



BEMS



Syllabus of the specialty BEMS

Building & Safety



BEMS





Syllabus

3A BEMS – S5

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Responsible: T. Lemenand



BEMS

 BEMS	English	 POLYTECH ANGRERS
	3A / Semester 5	
	28h TD	
		UE 5-1 General Skill

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Level B2 / CEFR.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction to achieve proficiency in everyday and professional situations.
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels groups based on ToEIC practice scores from the TOEIC . A base TOEIC score is required in the final year to graduate as an Engineer.

Contents:

Oral and written communication skills

Looking for a mandatory training experience abroad, writing a cover letter, a CV.

Communication skills in companies (letters, memos, emails, phone conversations, interviews etc.).

Current political, economic and social and professional issues.



Speech and presentation techniques.

Regular pronunciation and accent work.

Evaluation:

Continuous assessment (100%).

References:

 BEMS	Foreign Languages: German or Spanish	 UE 5-1 General Skill
	3A / Semester 5	
	12h TD	

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Basic oral and written communication skills.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1 ; A2 or B1 for the intermediate group,

A certification in German/Spanish is recommended for advanced students in final year.

Program:

Looking for a training experience abroad, writing a cover letter, a CV, an abstract.

Oral and written communication skills.

Communication skills in Companies.

Political, economic and social news.

Evaluation

100% Continuous assessment.

Learning outcomes:



Intermediate groups

- The student can write a CV in German/Spanish
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups

- The student can write a cover letter in German/Spanish
- The student can read an article or listen to a program in a standard language and comment on it.

References:

 BEMS	<i>Economics</i>	 POLYTECH ANGERS	
	3A / Semester 5		UE 5-1
	12 h TD		General Skill

Keywords:

market, economic growth, political economics, sharing economy.

Prerequisites:

none, except interest and curiosity.

Objectives:

- Understanding the issues of current economic debates
- Knowing about vocabulary and economic indicators



Contents:

- Economics challenge
- The basis of economics
- Economic news and analysis (student's reports)
- Sharing economy

Evaluation:

Continuous assessment (100%).

References:

 BEMS	<i>Sport / Scientific mediation / NaN</i>	
	3A / Semester 5	
	12h TD	General skills

Keywords: Sport ; Scientific mediation ; NaN

Prerequisites: None

Objectives:

Sport: Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

Scientific mediation aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

NaN: This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

Contents:



Specific actions are implemented during participation in one of the following three components:

- the practice of team and individual sports

- or scientific mediation
- or the NaN workshop

Evaluation:

Continuous assessment (100%)

 BEMS	Company knowledge & Accounting	 POLYTECH ANGERS
	3A / Semester 5	
	16 h TD	General Skill

Responsible Company knowledge (8h) : D. Rigole

Keywords: corporate functions, legal status, group, social economy, collaborative economy, CSR, business and corporate strategies

Prerequisite: None

Objectives: Discover :

- the main functions in companies
- the diversity of companies
- business and corporate strategies
- corporate social responsibility

Program:

- I- The main functions in companies
- II- All forms of companies : size, legal status, social economy, collaborative economy
- III- CSR
- IV- Business and corporate Strategies:

Evaluation: 100% Continuous assessment.

Learning outcomes: The student must be able to present any company: global presentation (activities, brands...),

Responsible Accounting « Fundamentals of Accounting and Financial Management» (8h) : V. Billaudeau

Keywords: Accounting, balance sheet, income statement, expense, income, assets, liabilities, cash, investment, financing

Prerequisite: none



Objectives: Discover the fundamentals of accounting and financial management

Program:

- Section 1: Presentation: Balance sheet and income statement
 - Management accounts: expense / income
 - Balance sheet accounts: assets / liabilities
- Section 2: Reconstruction of the balance sheet and the income statement
 - Go from the income statement to the balance sheet and vice versa
 - Impact study: cash flow / result
 - The result and the cash flow
- Section 3: Financing and investment operations
- Section 4: Some specific accounting concepts
 - VAT
 - ...

Evaluation: 100% Continuous assessment.

Bibliography: Colasse B., Comptabilité générale, Economica, 2000.

 BEMS	Functional analysis	 UE 5-2 Engineer's tools
	3A / Semester 5	
	5,33h CM + 10,67h TP	

Keywords: Value analysis, External Functional analysis, Internal Functional analysis, FAST, SADT, BdF.

Prerequisites: none.

Objectives: To know the function analysis tools, the design methods.

Program:

- Introduction to Value Analysis (VA)
 - *Historical review*
 - *VA characteristics and principal actors*
 - *VA steps*
- External Functional Analysis (VA)
 - *Needs analysis*
 - *Needs function analysis*
 - *Functions of service characterization*
 - *Functions of service prioritization*
- Internal Functional Analysis (VA)
 - *FAST, SADT, BdF technics*
 - *Cost estimates of functions of service*
 - *Functions of service prioritization*
 - *Functional prescriptions*
- Numerical modelling on TDC suite



Evaluation: 100% Continuous assessment.

Learning outcomes:

Students should be able to use the functional analysis tools to model and enhance the design of products and process.

References:

- L'analyse fonctionnelle: méthodes de recherche des fonctions, *Techniques de l'ingénieur, collection Pratique de la conception industrielle, article 0759*, mars 2012.
- Pratique de l'analyse fonctionnelle, Robert Tassinari, *Collection Fonctions de l'entreprise, Ed. Dunod*, mai 2006
- L'ingénierie concourante Un nouveau professionnalisme, C. Gobin, *Techniques de l'ingénieur, collection L'ingénierie de la construction, article C3050*, Mai 2001.
- Analyse fonctionnelle et construction, C. Gobin, *Techniques de l'ingénieur, collection L'ingénierie de la construction, article C3050*, Novembre 2003.
- Construction et conception Conditions d'une nécessaire concourance, C. Gobin, J.M. Perin, J.P. Franca, *Techniques de l'ingénieur, collection L'ingénierie de la construction, article C3054*, Aout 2004.

 BEMS	<i>Applied statistics for the engineer</i>	 UE 5-2 Engineer's tools
	3A / Semester 5	
	1,33h CM + 18,67h TP	

Keywords: ANOVA, Linear regression, Kruskal-Wallis test, Friedman test, T, Tinn-R, Rcommander.

Prerequisite: notions of courses Estimation and Tests and Statistics and Probability.

Objectives:

Introduce various exploratory statistical approaches that can be used depending on the nature of the available data. The illustration of the different statistical concepts discussed is performed using the R software (<https://www.r-project.org/>). The focus is on the interpretation of results and not on deepening theoretical concepts inherent in different approaches.

Program:

- The R software (read and record data; simple functions; graphics; Tinn-R; Rcommander package)
- Analysis of vector-type data structures (statistical description of data, graphical data visualization)
- Analysis of variance (ANOVA)
- Kruskal-Wallis test (non-parametric equivalent of the ANOVA 1 factor)
- Friedman test (non-parametric equivalent of the ANOVA 2 matched factors)
- Linear regression

Evaluation:



100% Continuous assessment.

Learning outcomes:

The student is able to choose the right statistical approach according to the nature and structure of the data. The student is able to use the R software for the calculation part and interpret the results obtained.

References:

Vincent Goulet - Introduction à la programmation en R, ISBN 978-2-9811416-6-8, Bibliothèque et Archives Canada, 2016

 BEMS	<i>Computer tools (Excel-VBA)</i>	
	3A / Semester 5	
	16h TP	Engineer's tools

Keywords: object oriented programming, Excel, VBA, macros, graphical interfaces, database, import/export, data modelling

Objectives: be able to develop numerical tools using Excel and VBA

Prerequisites: fundamentals of algorithmic and computer programming

Program:

- Bases of Excel
- Import/Export of data
- The use of spreadsheets
- The use of macros
- The use of PivotTables
- Introduction to Excel VBA programming
- Integration of VBA applications to Excel
- Development of user interfaces

Evaluation: continuous assessment (case study)

References:

[VBA Excel 2016 : programmer sous Excel : macros et langage VBA / \[Michèle Amelot\] St-Herblain : Éditions ENI, cop. 2016.](#)



[VBA Excel 2016 : créez des applications professionnelles : exercices et corrigés / \[Claude Duigou\] St-Herblain : Éditions ENI, cop. 2016.](#)

[Macros et langage VBA : apprendre à programmer sous Excel / \[Frédéric Le Guen\] St Herblain : Éd. ENI, cop. 2015.](#)

[Excel® 2013 et VBA : développez des macros compatibles avec toutes les versions d'Excel \(de 1997 à 2013\) / Mikaël Bidault Montreuil : Pearson, cop. 2013.](#)

[Introduction à la programmation avec VBA : applications avec Excel / Robert Chevallier, relecture scientifique, Jean-Michel Léry Montreuil : Pearson, cop. 2012.](#)

[Excel pour l'ingénieur : bases, graphiques, calculs, macros, VBA / Philippe Bellan,... Paris : Ellipses, impr. 2010.](#)

 BEMS	<i>Building technical monitoring I</i>	 POLYTECH ANGERS
	3A / Semester 5	
	12h TP	Engineer's tools

Keywords: Technical equipment, heating ventilation air conditioning, electricity, plumbing.

Prerequisite: none.

Objectives: Define systems of equipment and networks adapted to the typology of buildings, taking into account regulatory and environmental data.

Program:

Work by group of students who will have to study a technical system or equipment and write a report containing the technical description, the state of the art, the current suppliers, the technological evolutions, the novelties expected, ...



Evaluation:

100% Continuous assessment. Folder by group as a wiki.

Learning outcomes:

According the projects.

References:

 BEMS	Civil engineering	 UE 5-3 Building and Civil Engineering
	3A / Semester 5	
	8h CM + 12h TD	

Keywords: buildings construction stakeholders, Life cycle of buildings, Global performances of buildings, Real estate engineering

Prerequisite: All prerequisite of UE5-2 teaching unit " Engineering Sciences "

Objectives:

- To know the duties, assignments and scientific problematics supported by the main stakeholders involved in building construction, operations and maintenance.
- To know the various legal and technical frameworks related to buildings
- To apprehend buildings as systems and to be able to characterize their performances

Program:

- Part 1: the buildings' life cycle steps and the stakeholders involved from design to operations and maintenance
- Part 2: Technical, legal and financial repositories and frameworks (SELF-STUDY)
- Part 3: Buildings performances levers

Evaluation:



100% Continuous assessment (two tutorials report and an oral defence).

Learning outcomes:

- The student knows the duties of construction projects value chain stakeholders
- The student knows the different functions and performances of a construction

References:

Information basis (in French) : Techniques de l'Ingénieur, Groupe Moniteur

 BEMS	Structural mechanics	 UE 5-3 Building and Civil Engineering
	3A / Semester 5	
	8h CM + 12h TD	

Keywords: Fundamental Principle of Statics, linear elasticity, internal forces in a loaded beam, mechanical stress field, mechanical strain field, structural design, finite elements modeling.

Prerequisites: Fundamental concepts of physics and applied mathematics.

