluate the risks, and identify the actors of a crisis situation.* *Prerequisite: none.* *Content: Introduction to risk management, origins of cyndinics (founding axioms, systemic cyndinogenic deficits, etc.). Crisis management, definition of crisis, actors, crisis cell. Human factor in various major accidents.*	Fall – S5	1
II5C334I English	Fall – S5	2
II5C336I - Spoken communication *Course objective: to communicate orally with any colleague in any situation. Know how to explain, convince and motivate in front of a group, or one-to-one. Get familiar with non-verbal techniques.* *Prerequisites: none.* *Content:* *1) Structure of an oral presentation.* *2) Use of media (especially Power Point).* *3) Presentation of non-verbal techniques.* *4) Public speaking.*	Fall – S5	1
140-2 Granular media *Course objective: understand the basic properties of granular media, their importance in everyday life and in production.* *Prerequisites: elementary courses in material science.* *Content: definition and characteristics of a granular medium (size, shape, chemical composition, etc.). Techniques for the manufacture and the characterization of powders. Use of powders (ceramics, metallurgy, etc). Dangers of powders and means of protection (silicosis, asbestosis, etc.).*	Fall – S7	3
321-1 Surface physics and engineering	Fall – S7	3

Course objective: understand the importance of the surface of a product for its interaction with the environment. *Prerequisites: elementary physics and chemistry.* *Content: revisit elementary thermodynamics and electrochemistry.* *Adsorption (physisorption, chemisorption), reactivity, wettability.* *Mechanical, chemical, thermal, electrical and optical interactions.* *Surface characterization methods (roughness, specific surface).* *Surface treatments - Selection criteria.*		
162-5 Computational Fluid Dynamics for EMR *Course objective: apply the tools of CFD to study the Marine Renewable Energies converters.* *Prerequisites: fluid mechanics, Partial derivative equations, solid mechanics.* *Content: Introduction to CFD, Fundamental equations, numerical techniques, Fluid structure interactions, Practical Works (using of ANSYS, 18h).* *This lesson is classical coupled with a project using CFD.*	Fall – S9	2
52-13 Project	Fall – S5	3
II7C7A4I History of Nuclear Energy	Fall – S7	2
II7C7A5I Ethic and epistemology	Fall – S7	2
Spring semester		
II6C111I – Applied Thermodynamics *Course objective: get familiar with the concepts of heat transfer and energy conversion. Apply the fundamental principles to concrete situations.* *Prerequisites: elementary physics. Partial differential equations.* *Content: Introduction to the fundamental quantities of thermodynamics, fundamental principles, and thermodynamic relations. Perfect gases, real gases. Condensable substances. Thermodynamic diagrams, tables and cycles. Thermo-mechanical converters: internal and external combustion engines, refrigeration machines, heat pumps.*	Spring – S6	3
II6C112I - Heat transfer *Course objective: know how to solve a heat transfer problem in an industrial context.* *Prerequisites: general physics.*	Spring – S6	2

Content: conduction and convection of heat (thermal resistance, global exchange coefficient). Radiation (black body theory, Wien and Stefan laws). Practical examples: building insulation, heat transfer in industrial devices.		
II6C114I - Fluid Mechanics *Course objective: understand the physical properties of fluids and the principles of fluid motion.* *Prerequisites: elementary physics, mathematics and mechanics.* *Content: physical properties of usual fluids, density, surface tension, viscosity. Pressure and hydrostatics. Kinematics of fluids, streamline, streakline, pathline. Local mass and momentum conservation equations. Inviscid fluid and Bernoulli's theorem. Real fluid and head losses, pumps.*	Spring – S6	4
II6C115I – Strength of materials *Course objective: determine stress and strain in beams. Design beams to prevent failure.* *Prerequisites: elementary mechanics, general physics and calculus.* *Content: calculation of stress and strain in beams for several types of loads: traction, shearing, torsion, bending, buckling. The lesson consists of topics such as fundamental principle of statics, linkage (e.g. pivot), Hooke's law, safety coefficient, cohesion torsor, design of beams…*	Spring – S6	4
122-3 Hydraulics *Course objective: apply the principles of inviscid fluid motion to engineering problems involving flows in pipes, obstacles, and turbomachines.* *Prerequisites: elementary fluid mechanics, general physics and calculus.* *Content: application of first principles to flows through streamtubes. Force and torque exerted by water on obstacles and pipes, application to engineering situations. Properties of steady flows in a rotating frame. Introduction to turbomachines.*	Spring – S8	2
122-1 Transmission in Mechanical Devices *Course objective: get to know how to design a transmission system. Evaluate transfer of power, force and torque. Calculate the mechanical efficiency of the transmission system.* *Prerequisites: general mechanics, general physics and calculus.* *Content: general considerations about the transmission of energy, power, force and torque. Transmission wheels, gears, belt-drive, chain-drive. Contact mechanics : large surfaces, Gauss friction laws. Contact through small surfaces, Hertz theory.*	Spring – S8	4

II6C116I - Probabilities and statistics *<u>Course objective</u>: know how to exploit data, set up hypothesis tests, verify specifications.* *<u>Prerequisites:</u> mathematics.* *<u>Content</u>: notions of sample, sampling, sample quality. Positional variables, dispersion, major statistical laws (normal law, Poisson law, etc.), conformity tests (Chi-square, framing of means, etc.).*	Spring – S6	2
II6C122I - Polymers & composite materials *<u>Course objective</u>: master basic notions about polymers and composites, their properties, their use and their shaping.* *<u>Prerequisites:</u> elementary material science.* *<u>Content</u>:* *- Plastic materials: thermoplastic, thermoset and elastomer.* *- Characteristics and architecture of polymers.* *- Structures of polymers: crystalline, amorphous and semi-crystalline states.* *- Techniques for identifying polymer characteristics (DSC, XRD, ATD...).* *- Polymer cohesion: covalent bonding, V d W, and hydrogen.* *- Mechanical properties and rheology of polymers. Shaping.*	Spring – S6	2
II6C131I - Statistics of industrial production *<u>Course objective</u>: get to know how to monitor and correct the drifts of an industrial production. Identify the parameters and interactions that allow the optimization of the process. Analyze control charts and capability indicators.* *<u>Prerequisites:</u> statistics.* *<u>Content</u>:* *- Introduction to experiments design. Matrix of experiments and interactions between parameters. ANAVAR (estimation of the error on contrasts).* *- Modeling, multilinear regression.* *- Optimization, alias generator.* *- Mean/spread maps. MSP.* *- Random and systematic dispersion.* *- Indicators.* *- Repeatability & Reproducibility (R&R).*	Spring – S6	2
II6C134I - Project	Spring – S6	3
62-16 English	Spring – S6	2
II6C137I - Written communication *<u>Course objective</u>: know how to communicate in writing, synthesize information and transmit it to colleagues.* *<u>Prerequisites:</u> none.*	Spring – S6	1

<u>Content</u>: *1) Understand the media and the press.* *2) How to write a summary note.* *3) How to write notes and articles.*		