Objectives: Student should be able to calculate the mechanical actions, stresses and strains on a loaded beams and simple structures with linear elastic mechanical behaviour, and the initiation to the finite elements modelling.

Program:

- Introduction to the structural design and structural strength verification.
- Basic Principles of static
 - *Mechanical loads (forces, moment of force, ...)*
 - *Degrees of freedom*
 - *Mechanical linkages/boundaries conditions*
 - *Fundamental Principle of Static – Beam equilibrium equations*
- Geometrical properties of arbitrary cross sections
 - *Center of mass*
 - *First moment of area*
 - *Second moment of area – moment of inertia*
 - *Principal axes of inertia*
 - *Mohr's circle for moment of inertia*
- Analytical solution based on mechanics of materials (strength of materials)
 - *Mechanics of materials hypothesis*
 - *Computation of internal forces in a loaded beams*
- Numerical solution based on finite elements method (FEM)
 - *Stimulate the curiosity of students to the numerical solutions of mechanical problems. We will focused, on how to use the finite elements software cast3m, and not on the mathematical development of the finite elements method.*



Evaluation: 100% Continuous assessments.

Learning outcomes:

Students should be able to design a simple geometry civil engineering structures subjected to static loads.

References:

- Résistance des matériaux. P. Agati, F. Lerouge, M. Rosseto. DUNOD, 2008.
- Résistance des matériaux Tome 1 cours et exercices. A. Giet, L. Géminard. DUNOD, 1997.
- cast3m. <http://www-cast3m.cea.fr>.

 BEMS	Construction	 POLYTECH ANGERS	
	3A / Semester 5		UE 5-3
	8h CM + 12h TD		Building and Civil Engineering

Keywords: Finishing technologies, Durability, Maintainability, Safety

Prerequisites: Civil engineering materials and their durability

Objectives:

- To know operational performances of the main finishing elements of a construction
- To be able to select a finishing element according to its operational performances and its durability and maintainability.

Program:

- Buildings envelope
 - The facade
 - Roof terraces
 - Outside joineries
- Coverings
 - Paint
 - Floor coverings
- Bulkheads, communications
 - Internal woodwork
 - Stairs, lift

Learning outcomes:

The student is able to analyze a technical document and to respond to constructive requirements.

References:

- La technique du bâtiment tous corps d'état, H. Duthu, M. Platzer, *Ed. Le Moniteur*, Juin 2012.
- Les couvertures en tuiles: référentiels, terminologie et modèles, *Techniques de l'ingénieur, collection Techniques du bâtiment: Les couvertures*, article TBA1836, septembre 2006.
- Les différentes couvertures en ardoise, *Techniques de l'ingénieur, collection Techniques du bâtiment: Les couvertures*, article TBA1822, décembre 2005.
- Définitions et caractéristiques techniques de l'étanchéité des toitures terrasses, *Techniques de l'ingénieur, Collection Techniques du bâtiment: Les toitures-terrasses*, article TBA1905, mars 2006.
- Applications des revêtements d'étanchéité préfabriqués, P. Cognard, *Techniques de l'ingénieur, Collection L'enveloppe du bâtiment*, article C3556, février 2005.

- Fenêtres et portes extérieures Fonctions de base et terminologie, J. Besset, *Techniques de l'ingénieur, Collection Les fermetures extérieures des bâtiments, article C3610*, novembre 2002.
- Les enduits de façade Chaux, plâtre, terre, V. Le Roy, Ph. Bertone, S. Wheeler, Ed. Eyrolles, *Collection: Guide pratique*, Novembre 2010.
- Vocabulaire illustré de la construction, M. Paulin, Ed. Le Moniteur, Septembre 2003.

Keywords: Construction, shell, finishings, insulation, heating, carpentry.

Prerequisite: none.

Objectives:

The objectives of the course are the knowledge of the main techniques of civil engineering execution implemented during the construction of a building. To know the associated vocabulary. The environmental, cost, safety and construction aspects are considered.

Program:

- Construction of building
 - Masonry
 - Structural work
 - Roofing
- Interior fittings
 - Finishings
 - Insulation
 - Partitions and Ceilings
- Building energy
 - Heating
 - Hot water
- • Building envelope
 - Carpentry
 - Facades

Evaluation



100% Continuous assessment (report about a finishing technique).

Learning outcomes:

The student will be familiar with the main civil engineering techniques used in the construction of a building. He will know the associated vocabulary.

References:

Procédés généraux de construction Tome 1 : Coffrage et bétonnage, J. MATHIVAT, Eyrolles.
 Bâtir, Manuel de la construction, R. VITTONÉ – PPUR - Collection : Architecture.
 Travaux de construction, Technologie du bâtiment - Gros œuvre, H. RENAUD, Ed. : Foucher.
 Memotech de Génie Civil, J.M. DESTRAC, D. LEFAIVRE, Y. MALDENT et S. VILA, /, Ed. Casteilla.
 Guide du constructeur en bâtiment, R. ADRAIT et D. SOMMIER, Collection Hachette.

 BEMS	<i>Building acoustics</i>	 UE 5-3 Safety and comfort
	3A / Semester 5	
	6h CM + 6h TP	

Keywords: Building acoustics, acoustics losses, acoustic insulation, acoustic regulation.

Prerequisite: vibratory physics.

Objectives:

- Knowing the acoustics of the buildings to allow the application of the regulation and the improvement of housing.

Program:

- Characterize acoustic comfort performance
 - Physical acoustics/ Definitions in acoustics of the buildings
 - Regulation in acoustics
 - Calculations of soundproofing/ Calculations of acoustic correction
 - Solutions of soundproofing in acoustics of the buildings
- Measuring impact of dimensional and environmental factors by using the software "Acoubat" from C.S.T.B. Company.

Evaluation:

100 % Continuous assessment.



Learning outcomes:

The student is able to recognize the origin of the noise, the origin of acoustic losses, to provide solutions of improvement.

The student is able to check by calculation or by software acoustic performance and comfort of a room.

References:

- "Réussir l'acoustique d'un bâtiment" - Loïc Hamadon - ed. Moniteur
- "L'acoustique du bâtiment par l'exemple" - ed. Moniteur
- « Acoustique et réhabilitation » - Simonin Adam Christine – PUCA - 2002

 BEMS	Geotechnical	 UE 5-3 Building and Civil Engineering
	3A / Semester 5	
	5,33 CM + 6,67h TP	

Keywords: geotechnical engineering, soil mechanics, positioning, triangulation, volume measurement, longitudinal section, return period, catchments area.

Prerequisite: notions of trigonometry.

Objectives:

- Identify and characterize the physical and mechanical properties of soils,
- Classify soil, design geotechnical structures
- Knowing the main disciplines and methods that contribute to the implementation and sizing of structures of VRD.

Program:

- GEOTECHNIQUE
 - Missions and geotechnical engineering recommendations
 - Program and classification of geotechnical Missions
 - Geological, morphological and other hazards
 - Geotechnical investigation
 - Choosing a principle of foundation by in-situ and laboratory test
 - Selection of soil for embankment
 - Soil mechanics
 - Shear behaviour and limit equilibrium in the solid masses soil
 - Reactions on the works: general shear failure mechanism and bearing capacity
 - Calculations of bearing capacity and subsidence under a foundation
- VRD
 - Drainage system
 - Technology
 - Methods and sizing networks

Evaluation:

100% Continuous assessments: case study.

Learning outcomes:

The student is made aware of the responsibility of the prime contractor for the prevention of risks related to the soil.



The student is able to characterize soils and geotechnical structures.

The student is made aware of the need for hydraulic management.

The student is able to control and analyze a geotechnical or sanitation study.

References:

- Eurocode 7: calcul géotechnique
- Recommandations étude géotechnique (CCM Recommandations TI 96 – note n°1)
- Mécanique des sols: aide-mémoire: concepts, applications / Yves Berthaud, Patrick de Buhon, Nicolas Schmitt
- Introduction à la géodésie / Jean-Philippe Dufour ; Hermès science, 2001
- La pratique des VRD ed. du Moniteur
- Instruction technique relative aux réseaux du 22 juin 1977

 BEMS	Materials	 POLYTECH ANGERS
	3A / Semester 5	
	5,33 CM + 6,67h TD	Building and Civil Engineering

Keywords: Rheology, thermal, fire behavior, elasticity, fatigue, creep, HQE label, Fdes, durability, energy consumption.

Prerequisites: none.

Objectives: Knowing the building materials and be able to predict their behavior according to their physical performance (mechanical, thermal...) in the short and long terms and according to their environmental impact.

Program:

- General properties
 - different classes of materials
 - macroscopic properties, behavior laws
 - sustainability and pathologies related to the properties or implementation, and aging disorders
 - choice of materials according to economic, health and environmental criteria
- The main building materials and the study of their properties, their pathology and their environmental impact, i.e.: the different types of binders, cement concrete, wood in its different forms and metallic materials such as steel and aluminum.

Evaluation:

100% Continuous assessment.

Learning outcomes:



The student recognizes the families of materials and is able to classify materials.

The student is able to understand the physical and mechanical behavior of the material.

The student seeks to identify the composition of a material and its influence on its properties and its use in construction.

References:

- Les propriétés physico-chimiques des matériaux de construction : matière & matériaux, propriétés rhéologiques & mécaniques, sécurité & réglementation, comportement thermique, hygroscopique, acoustique et optique / Christian Lemaitre Eyrolles, 2012
- Précis des matériaux / Michel Dequatremare, Thierry Devers Dunod, 2012

 BEMS	<i>Building: energy, maintenance, safety</i>	
	3A / Semester 5	UE 5-3
	4h TP	Building and Civil Engineering

Keywords: Building safety, reliability.

Prerequisite: Construction systems.

Objectives:

To know the principles applied when designing and building safety in a building. Know the principles implemented during the study and evaluation of the reliability of building components and technical equipment.



Program:

- Security in buildings
 - Principles applied
 - Development and implementation
- Reliability
 - Building structure
 - Technical equipment

Learning outcomes:

The student will be familiar with the principles applied in the design and development of safety in a building. It will know the principles implemented during the study and evaluation of the reliability of building components and technical equipment.

References:

 BEMS	<i>Applied heat transfers</i>	 UE 5-4 Energy and Fluids
	3A / Semester 5	
	8h CM + 8h TD	

Keywords: Thermal conduction, radiation, convection, energy, fan, pump.

Prerequisite: Physics and mathematics.

Objectives:

To know the orders of magnitude of energy of the energy systems encountered in the industry and the building. Know how to calculate thermal transfers in usual practical cases, steady state and variable regime.

Program:

- General information on heat transfer
- Continuous heat transfers
 - The heat equation
 - Unidirectional transfer: single wall / multilayer wall / composite wall / hollow cylinder / ...
 - The fins: the bar equation / heat flux and efficiency of a fin / choice of fins
- Heat exchangers
 - Co-current exchangers
 - Counter-current heat exchangers
 - Logarithmic mean difference of temperatures

Evaluation:



100% Continuous assessment.

Learning outcomes:

The student will know the orders of magnitude of energy of energy systems encountered in industry and building. He will be able to calculate thermal transfers in usual practical cases, steady state and variable regime.

References:

- Fondamentaux d'hydraulique pratique - Clim / Energies Renouvelables – Ed. Tethila.
- Systèmes énergétiques – PPUR presses polytechniques.
- Réseaux de chaleur et énergies renouvelables – Ed. Géo conseil.
- Chauffage, isolation, et ventilation ... – Ed. Eyrolles.

 BEMS	HVAC engineering	 POLYTECH ANGERS	
	3A / Semester 5		UE 5-4
	16h CM + 8h TD		Energy and Fluids

Keywords: Air Conditioning Systems - Ventilation systems - Filtration - Diffusion - Hydraulic systems.

Prerequisites: Basic principles of thermodynamics knowledge and heat transfer. Knowledge of technical systems of buildings

Objectives: To know the various technical equipments for HVAC air conditioning, ventilation and hydraulic systems, filtration and diffusion of air in a building.

Program:

- Refrigeration cycles
 - Compressor refrigeration machines
 - Absorption refrigeration machines
 - Refrigerants
- Psychrometry
 - Characteristics of moist air
 - Wet Air Diagram
 - Basic evolutions of treated air
- Air conditioning systems
 - Direct expansion systems
 - All air systems
 - All water systems
- Ventilation systems
 - Ventilation circuits
 - Air Filtration
 - Air diffusion



Evaluation: 100% Continuous assessment.

Learning outcomes:

The student knows the different methods of refrigeration production, the most common refrigerants and the restrictions related to their use and recycling. The student is familiar with the various systems and materials used for the refrigeration production, as well as materials related to the distribution, filtration and diffusion of treated air.

References:

- Fondamentaux d'hydraulique pratique - Clim / Energies Renouvelables – Ed. Tethila.
- Technologie des installations frigorifiques – Ed. Dunod.
- Les bases du froid – Ed. Didafrio.
- Aide-mémoire du froid industriel – Ed. Dunod.
- La climatisation solaire / Thermique ou photovoltaïque – Ed. Dunod.
- Systèmes énergétiques – PPUR presses polytechniques.
- Aide-mémoire de génie climatique – Ed. Dunod/ Pyc.

 BEMS	<i>Thermal equipment's of building</i>	 POLYTECH ANGERS
	3A / Semester 5	
	16h CM + 4h TD	Energy and Fluids

Keywords: Heat production - Heating - Fossil fuels (fuel oil, gas,...) - Boilers - Renewable energies (solar thermal, geothermal, ...).

Prerequisite: Basics of thermodynamics and heat transfer.

Objectives: To know the different technical equipment allowing the production of heat and the heating in a building.

Program:

- Theoretical basis of heating
 - Combustion / Fuels / Heating installations
 - Flow / mixing control
- Heat production
 - Conventional generators / Condensing boilers
 - Heat pumps / Solar thermal energy
 - Cogeneration / Urban district heating network / Fuel cells
- Hydraulic systems
 - Hydraulic circuits (primary / secondary)
 - Safety devices / Treatment of impurities / hydraulic balancing

Evaluation:



100% Continuous assessment.

Learning outcomes:

The student knows the principles of burning fossil energy used in fuel or gas boilers. The student knows the different systems and materials available to ensure the heating of a building, he knows the advantages and disadvantages of each system. Student can assess the cost and environmental impact of using a particular energy.

References:

- Les pompes à chaleur – Ed. Eyrolles.
- Chauffage au bois: choisir un appareil performant – Ed. Terre vivante.
- Réseaux de chaleur et énergies renouvelables – Ed. Géo conseil.
- Installer un chauffage ou un chauffe-eau solaire – Ed. Eyrolles.
- Cogénération / Améliorer l'efficacité énergétique – Ed. Dunod.
- La chaudière - Ed. ComprendreChoisir.com.
- La pile à combustible. 2e éd. / L'hydrogène et ses applications – Ed. Dunod.
- Chauffage, isolation, et ventilation ... – Ed. Eyrolles.
- Régulation en génie climatique: Froid, Climatisation, Chauffage – Ed. Dunod.
- Le guide du chauffage géothermique – Ed. Eyrolles.

 BEMS	Electrical risks, legal authorization to access the electrical rooms	 UE 5-4 Energy and Fluids
	3A / Semester 5	
	8h TD + 4h TP	

Keywords: Electrical risks in medium and high voltage, residual current protection, legal French authorization to access at the electrical rooms, NFC18-510.

Prerequisites: none.

Objectives:

- To know the current effect in the human body,
- To be able to identify the electrical risks and to know the protections to remove them.
- To meet the requirements of the standard NFC 18-510 for H0B0 and BS authorization.

Program:

- Electrical risks:
 - Electrical shock, Direct and indirect contact, Current effect in the human body, The requisite attitude in the event of an accident, Protection against direct contacts, Protection against indirect contacts.
- legal electrical authorization: H0B0 and BS
 - Program of the standard NFC 18-510

Evaluation:



100% Continuous assessment: theoretical and practical test for electrical authorization in accordance with the standard NFC18-510.

Learning outcomes:

The student will know the effects of electric current in the human body, he will know the electrical risks and he will know the personal and collective protections to be established if necessary.

References:

- AFNOR, Norme NFC 18-510: Opérations sur les ouvrages et installations électriques et dans un environnement électrique - Prévention du risque électrique, AFNOR. Consultable gratuitement en ligne (<http://www.boutique.afnor.org>)
- Recueil UTE C18-510-1 Juin 2012: « Recueil d'instructions générales de sécurité d'ordre électrique »
- Roland CHOQUET, Jean-Claude GILET, « Sécurité électrique », RGS Edition, 352 pages, ISBN: 2-905015-24-1
- René BOURGEOIS, Denis COGNIEL, « Electrotechnique », Casteilla, 719 pages, ISBN: 2-7135-2650-7

 BEMS	<i>Electrical installations and machines</i>	 UE 5-4 Energy and Fluids
	3A / Semester 5	
	8h CM + 8h TD + 12h TP	

Keywords:

Electrical motors, electrical lighting, electrical heating system, sizing.

Prerequisites:

Electrics: direct current, single phase and three phases circuits

Mechanics: fundamental principle of the dynamics, moment of inertia.

Objectives:

To understand the operation principle of the different electrical loads in building (Electrical motors, electrical lighting, electrical heating system) and their sizing and regulation principle.

Program:

Lessons:

- Electrical motors:
 - motor sizing,
 - ASynchronous Motor,
 - Generators and synchronous condensers (Synchronous Motor),
 - Direct Current Motor,
 - Single phase motors.
- Electrical lighting:
 - Lighting basis,
 - Technologies,
 - Sizing of room lighting.
- Heating system

TPs:

- ASynchronous Motor, Synchronous generators, Speed drive for ASynchronous Motor, Direct Current Motor.

Evaluation:

100% Continuous assessment: written test + TPs.

Learning outcomes:

The student will know the principle of operation of the different electrical loads of a building as well as their principles of dimensioning and regulation.

References:

- V. LEGER, A. JAMEAU « Conversion d'énergie, électrotechnique, électronique de puissance - Résumé de cours, problèmes corrigés », Ellipses, ISBN : 2-7298-1864-2.
- D.F. WARNE, « Génie électrotechnique », Dunod, 533 pages, ISBN : 978-2-10-0505.
- Patrick VANDEPLANQUE, « L'éclairage: Notions de base, projets d'installations », Tec & Doc (Editions), 270 pages, ISBN : 2-7430-0799-0.
- R. BOURGEOIS, D. COGNIEL « Electrotechnique », Casteilla, ISBN : 2-7135-2650-7.

- KOTZA, « Manuel du dépanneur - Manuel pratique de dépannage en froid, climatisation, électricité, hydraulique et régulation », KOTZA INTERNATIONAL, 1007 pages, ISBN : 2-00-191903-4.



BEMS





Syllabus

3A BEMS – S6

Version September 2022
Responsible: T. Lemenand



BEMS

 BEMS	English	 UE 6-1 General Skill
	3A / Semester 6	
	16h TD	

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Level B2 / CEFR.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction to achieve proficiency in everyday and professional situations.
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels groups based on ToEIC practice scores from the TOEIC . A base TOEIC score is required in the final year to graduate as an Engineer.

Contents:

Oral and written communication skills

Looking for a mandatory training experience abroad, writing a cover letter, a CV

Communication skills in companies (letters, memos, emails, phone conversations, interviews etc.)

Current political, economic and social and professional issues



Speech and presentation techniques.

Regular pronunciation and accent work.

Evaluation:

100% Continuous assessment.

References:

 BEMS	Foreign Languages: German or Spanish	 UE 6-1
	3A / Semester 6	
	12h TD	Général Skill

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Basic oral and written communication skills.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group,

A certification in German/Spanish is recommended for advanced students in final year.

Program:

Looking for a training experience abroad, writing a cover letter, a CV, an abstract

Oral and written communication skills

Communication skills in Companies

Political, economic and social news

Evaluation

100% Continuous assessment

Learning outcomes:



Intermediate groups

- The student can write a CV in German/Spanish
- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups

- The student can write a cover letter in German/Spanish
- The student can read an article or listen to a program in a standard language and comment on it.

References:

 BEMS	Communication	 POLYTECH ANGERS	
	3A / Semester 6		UE 6-1
	20h TD		General Skill

Keywords:

presentation, Internship report, poster.

Prerequisites:

none.

Objectives:



- Present a synthetic work experience
- Write an internship report
- Create a poster
- Stakes of the intercultural

Examination:

oral presentation and poster. 100% Continuous assessment.

References:

- L. Bellenger, *Etre constructif dans les négociations et les discussions*, Entreprise Moderne d'Édition, 1984.
- A. Da-Silva, *Savoir se présenter efficacement*, Kindle, 2012.
- M.I. Laborde, *Ecrire un rapport de stage*, Mémo 122, Seuil, 2012.
- B. Lebel, *L'art des présentations power point*, Broché, 2012.
- P. Morin, *Organisation et motivations*, les éditions d'organisation, 1989.
- P. Oléron, *L'argumentation*, Presses universitaires de France, 1987.
- W. Ury, *Négocier avec des gens difficiles*, Paris, Le Seuil, 1990.

 BEMS	Management	
	3A / Semester 6	
	20 h TD	General Skill

Keywords: organizational behavior, social influence, corporate structures, corporate culture.

Prerequisites: none.

Objectives:

To understand the human behavior in the organizations

To meet the requirements to act more effectively in a professional situation

Program:

Introduction to Organizational Behavior

I- Individual characteristics and behavior

- a. The diversity of individuals in organizations
- b. Individual determinants of organizational behavior

II-Groups

- a. Group pressure or conformism
- b. Standards in a group
- c. Group decision-making

III- The impact of the organizational context on behavior

- a. Corporate structure and behaviors
- b. Corporate culture

Evaluation:

100% Continuous assessment.

Learning outcomes:

Students must be able to analyze human behavior in organizational situations, to consider all possible determinants. Students must have understood the interest and limits of experiments in social psychology.

References:



Alexandre-Bailly F. (coll.): « Comportements humains et management » Ed. Pearson Education, 2006

Crozier M. et Friedberg E: « L'acteur et le système » Ed. Seuil, 1977

Doise W., Deschamps J-C. , Mugny G.: « Psychologie sociale expérimentale » Ed. Colin, 1991

Robbins S. et Judge T.: « Comportements organisationnels. »: Ed Pearson, 2011

Schermerhorn JR. Et al. (collectif): « Comportements humains et organisation » Ed ERPI, 2010

 BEMS	<i>Sport / Scientific mediation / NaN</i>	
	3A / Semester 6	
	12h TD	General skills

Keywords: Sport ; Scientific mediation ; NaN

Prerequisites: None

Objectives:

Sport: Physical and sports education courses help train future engineers, promote their physical and mental balance, facilitate their integration, strengthen the team spirit and the dynamics of the school. Being able to work as a team, communicate, build relationships of trust, be healthy and resist stress are qualities that are required of future engineers. The proposed sports activities involve new motor acquisitions, individual and collective strategies, and an adaptation to the effort. These elements contribute to development and are additional assets for their training. Our missions are to participate in the training of future engineers, to promote the physical and psychic balance of the students, to facilitate the integration of the students of the school, to strengthen the team spirit.

Scientific mediation aims to offer our students to create a link, an exchange, between the scientific / technical world and young students. It is important to note that a special place is given to the social responsibility of our future engineers who must contribute as significantly as possible to the dissemination of knowledge. This specific scenario also allows students who choose this activity to develop their interpersonal skills, to think about the best approach to impart skills and finally to implement elements to ensure that the learner has really progressed. The students involved in this action start by following training in scientific mediation which they then put into practice by sponsoring a group of young students during the robotics trophies. This national meeting puts teams of young students in competition around scientific and technical challenges.

NaN: This is an interdisciplinary, inter-institution program on the theme of Digital Arts-Sciences. This program is supported by the Research-Training-Innovation program in Pays de la Loire as the winner of the call for projects "innovative initial training". Since 2017, the workshop takes the form of a time weekly (Thursday afternoon, from 2:00 p.m. to 5:00 p.m.) of experiments and collective work led and supervised jointly by teachers from ESAD TALM and Polytech Angers. It brings together an average of twenty students, half registered at ESAD TALM Angers (having chosen the workshop from the TALM grids) and the other half registered at Polytech Angers. The work carried out by the students is presented during events: exhibitions at the Musée des Beaux-Arts d'Angers (in 2018 and 2019), installation at the Jean Lurçat museum in 2018, conference performed at the Quai in 2019, exhibition within the Lycée Joachim du Bellay in Angers in 2019.

Contents:



Specific actions are implemented during participation in one of the following three components:

- the practice of team and individual sports

- or scientific mediation
- or the NaN workshop

Evaluation:

Continuous assessment (100%)

 BEMS	Process optimization	
	3A / Semester 6	
	6.67h CM + 9.33h TD	Engineer's tools

Keywords: design of experiments, analysis of variance

Prerequisite: statistics, linear algebra

Objectives: To design and use experiments

Program:

- Bases of industrial process optimization
- Experiment principles
- Analysis of variance
- Two-level factorial experiments
- Taguchi experiments (design and interpretation)

Examination:



100% Continuous assessment.

Learning outcomes:

- The student builds and uses a full factorial two-level design plan
- The student conducts an ANOVA
- The student proposes a simple linear regression model
- The student is able to construct and explain a Taguchi design

References:

- La méthode des plans d'expériences, J. Goupy, *Dunod, 1988*.
- Conception de la qualité: les plans d'expériences, R.H. Lochner, J.E. Matar, *AFNOR, 1992*
- Pratique industrielle de la méthode Taguchi, J. Alexis, *AFNOR, 1995*
- Les plans d'expériences, G. Sado, MC. Sado, *AFNOR, 1991*
- Design and analysis of experiments, D. C. Montgomery, *Wiley, 2001*
- Design and analysis of experiments, A. Dean, D. Voss, *Springer, 1999*

 BEMS	<i>Building technical monitoring II</i>	 POLYTECH ANGERS
	3A / Semester 6	
	12h TP	Engineer's tools

Keywords: Technical equipment, heating ventilation air conditioning, electricity, plumbing.

Prerequisite: none.

Objectives: Define systems of equipment and networks adapted to the typology of buildings, taking into account regulatory and environmental data.

Program:

Work by group of students who will have to study a technical system or equipment and write a report containing the technical description, the state of the art, the current suppliers, the technological evolutions, the novelties expected,...



Evaluation:

100% Continuous assessment. Folder by group as a wiki.

Learning outcomes:

According the projects.

References:

 BEMS	<i>Eurocodes fundamentals</i>	 POLYTECH ANGERS
	3A / Semester 6	
	12h CM + 16h TD	Building and Civil Engineering

Keywords: Eurocodes, design, structural elements, concrete, wood, metallic structure.

Prerequisites: Mechanics of solids, applied mechanics.

Objectives:

- To understand the challenges (safety, durability, costs) and the design principles of building's structural elements and to be able to carry out basic design
- To catch the influence of material, geometrical, environmental (loads, temperature, moisture, chemical attacks...) parameters on the design and the stability of reinforced concrete, wood or metallic structures.

Program:

- General introduction - Course objectives and general objectives of Eurocodes (EC)
 - Eurocodes collection in 2013
 - Relation between Eurocodes
 - EC used for building design
 - Reliability requirements
 - Skillness, experience and quality requirements
 - Semi-probabilistic approach and limit states
- EC0 -
 - Requirements (equilibrium, strength, service capability)
 - Basic variables (actions, material properties, geometrical data)
- EC1 -
 - Density of materials
 - Operation load within buildings
 - Variable loads (snow, wind, thermal, during execution, traffic loads)
 - Exercises: Moment calculation, continuous beams, combined actions.
- EC2
 - Reinforced concrete principles
 - Fundamentals of design - Partial safety coefficient related to materials
 - Materials, simplified behaviour laws
 - Durability and steel cover
 - Design principles for a reinforced concrete beam
 - Examples of RC beam design
 - Examples of RC column design
- EC3
 - Example and notations concerning transverse sections
 - Characteristic strengths
 - Classification of transverse sections

- Columns case
- Assemblies case
- Trusses case
- EC5
 - Service class
 - Partial safety coefficients
 - Example : wood beam under fire



Evaluation: 100% Continuous assessment (two flipped classrooms).

Learning outcomes:

- The student has understood the concept of probabilistic design
- The student characterize static, snow, wind loadings effects on beams, slabs facades
- The student is able to design a reinforced concrete beam under pure bending
- The student is able to design a reinforced concrete slender column
- The student classifies metallic sections
- The student has understood the different steps of assembled metallic construction
- The student knows how to estimate wood beams creeping

References:

- EN 1990, Eurocode Base de calcul des structures
- EN 1991, Eurocode 1. Actions sur les structures
- EN 1992, Eurocode 2. Calcul des structures en béton
- EN 1993, Eurocode 3. Calcul des structures métalliques
- EN 1995, Eurocode 5. Calcul des structures en bois
- Eurocode 2. Béton armé Dispositions et données générales, J. Perchat, *Techniques de l'ingénieur, collection Les bétons spéciaux dans la construction, article C2330*, mai 2006.
- Eurocode 2. Béton armé Vérification des états-limites ultimes, J. Perchat, *Techniques de l'ingénieur, collection Les bétons spéciaux dans la construction, article C2331*, mai 2006.
- Eurocode 2. Béton armé Vérification des états-limites de service, J. Perchat, *Techniques de l'ingénieur, collection Les bétons spéciaux dans la construction, article C2332*, novembre 2006.
- Eurocode 2 – Béton armé Dispositions constructives, J. Perchat, *Techniques de l'ingénieur, collection Les bétons spéciaux dans la construction, article C2333*, novembre 2006.
- Base de calcul de l'Eurocode 3, *Techniques de l'ingénieur, collection Techniques du bâtiment: Construire métallique, article TBA1350*, mars 2006.
- Eurocode 5 - Calcul des structures en bois, Guide d'application, Y. Benoit, B. Legrand, V. Tastet, *Afnor, Ed. Eyrolles*, 2009, 510 pages.
- Sécurité incendie des ouvrages en structures métalliques: partie 1, J. Kruppa, *Techniques de l'ingénieur, collection Les constructions métalliques, article C2506*, novembre 2004.
- Sécurité incendie des ouvrages en structures métalliques: partie 2, J. Kruppa, *Techniques de l'ingénieur, collection Les constructions métalliques, article C2507*, novembre 2004.
- Eurocodes - Codes européens de conception des constructions, P. Bisch, J.A. Calgaro, *Techniques de l'ingénieur, collection Réglementation et planification dans la construction, article C60*, février 2004.

 BEMS	<i>Buildings Information Modeling</i>	 POLYTECH ANGERS
	3A / Semester 6	
	4h CM + 20h TP	Building and Civil Engineering

Keywords: Building Modeling, Autodesk Revit, C.A.D.

Prerequisites: technical drawing.

Objectives:

- To be capable of composing a digital model of the building with its three architectural, structural and fluid components.
- To be able to generate heating ratios, pressure drops in the ducts.

Program:

- Architectural modeling
 - Components
 - Families and Profiles
 - Components, surfaces
 - Presentation
 - Nomenclatures, annotations
 - Heating and cooling ratio
- MEP Project
 - Facilities
 - System definition
 - Control and dimensioning
- Structural model
 - Structural frame, framework

Evaluation:

100% Continuous assessment: Practical work on Autodesk Revit.



Learning outcomes:

The student is able to acquire automatisms and a methodology in C.A.O.

The student meets the requirements of precision and rigor of the function of designer.

References:

- Dessin technique et lecture de plan : bâtiment -gros œuvre / H. Renaud Paris : Foucher, 1989
- Dessin technique, lecture de plan : bâtiment - béton armé / H. Renaud Paris : Foucher, 1996
- Support de formation Bureau d'études Aricad 2015 : « Autodesk Revit 2016 : Concevez et Construisez vos projets BIM »
- Normes NF P 02-001, 02-003, 02-005.

 BEMS	<i>Building requirements for hygiene, safety, comfort</i>	 UE 6-3 Building and Civil Engineering
	3A / Semester 6	
	6h CM + 6h TP	

Keywords: Safety, health, comfort, functional analysis, performance ranking, Regulation.

Prerequisite: Building constructive methods.

Objectives:

- Know and apply the French and European requirements regarding comfort, health and safety.

Program:

- Compliance with technical regulations regarding the essential requirements for safety, health, comfort (European Construction Products Directive, National Health and Environment Plan, SRU act, departmental health regulations)
- Identify the functions of habitat safety, health and environment.
- Use the tools of functional analysis in terms of comfort safety
- The performance- prescription of functional groups of components

Evaluation:

100 % Continuous assessment.



Learning outcomes:

The student is able to identify a context, in relation to comfort and safety requirements.

The student is able to dimension and control the performance of buildings in relation to the needs of users in accordance with regulation.

References:

- Mémento des performances des ouvrages du bâtiment – Certu – Ministère de l'Équipement, des Transports, du Logement, du Tourisme et de la Mer – Décembre 2001
- Les outils de l'analyse fonctionnelle appliquée au bâtiment. Méthode APTE - APTE SA.
- Groupement du Mur Manteau : mémento pour construire en mur manteau

 BEMS	<i>Building and site safety</i>	 POLYTECH' ANGERS
	3A / Semester 6	
	6,67h CM + 13,33h TP	Building and Civil Engineering

Building safety

Keywords: Security integrated production facilities, collective means of prevention, protective clothing, general coordination plan, PPSPS, coactivity risks.

Prerequisites: Methods of risk analysis.

Objectives: Awareness of the need to evaluate work hazards on building site, know the organizational framework of prevention and define preventive measures when performing work, when maintaining building.

Program:

- The major accidentology in the construction industry and its typology, taking account of work accidents and occupational diseases, the analysis of the cause of the accidents.
- Prevention actors: how the on building site safety is related to the application of the Labour Code by the different institutional actors and private contractors on a construction site.
- The establishment of the general principles of prevention by organizing prevention in the enterprise. Application to building site logistics.
- Technical prevention on building site by the resources and methods employed. Application to risk reduction on a house wood frame building.

Learning outcomes:

The student is made aware in accordance to the safety on buildings sites work and interventions.

The student is able to justify actions to reduce risks in relation to representative situations.

The student is familiar with the organization of safety in the field of construction.

References:

- INRS documentation (French National Institute of Research and Safety for the prevention of work accidents and occupational diseases)
- Aide-mémoire BTP Prévention des accidents du travail et des maladies professionnelles dans le bâtiment et les travaux publics (INRS)

Site safety

Keywords:

Security of persons and property; buildings; public institutions (ERP); classified installations for the protection of the environment (ICPE); Code of Construction and Housing ; Code of Urbanism; Labor Code ; checks and verifications; Fundamentals of fire; thermal phenomena; police authority; Security Law.

Prerequisite:

None

Objectives:

- Understand the phenomena related to the fire and its development
- Understand the risks for people and issues of all kinds for builders; installers; owners and operators
- Allow students to acquire the minimum knowledge necessary for the subsequent approach of regulatory texts.

Program:

- Risks for people in buildings of all types;
- The fire phenomenon (combustion, development, propagation, different thermal phenomena ...);
- ERP; ICPE; housing: the regulatory context;
- Awareness of the Security Law.

Evaluation:

100% Continuous assessment

Learning outcomes:



Students will have to develop sensitivity to risk and especially to the risk of fire. They will be able to perceive the human and economic stakes of the claims and to deduce the place of these parameters in the management of the real estate patrimony.

They will be able to distinguish the fundamental differences in regulatory treatment between ERP and any other type of operation.

Students will have a partial vision of the division of responsibilities in the aforementioned fields.

References:

- Supports pédagogiques fournis par l'enseignant ;
- Code de la construction et de l'habitation
- Les phénomènes thermiques de l'incendie de bâtiment (Steve Brisebois et Martin Fournelle / France sélection)

 BEMS	Waste management	 POLYTECH ANGERS
	3A / Semester 6	
	4h CM + 4h TD	Building and Civil Engineering

Keywords: waste, waste management, nomenclature

Prerequisite: none

Objectives: Be able to organize Waste management in companies

Program:

- All about waste
 - What is waste?
 - Distinction based on activity at origin
 - Acquisition or loss of waste quality
 - The waste nomenclature
 - Fundamental Principles for Waste Management
 - The Polluter Pay principle
 - Obligations of the waste producer
 - The BSD / Waste Register

- Organize waste management in companies
 - The preliminary steps
 - Find out more
 - Raise awareness of staff
 - Main actions to be implemented
 - Transfer of responsibility
 - Contract Content
 - Financial aspects
 - Liability and insurance

Evaluation:

100% Continuous assessment.

Learning outcomes:



The student will be familiar with the principles and obligations to be set up for waste management.

References:

Base de données AIDA INERIS.

Légifrance.

Guide pour la gestion de déchets en entreprise – CCI IDF.

 BEMS	<i>Building: energy, maintenance, safety</i>	 POLYTECH ANGENERS
	3A / Semester 6	
	4h TP	Building and Civil Engineering

Keywords:

Building safety, reliability.

Prerequisite:

Construction systems.

Objectives:

To know the principles applied when designing and building safety in a building. Know the principles implemented during the study and evaluation of the reliability of building components and technical equipment.



Program:

- Security in buildings
 - Principles applied
 - Development and implementation
- Reliability
 - Building structure
 - Technical equipment

Learning outcomes:

The student will be familiar with the principles applied in the design and development of safety in a building. It will know the principles implemented during the study and evaluation of the reliability of building components and technical equipment.

References:

 BEMS	<i>Building thermal analysis (Regulation and Simulations)</i>	 UE 6-4 Energy and Fluids
	3A / Semester 6	
	8h CM + 6,67h TD + 20h TP	

Keywords: Building envelope, Thermal losses, Solar and internal gains, Heating load, Energy consumption, Building dynamic energy simulations, Energy management, Energy Efficiency, Thermal comfort assessment, Building energy regulation.

Prerequisite:

- Basic knowledge of physics and mathematics;
- Basic principles of thermodynamics and heat transfer;
- Knowledge of buildings and construction

Objectives:

- Knowing sources of heat losses and heat gains in a building;
- Being able to calculate heating loads and energy consumptions of buildings;
- Knowing and understanding the use of tools for prediction, optimization of the energy consumption of a building;
- Being able to assess thermal comfort in buildings and propose strategies to improve thermal comfort;
- Being able to run a regulatory calculation (French regulation) and understanding the underlying hypothesis of the calculation.

Program:

- Heat transfer: conduction, convection and radiation (recall);
- Heat losses through opaque and glazed walls (thermal resistance R, thermal transmittance U), through thermal bridges and by air renewal and infiltrations;
- Solar and internal gains;
- Useful gains, avoiding overheating in summer, thermal inertia, bioclimatic architecture;
- Dynamic building energy simulation (DBES) using the STD module of Pléiades+COMFIE;
- Introduction to performance guarantee and uncertainty in building simulations;
- Calculation of consumption using the French method (RT 2012 and RE 2020) and case study on Perrenoud software (RT module) or on Pléiades+COMFIE (RT module);

Evaluation

100% Continuous assessment (project reports, oral presentations, written exam).

Learning outcomes:



The student is able to model a building on Pléiades+COMFIE, to present its thermal characteristics and analyze the main issues.

The student is able to suggest and argue solutions in order to reduce the energy consumption and improve thermal comfort.

The student will be able to calculate the regulatory energy consumption of the buildings.

References:

- Bruno Peuportier, Éco-conception des bâtiments et des quartiers – Presses des Mines, 2008.
- Armand Dutreix, Bioclimatisme et performances énergétiques des bâtiments – Ed. Eyrolles, 2010.
- Jean-François Sacadura : Transferts thermiques, Initiation et approfondissement, 2015.
- CSTB, « Tout savoir sur l'expérimentation E+C- », MOOC Bâtiment Durable, décembre 2018.

	<i>Building energy</i>	
	3A / Semester 6	
	18h TP	
		UE 6-4 Energy and Fluids

Keywords: Building energy systems, Renewable energy, Coefficient of performance, Solar productivity, Efficiency

Prerequisite: Basic knowledge of physics

Objectives:

- Understanding the operating principle of energy systems commonly used in buildings;
- Determining of the efficiency of energy systems;
- Knowing the key parameters to design efficient energy systems;

Program:

- Study of the operating principles of an air to water heat pump;
- Study of the performance of a solar thermal collector;
- Study of the performance of photovoltaic solar cells;
- Study of the functioning of an air handling unit;

Evaluation:

100% Continuous assessment (exercises preparation; practical exercises during the session; experimental report).

Learning outcomes:



The student is able to explain the operating principles of the studied energy systems and to provide recommendations to improve their performance.

References:

Programme RAGE, « Pompes à chaleur air extérieur / eau en habitat individuel. Conception et dimensionnement. Recommandations professionnelles », Edition AQC, ISBN : 978-2-35443-115-0, Octobre 2013.

Programme RAGE, « Chauffe-eau solaire en habitat individuel. Conception et dimensionnement. Recommandations professionnelles », Edition AQC, ISBN : 978-2-35443-131-0, Juillet 2013.

Programme RAGE, « Systèmes photovoltaïque par modules rigides en toiture inclinées. Guide de conception, de mise en œuvre et de maintenance », Edition AQC, ISBN : 978-2-35443-127-3, Mars 2013.

 BEMS	<i>Environmental certifications of buildings</i>	 POLYTECH ANGERS	
	3A / Semester 6		UE 6-4
	5,33h CM + 4h TD		Energy and Fluids

Keywords: Environmental certifications – HQE Exploitation – BREEAM In Use – LEED EBOM (Existing Building: Operation and Maintenance) – DGNB – Sustainable building - Enhancement of existing buildings.

Prerequisite: Knowledge of building actors and links between them

Objectives:

- To know the major issues of sustainable buildings
- To know the aims and performance requirements of environmental certifications for existing buildings.
- To understand how to manage environmental certifications for existing buildings.
- To identify the most adapted environmental certification for one existing building, depending on the context and the actors involved.

Program:

- Major issues of sustainable buildings
 - Environment (Energy, Water, Waste, Transport, Construction, Biodiversity, Materials, Equipment's)
 - Wellbeing/Health
 - Economics (Maintenance, using charges, continuity of functioning)
 - Communication and enhancement
- Certifications – tools for continuous improvement and enhancement of existing buildings
 - Environmental certifications for existing buildings (main principles, benefits, overview of environmental certifications for existing buildings)
 - Presentation of the HQE Exploitation certification (SMEx/SMG, Categories, Bâtiment Durable/Gestion Durable/Utilisation Durable axes, Assessment process, Presentation of a real case)
 - Presentation of the BREEAM In Use certification (Categories, Asset/Building Management/Occupier Management axes, Assessment process, Presentation of a real case)
 - Presentation of the LEED EBOM certification (Categories, Assessment process, Prerequisites presentation)
 - Presentation of the DGNB certification
 - Comparison of the HQE Exploitation, BREEAM In Use and LEED EBOM certifications (strong and weak points)
 - E+C- label
- A step further: healthy buildings
 - Major issues of healthy buildings

- WELL Building Standard certification
- Introduction to life cycle assessment

Evaluation



100% Continuous assessment.

Learning outcomes:

The student will know the objectives and obligations of the certifications in operation, will include the management of certifications in operation, and will be able to identify the environmental certification in operation most adapted according to the context and the actors involved.

References:

- Referential HQE Exploitation – CERTIVEA Website.
- Referential BREEAM In Use – BREEAM Website.
- Referential LEED EBOM – USGBC Website.
- Referential DGNB – DGNB Website.
- Referential WELL Building Standard – IWBI Website.

 BEMS	Electricity energy distribution	 UE 6-4 Energy and Fluids
	3A / Semester 6	
	5,33h CM + 13,33h TD + 9,33h TP	

Keywords: Electrical protection, wire cross-section, overcurrent, fuse, circuit breaker, medium voltage substation, insulated switchgear, standard NFC15-100 and NFC 12-100.

Prerequisites: Three phases circuit, electrical risks

Objectives:

- To know the principle of the Earthing systems and size their protection elements (Earth connection, Residual current protection, ...)
- To know the infrastructures of electrical energy distribution in building.
- To size electric conduit and its protections.

Program:

- Earthing systems
- Medium voltage substation
- Sizing of electric conduit (wire, cable, wire cross-section)
- Equipment protection (Required functions in electrical circuit, Default in electrical installation, Protection against overcurrent, Short-circuit current, Protection against overvoltage)
- Case of home installation: standard NFC15-100
- Student presentation about: Electrical standards, Management and quality of electrical energy, Legal controls in building with public

Evaluation:



100% Continuous assessment: written test (1h30) + presentation (15-20min) + TPs.

Learning outcomes:

The student will be familiar with the principle of Earth-Linking schemes and its sizing. He will know the structures of distribution of electrical energy in a building. He will be able to dimension an electrical pipeline and its protections.

References:

- AFNOR, « Norme NFC 15-100: Installations électriques à basse tension », AFNOR. Consultable en ligne (<http://www.boutique.afnor.org>)
- SCHNEIDER ELECTRIC, « Distribution Electrique BT et HTA Compléments techniques 2012 », SCHNEIDER ELECTRIC. Consultable en ligne (<http://www.schneider-electric.fr>)
- René BOURGEOIS, Denis COGNIEL, « Electrotechnique », Casteilla, 719 pages.
- Patrick LAGONOTTE, « Les installations électriques », Hermes Science Publications.

 BEMS	Low currents	 UE 6-4 Energy and Fluids
	3A / Semester 6	
	4h CM + 8h TP	

Keywords:

Voice Data Image Network, telephony, technical management system of building, supervision, image distribution, home automation and communication of fire safety.

Prerequisites:

digital electronics, feedback control system.

Objectives:

- to know the working principle, the technologies and the installation standards used in the low voltage systems (computer network, telephone network, Voice Data Image Network, technical management system, supervision...)
- to know the principles and the possible functionality of the intelligent buildings.

Program:

- Introduction: Definition, reminder of digital electronics and feedback control system.
- Sensors: Types, Metrological specification, Technology.
- Analogue data transmission: Current loop, Voltage loop.
- Digital data transmission: OSI model, Physical layer, Network layer, Transport layer, Presentation layer, Example of protocols
- Study of systems: Field network, Data network, Wireless network, Telephony, Intercom system, Image distribution (TV network), Access management, Technical management system and supervision of building, KNX building management, Home automation and multimedia, communication of fire safety.

Evaluation:



100% Continuous assessment: report and oral about study of system.

Learning outcomes:

The student will be familiar with the principle of operation, the technologies used and the installation standards of the low voltage systems. Students will learn the principles and functionality of smart buildings.

References:

- Tamara DEAN, « Réseaux informatiques », Goulet, 50 pages, ISBN: 2-89377-266-8.
- CIAME, « Réseaux de terrain - Description et critères de choix », Hermès Science Publications, ISBN: 2-86601-724-2.
- Patrick LALLEMENT, « Téléphonie d'entreprise - Codage, transport, signalisation, services, » Ellipses Marketing, 238 pages, ISBN: 978-2-7298-6117-9.
- René BESSON, « Réception TV numérique et analogique. Satellite, câble, numérique terrestre, WebTV... », Dunod, 276 pages, ISBN: 2-10-006885-7.

 BEMS	<i>Tutored project</i>	 POLYTECH' ANGERS
	3A / Semester 6	
	32h TP	Project

Keywords: Project, case study.

Prerequisites: Project management, quality approach.

Objectives:

To be able to carry out a workgroup till its end.

Program:

The subjects of tutored project vary from year to year according to the actuality and the evolution of the referential trades. They concern a particular technical field (heating, thermal or acoustic insulation, air conditioning, ventilation, air quality, etc.) that students will have to study from a technical point of view and generally study its application to a real case study.

Evaluation:

100% Continuous assessment.

Learning outcomes:



The student is able to apply project management methods.

The student is able to operate the best of the internal and external resources around the project.

The student can meet the project criteria in terms of time, investment, quality.

References:

According the project.

 BEMS	Internship	
	3A / Semester 6	
	17 weeks minimum	Internship

Keywords: Traineeship.

Prerequisite: None.

Objectives: To adapt to the operational constraints for the implementation of actions or projects during an internship abroad, in a company, an association or a university structure (research laboratory essentially). The main objective of the internship of the student abroad in the first year of the engineering cycle is to complete his training by an experience abroad in a professional context.

Program:

During his internship, the student is supervised by two people:

- a representative of Polytech Angers: pedagogical tutor,
- a representative of the host organization: tutor.

Evaluation

100% Continuous assessment: the general evaluation of the internship includes a note for the report, a note for the quality of the poster, a note for the oral presentation.

Learning outcomes:

The student will have to develop an ability to live, work in a different environment by language, culture, economic and social conditions, which is indispensable for every engineer. The student will be able to mobilize the knowledge acquired in the school and to show initiative and open-mindedness.

References:

- Guide de recherche du stage à l'étranger (Polytech Angers), distributed to all students.
- Guide du stage de 3A (Polytech Angers), distributed to all students.



BEMS





Syllabus

4A BEMS – S7

Version September 2022
Responsible: T. Lemenand



BEMS

 BEMS	<i>English</i>	 POLYTECH ANGERS
	4A / Semester 7	
	28h TD	UE 7-1 General skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Level B2 from the CEFR

Objectives:

- Validating TOEIC minimum score to graduate as an Engineer.
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

A practice TOEIC test is organized at the beginning of term 7 to set up language proficiency groups for TOEIC Preparation.

Program:

- Understanding the TOEIC test format and requirements.
- Practising oral and written communication skills.
- Reviewing and Strengthening English grammar skills.
- Regular practise of pronunciation and word stress.
- In company communication situations.
- Current political, economic and social issues.
- Oral proficiency practice.

Evaluation:



Continuous assessment

Learning outcomes:

- The student can speak about a technical issue related to his/her field of expertise.
- The student can infer and understand gist, purpose and details in a spoken document related to a general or technical topic.
- The student can infer and understand gist, purpose and details in a written document related to a general or technical topic.

The student can speak and write in a clear and fairly complex language.

References:

 BEMS	<i>Foreign Languages: German or Spanish</i>	
	4A / Semester 7	
	14h TD	General skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Basic oral and written communication skills.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group.

A certification in German/Spanish is recommended for advanced students in final year.

Program:

Oral and written communication skills
 Communication skills in Companies
 Political, economic and social news

Evaluation

100% Continuous assessment

Learning outcomes:



Intermediate groups

- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups

- The student can read an article or listen to a program in a standard language and comment on it.
- The student can write an abstract and a report in German/Spanish
- The student can make an oral presentation on professional topics
- The student can argue and justify his/her point of view fluently

References:

 BEMS	Global responsibility and prevention of occupational risks	 POLYTECH ANGERS	
	4A / Semester 7		UE 7-1
	12h TD		General skills

Keywords: occupational health and safety, occupational risks, ergonomic, occupational psychology, musculo skeletal disorder, psychosocial risks, single document

Prerequisites: Business organization, rules and regulation

Objectives:

This module is constructed on the base of the referential BES&ST «Bases Essentielles en Santé et Sécurité au Travail» formalised in 2005 (Inrs). It is intended to give to any future engineer essential skills in order to integrate occupational hygiene within all of his/her professional activities.

- **Identify in any working organization the human, social, economic and legal issues of occupational hygiene**
Regulatory and normative context, responsibilities
Internal and external actors of occupational hygiene
Occupational hygiene indicators and sources of information
- **Integrate occupational hygiene in the management of its activities and projects**
Vocabulary and definitions - Identify hazardous situations
Take into account the human factor at work including physical, physiological, cognitive and psychological dimensions, and the working reality
Identify et assess risks: a priori and a posteriori
Ergonomics, tools and methods
« Unique document » for risks assessment: methods and issue
Risks prevention – Prevention principles
- **Contribute to occupational hygiene management**
Occupational hygiene management and integrated management system, management commitment
Safety culture - Reflection on Lean Management: which issue for health at work?

Program: Tutorials

- Practice and study on concrete cases based on videos, photos and if possible role-playing, evaluation of working situations (human and technical)
- Calculation, analyses and interpretation of occupational hygiene indicators
- Analysis of the different dimensions of an occupational accident : causal tree method
- Identification and risks assessment : « unique document » construction and action plan

Evaluation: 100% Continuous assessment



Learning outcomes: Integration of occupational hygiene in its professional activity

References:

Sources d'information en santé et sécurité au travail, L. Laborde, B. Berlioz, M. Ferreira, *Techniques de l'ingénieur, collection Santé et sécurité au poste de travail, article se3950*, octobre 2008.

- Le guide de la sécurité au travail - Les outils du responsable, B. Péribère, Ed. AFNOR, 218 p., 2013.

- www.inrs.fr; www.anact.fr; www.travail-et-securite.fr

 BEMS	<i>Sport</i>	
	4A / Semester 7	
	12h TD	
		UE 7-1 General skills

Keywords: Physical and Sports Education

Prerequisites: None

Objectives:

Sports education courses help train future engineers by promoting physical and psychological development, by facilitating their integration, and by strengthening the team spirit and dynamics of the school.

Having the ability to work as part of a team, to communicate effectively, to build relationships of trust, be healthy and to withstand stress, are all qualities required of future engineers.

The sports activities proposed involve the acquisition of new motor skills, the implementation of individual and collective strategies, the resolution of problematic situations, while simultaneously requiring a constant adaptation of one's effort.

All of these elements contribute to the development of the engineers in the making and will be additional advantages for their training and their socio-professional integration.

Program:

The program of physical sports and artistic activities is built over the first four years of study at the school. Each engineering student must choose a different activity per semester from the five individual and team sports offered.

Evaluation:

100% Continuous assessment

Learning outcomes:

Each student is expected to participate actively. This requires serious commitment, both physically by "doing" and also reflectively by demonstrating "know how", with a cultural understanding of the activity. Physical investment will be carried out via the management of one's own physical and psychological integrity, and those of others (with adapted muscular, joint and cardio-respiratory warm-ups, and also respect of basic safety precautions).

The student will also have to demonstrate his / her ability to acquire skills specific to each sporting and artistic activity that he / she chooses. These teaching contents are grouped into three types of General Competences:



C1: To progress technically, tactically and / or behaviorally on one's individual and initial level.

C2: Achieve a performance in an enabling context.

C3: Produce the best possible result in a reference situation.

References:

Site UA Moodle : <http://moodle.univ-angers.fr/course/view.php?id=2687>

 BEMS	<i>Entrepreneurship</i>	
	3A / Semester 7	
	18h TD	General Skill

Keywords: Entrepreneurship, intellectual property,

Prerequisites: none

Objectives:

Discern the entrepreneurial spirit, the passion of entrepreneurs, their needs to create and innovate and their orientation towards action

Propose entrepreneurial projects

Establish creativity and monitoring methods

Build a CANVAS business model

Program:

This introductory course in entrepreneurship aims to develop students' sense of initiative and entrepreneurship, in order to make them discover and exploit their full entrepreneurial potential. The program sweeps the entrepreneurial process. Students are introduced to the process of business creation: from idea creation to marketing. This course integrates the concepts of industrial property: brands, model and patent. The concepts are approached through the construction of a virtual business that the students will build on the basis of creativity methods, construction of CANVAS business model through the creation of the identity and values of the business to be built.

Evaluation:

100 % continuous assessment.

Learning outcomes:

The student is expected to identify the stages of business creation and be able to organize a process from the idea to the realization of his entrepreneurial project. The student must understand the issues of intellectual protection and know the broad outlines of the rules of law that govern all activity in society

References:



BODELL, Richard W., Garry RABBIOR et Larry W. SMITH, *Entrepreneuriat - L'esprit d'aventure*, Montréal, Les Éditions de la Chenelière, 1994, 35 p. *

BODELL, Richard W., Garry GASSE, Yvon, et al., *PME - Posséder mon entreprise*, Vanier, Centre franco-ontarien de ressources pédagogiques, 1998, 281 p.* GASSE, Yvon, et al., *PME - Posséder mon entreprise*, (Guide de l'étudiant et guide pour réaliser le plan d'affaires),

JOHNSON, M. W. CHRISTENSEN C.M., KAGERMANN H. *Reinventing Your Business Model*. Harvard Business Review, Dec 2008

LE LOARNE, S. BLANCO, S. et al., *Management de l'Innovation*, Ed. Pearson, 2e édition, 2012

RIES E., *Lean startup*, ed Pearson, 2015, 319p

 BEMS	<i>Professional communication</i>	
	4A / Semester 7	
	20h TD	
		UE 7-1 General skills

Keywords:

Professional project, curriculum vitae, cover letter, meeting animation

Prerequisites:

French language written and spoken

Objectives:



- Preparing for job search
- Meeting and group animation

Examination:

- Oral checks (50%)
- Written tests (50%)

References:

- L. Bellenger, *Etre constructif dans les négociations et les discussions*, Entreprise Moderne d'Édition, 1984.
- V. Billaudeau, *Le recrutement : quelles pratiques actuelles ?*, [Julhiet Editions](#), 2012.
- M.J Chalvin, *Prévenir conflit et violence*, Paris, Nathan, 1996.
- S. Milgram, *Soumission à l'autorité*, Calman Lévy, 1974.
- R. Mucchielli, *La conduite des réunions: Les fondamentaux du travail en groupe*, ESF éditeur, réédité, janvier 2016.
- P. Morin, *Organisation et motivations*, les éditions d'organisation, 1989.
- P. Oléron, *L'argumentation*, Presses universitaires de France, 1987.
- [C.Papetti](#), [B. Dogor Di Nuzzo](#), *Un CV réussi !*, Ellipses, 2016.
- [D. Pérez](#), *Le guide du CV et de la lettre de motivation*, Solar, 2014.
- W. Ury, *Négocier avec des gens difficiles*, Paris, Le Seuil, 1990.

 BEMS	<i>Human Resource Management</i>	 POLYTECH ANGERS	
	4A / Semester 7		UE 7-2
	6,67h CM + 5,33h TD		Engineer's tools

Keywords: recruitment, training, compensations & benefits, competencies and skills management, labor conditions, employment, labor relations

Prerequisites: Connections with the labor law course.

Objectives: beyond the presentation of the HR scope, the goal is to understand the stakes that the decentralization of the HRM involves in terms of responsibilities for supervisors and managers.

Program:

- The development of the HRM : the evolution of the human dimension within organizations (2 hours)
- HRM Fundamentals : responsibilities and missions (4 hours)
- Cases (2 hours)

Examination: Continuous assessment



References:

Gestion des Ressources Humaines, J.M. Peretti, 17^{ème} édition, collection entreprise, Vuibert, Paris, 2012.

- Gestion des ressources humaines, L. Garcia, *Techniques de l'ingénieur*, collection Management de l'entreprise, article AG1430, janvier 2002.

- Évaluer les ressources nécessaires au projet : hommes, *Techniques de l'ingénieur*, collection Organiser et animer un projet, article 0881, aout 2012.

- Planifier les ressources nécessaires au projet, *Techniques de l'ingénieur*, collection Organiser et animer un projet, article 0881, septembre 2012.

 BEMS	<i>Public procurement</i>	 POLYTECH ANGERS
	4A / Semester 7	
	4h CM +4h TD	
		UE 7-2 Engineer's tools

Keywords: Public procurement, public contract, tender procedure, appropriate procedure tender.

Prerequisites: General organization of regional and local authorities and of public institutions

Objectives:

- To acquire the public tendering approach,
- To know the procedures to implement

Program:

- Public procurement : prerequisite - needs analysis
- Procurement methodology : the various procedures - procurement process
- Performance of the public contract

Examination: Continuous assessment

Learning outcomes:

The student is able to identify the responsibilities and obligations inherent in public procurement. He can offer the type of procedure and the advertising to be implemented according to the public contract and the amount of the purchase.



References:

Code des marchés publics.

- Réussir un achat public durable, G. Courtois, P. Ravenel, *Ed. du Moniteur*, 2008

- Le mémento des contrats complexes de la commande publique. La conception-réalisation ; Le partenariat public privé (PPP) : BEA, AOT, CP, P. Grelier Wyckoff, *Ed. Eyrolles*, mars 2012.

- Marchés de travaux Concessions de travaux publics – Procédures et contenu, B.M. Bloch, G. Flécheux, M. Bazex, *Techniques de l'ingénieur, collection Réglementation et planification dans la construction, article C71*, août 2012.

 BEMS	<i>Costing in multitechnics and services</i>	 POLYTECH ANGERS
	4A / Semester 7	
	5,33h CM + 8h TP	Engineer's tools

Keywords:

Financial costing, facility management, tertiary building, general services

Objectives:

Be able to perform financial costing of FM project.

Prerequisites:



Financial costing, maintenance, project management

Program:

- FM through the creation of a Specifications + Scoring grid
- FM through a Response to Specifications
- Innovation and Added Value
- FM through a Commercial Defense with Jury

Evaluation: continuous assessment

References:

 BEMS	<i>Literature search and analysis methodology</i>	 POLYTECH ANGERS
	4A / Semester 7	
	12h TD	Engineer's tools

Keywords: Literature review

Prerequisites: Project management, Real estate engineering, English

Objectives:

- To be able to quickly find the accurate literature references
- To analyse and to write a relevant literature summary.

Program:

- Analysis of the topic and first literature search
 - Assess its inner knowledge about the topic
 - Keywords definition
 - Science and technology documents data base
- How to deal with the information?
 - How to correctly use the documents?
 - How to cite a document?
 - How to write a bibliography?
- Reading of scientific papers related to real estate engineering
- Writing of a literature summary note.



Examination: Continuous assessment

Learning outcomes:

- The student knows how to make a literature review with keywords
- The student is able to quickly identify if a paper (written either in French or in English) is of interest
- The student knows how to summarize a technical or scientific paper
- The student is able to provide a synthesis of several papers related to the same topic
- The student is able to identify prospects of improvement for a scientific and/or technical topic

References:

- La recherche d'information et le travail documentaire, M.M. Castellanos, F. Delacroix-Tessereau, V. Delarue, P. Pouliquen, *Ed. Nathan, collection Repères Pratiques*, 2012, 144 p.
- Autres documents bibliographiques selon les sujets traités chaque année

 BEMS	<i>Listening to needs and measuring customer satisfaction</i>	 POLYTECH ANGERS	
	4A / Semestre 7		UE 7-3
	5,33h CM + 6,67h TD		Building Operations- Maintenance Engineering

Keywords: Marketing, listening to the market, design according to needs, functional specifications, customer satisfaction

Prerequisites: None

Objectives: Introduce students to the need to listen to customer needs very early on, before and during the design phase of a service or product. Make them practice the methods allowing to structure this listening in the marketing departments and design office.



Program:

- Reminder of the “Quality” concept
- Design at the heart of the Quality approach
- Usual flow of a design cycle
- Principle of listening to customers before and during design
- Formalization of customer listening through the Functional Specifications
- Customer criticism of new products or services offered by the use of value analysis methods and FMECA
- Research of latent needs with customers with the CEM method in order to innovate.

Examination: Continuous assessment

References:

- Normes AFNOR relatives aux méthodes de conception, d’analyse de la valeur, d’AMDEC...
- Expression du besoin et cahier des charges fonctionnel. Jacques Bernard Bouissières, Edition AFNOR : ISBN 2-12-465135-1
- Aide à l’élaboration du cahier des charges fonctionnel. Jacques Bernard Bouissières, Edition AFNOR : ISBN 2-12-465048-3
- La conception à l’écoute du marché. Shoji Shiba, ISBN 2-901-323-63-4

 BEMS	<i>Facility and service engineering</i>	 POLYTECH ANGERS	
	4A / Semester 7		UE 7-3
	8h CM + 12h TD		Building Operations- Maintenance Engineering

Keywords: Outsourcing - Facility Management – Contract - Maintenance

Prerequisites: Basic knowledge of labor law. Basic knowledge of management

Objectives: To be able to choose how best property management in a given having entered all the issues of outsourcing circumstances, knowing the market, the actors, risks, pitfalls and benefits of all alternative management of support functions.



Program:

- The history of support functions
 - In the military
 - in the civilian world
 - In politics.....
- The business of real estate development
 - Their evolution
 - Their current situation
 - the different actors on the world scene
 - The role of the public project
- Developing a list of operating expenses
 - The expression of needs and flowchart
 - Assumption outsourcing resources
 - Consultation and selection of candidates
 - Social constraint requirements and implications choice of partner
- The contracting
 - Pitfalls
 - Contract monitoring, control and penalties
 - Contract limits
 - Limits on the exercise.

Examination: Continuous assessment

References:

- Le Supervisor de services généraux Maimi & Parronchi Editions Dunod
- Guide Facilities le guide des services généraux Editions Française de Presse
- Baromètre annuel outsourcing Andersen Ernst & Young

 BEMS	<i>Economy in construction</i>	 POLYTECH ANGERS
	4A / Semester 7	
	5,33h CM + 6,67h TD	Building Operations- Maintenance Engineering

Keywords: Economy, construction, cost analysis, simulation, comparison, choice.

Prerequisites: Knowledge in calculations of "simple" costs.

Objectives:



- To be able capable of arresting the construction economy as a reflection on the costs management.
- To realize a technical and financial feasibility study in an operational arrangement. Plan and follow the spending.
- To raise awareness to the analysis in life cycle cost.

Program:

- Thème 1 : Method of the estimation, the tool of economic forecast
 - 1.1. Information necessary for the estimation
 - 1.2. Notion of estimation
 - 1.2.1. Econometric approach of the estimation
 - 1.2.2. Statistical foundations of the estimation
 - 1.3. Methodology to approach the estimation
 - 1.3.1. Choice of a structured method of analysis
 - 1.3.2. Creation of a base(basis) of statistical prices(prizes)
 - 1.3.3. Simulation and optimization
- Thème 2 : Forecast and follow-up of the spending
 - 2.1. Identification of the spending
 - 2.2. Projected payment schedules
 - 2.3. Financial system of property market
 - 2.4. Prices variations of property market

Examination: Continuous assessment

References:

 BEMS	<i>Operation and Maintenance contracts requirements and resources allocation</i>	 POLYTECH ANGERS
	4A / Semester 7	
	16h CM + 16h TD	Building Operations- Maintenance Engineering

Keywords: outsourcing, maintenance, real estate exploitation, contract requirements, contract, contract management

Prerequisites: Basic principles of, real estate maintenance, legislation and regulation of public market

Objectives:

Implementation of outsourcing maintenance framework, needs analysis and contract monitoring

Program:

- Context
 - Outsourcing
 - The involved actors
- Outsourcing procedure
 - Prec-contract step
 - Contract allocation step
 - Implementation step
 - Provider setting up
 - Risk management
 - Contract life cycle
- Case study



Examination: Continuous assessment

Learning outcomes:

The student is able to setting up a maintenance contract

References:

- OUTILS POUR SÉCURISER LES CONTRATS DE MAINTENANCE DE BÂTIMENTS, Méthode et outils de suivi, Didier Adda, Mike Sissung, Éditions du Moniteur.
- Entreprise Utilisatrice et Entreprises Extérieures, Guide d'aide à destination des entreprises pour une mise en œuvre opérationnelle de la démarche de prévention liée à l'intervention des entreprises extérieures, Carsat Nord-Picardie , Sébastien Triopon.

 BEMS	<i>Operation implementation methods and tools</i>	 POLYTECH ANGERS	
	4A / Semester 7		UE 7-3
	5,33h CM + 6,67h TD		Building Operations- Maintenance Engineering

Keywords: Facility management, set up contract, CAFM, Quality indicators, HQE certifications

Prerequisites: General Principles on real estate and building maintenance

Objectives:

- To understand a facility management site set up methodology
- To discover tools and methods to run the facility management of a site
- To learn how to manage a facility management thanks to quality indicators
- To discover HQE during operation, possible energy savings in a building, PFI (Private Finance Initiative)

Program:



- Setting up Planning
 - Objective
 - Milestones
- CAFM (Computer-Aided Facility Management)
 - Objective
 - Setting up methodology
 - Reporting set up
- Services home page
 - Objective
 - Setting up methodology
- Inventory and state analysis
 - Objective
 - Program
- Setting up team project
- Setting up services reporting
- Setting quality indicators
- Administrative setting up
 - Objective
 - Technical documents
- On-call technical support
- CTM (Centralized Technical Management), (BMS) Building Management System
 - Objective
 - Setting up methodology
- Regulatory control
- Classified Installations for Environment protection
- Building Security
- HQE Certifications
 - Objective
 - Targets

- Setting up methodology
- Building Energy savings
- The PFI (private finance initiative)

Examination: Continuous assessment

References:

- Référentiel pour la Qualité Environnementale des Bâtiments en Exploitation, *Certivéa*, Juillet 2009.
- Référentiel pour la Qualité environnementale des pratiques Bâtiments Tertiaires, *Certivéa*, Juillet 2009
- Référentiel du système de management de l'exploitation Bâtiments Tertiaires, *Certivéa*, Juillet 2009
- La maintenance du patrimoine bâti. Optimiser la gestion technique des bâtiments publics, J.P. Stéphant, *Territorial Editions*, juin 2006.
- Aide-mémoire Maintenance et GMAO. Tableaux de bord, organisation et procédures, J.P. Vernier, *Ed. Dunod*, janvier 2010.
- ICPE. Installations classées pour la protection de l'environnement, Principes et nomenclatures, P. Cherrière, *Ed. France-Sélection*, Mars 2008.
- Pratique des partenariats public-privé - Choisir, évaluer, monter et suivre son PPP, 2e édition, F. Lichère, B. Martor, G. Pédini, S. Thouvenot, *Ed. Lexis Nexis/Litec*, mai 2009.

 BEMS	<i>Technical monitoring III</i>	 POLYTECH ANGERS
	4A / Semester 7	
	12h TD	Building Operations- Maintenance Engineering

Keywords: information acquisition, information storing, information disseminating, technical monitoring

Prerequisites: computer basics, technical facilities, building disorders, building maintenance

Objectives:

Developing a scalable digital platform on 'Netvibes' using the web 2.0 technology, which will allow the monitoring of the evolution of technical facilities used in buildings and the techniques of maintenance and rehabilitation of buildings.

Program:

After completing the 'Netvibes' tool and choosing one of the themes below, the students will work in groups of 2 to 3 in order to develop a technical monitoring dashboard.

Topic 1: Power supply and lighting

Topic 2: Vertical traffic

Topic 3: Heating, Ventilation, Air Conditioning (HVAC)

Topic 4: Plumbing



Topic 5: Access control system and video surveillance

Topic 6: Energy efficiency of buildings.

Examination: Continuous assessment

Learning outcomes:

- The student knows how to do technical monitoring using a computers tools
- The student knows the mains technological developments in the technical building management field.

 BEMS	<i>Risk analysis methods</i>	 POLYTECH ANGERS
	4A / Semester 7	
	4h CM + 8h TD	Control of risks related to the operation of buildings

Keywords: Risk Analysis - FMEA - PRA - IDAR - HAZOP - Cause-Effect Diagram

Prerequisites: none

Objectives: Be able to perform a risk analysis on all types of situations. Be able to choose the right tool for a situation analysis. Create assessment scales and justify the evaluation criteria and risk classification.

Program:

- Risk analysis and risk
 - Risk typology
 - Vocabulary danger
 - Type of risks and business risk
 - Objectives and methods of risk analysis

- Tools
 - Cause and effect diagram - Chaining causal
 - FMECA and PRA (primary risk analysis)
 - IDAR (Intégrer – Développer – Analyser – Rapporter)
 - HAZOP (Hazard operating studies)
 - Choice of evaluation criteria - risk assessment
 - scale and aggregation operator
 - Risk analysis systems intrinsic risk

- threshold of acceptability
 - Setting a threshold of acceptability
 - semantics colored graph
 - ALARP, GAMAB, MEN Methods

Examination: Continuous assessment

Learning outcomes:



It is able to define a system of risk analysis for simple situations in FM, to use the most appropriate tool and create the acceptability level, threshold of risk

References:

Norme ISO 31000 - Management du risque — Principes et lignes directrices – AFNOR - 2009

Fonction Risk manager - Catherine Véret, Richard Mekouar - Dunod - 2005

Risque et complexité – J.L. Nicolet – Ed l’Harmattan – 2010 Technique de l’ingénieur

 BEMS	<i>The business continuity in the company</i>	 POLYTECH ANGERS
	4A / Semester 7	
	6,67h CM + 8h TD	Control of risks related to the operation of buildings

Keywords: Business Continuity Management (BCM) - Business Continuity Plan (BCP) - Crisis Management Plan (CMP) - Business Impact Analysis (BIA)

Prerequisites: None

Objectives: To be able to understand the principle of the BCM in the company and the various related plans (BCP, CMP...). Identification of risks and ways to improve the company's resilience. Acquire reflexes when the theme of business continuity is planned in the company.

Program:

- Origin, needs and obligations related to business continuity
- Manage business continuity in the company
 - The problem and the actors of the business continuity
 - Standards and Regulations
 - The Business Continuity Plan
 - Analysis of the risk scenarios used in the company
 - Business Impact Analysis (BIA)
- Business continuity methods and tools
 - Presentation of the E = BCM approach
 - Overview of technical back-up solutions
- Putting concepts into practice and deepening
 - Based on a practical simulation demonstrating that the theoretical notions have been acquired

Examination: Continuous assessment

Learning outcomes:



The student must:

- Be able to understand the stakes of the business continuity in the company
- Be able to project itself as a major stakeholder in this business project
- Be aware of the risks to avoid related to the business continuity
- Acquire theoretical reflexes allowing a clear approach of the notion

References:

Plan de continuité d'activité et système d'information, vers l'entreprise résiliente, de Matthieu Bennasar - Dunod 2010

« Guide pour réaliser un plan de continuité » du Secrétariat général de la défense et de la sécurité nationale – 2013.

 BEMS	<i>Constructions disorders</i>	
	4A / Semester 7	
	5,33h CM + 4h TD + 4h TP	Control of risks related to the operation of buildings

Keywords: Disorders within buildings, Diagnosis, Risks Identification, Correction, Prevention

Prerequisites: Civil engineering materials and their durability, Eurocodes fundamentals, General process of construction, Technical monitoring

Objectives:

- To know the main disorders encountered all along the life cycle of a building,
- To understand the reasons of these disorders,
- To propose a solution to correct or prevent them,
- To be able to write a report or an expertise survey after carrying out a technical diagnosis

Program:

- Introduction
 - Mandatory diagnosis
 - Internal and external factors of disorders
 - Disorders statistics
- Disorders of Construction Materials
 - Reinforced concrete alterations
 - Steel alterations
 - Wood durability
- Disorders of the main structure
 - Disorders resulting from soil-structure interaction,
 - Main Structure
 - Roofing and Frames
- Disorders of building envelop
 - Claddings
 - Bay windows
 - Thermal performances
- Disorders of fabric and finishings
 - Floor coverings
 - Internal vertical walling claddings
 - Ceilings
 - Acoustic isolation
- Disorders of Equipments and Installations
 - Thermal installations
 - Health installations

Examination: Continuous assessment



Learning outcomes:

- The student knows how to characterize in experts terms the physical environment in

- which is located the component for which the disorder is studied
- The student knows how to accurately describe the observed disorder
 - The student knows the main causes of the most frequent disorders
 - The student knows the main actions face to the most frequent disorders
 - The student is able to estimate the disorders' criticity (frequency, impact, detectability, evolution, mitigation, ...)
 - The student can compare several disorders and is able to prioritize them

References:

- Fiches Pathologie Bâtiment, Agence Qualité Construction, *Collection L'information professionnelle du maître d'œuvre*, Ed. AQC, Avril 2011.
- La pathologie des ouvrages de bâtiment, J. Drège, J. Putatti, C. Illouz, B. Caroff, G. Patierno, Ed. WEKA, Novembre 1997.
- La pathologie des façades, Diagnostic, réparations et prévention, Philippe Philipparie, Ed. CSTB, Aout 2011.
- Pathologies du béton armé Origine des désordres, J. Delefosse, *Techniques de l'ingénieur Collection Pathologie générale - Pathologie du béton*, article C6150, mai 2011.
- Pathologie de l'humidité. Parois revêtues en bâtiment Isolation thermique, P. Dahan, *Techniques de l'ingénieur, Collection Pathologie de l'humidité des parois - Pathologie des ponts*, article C7142, novembre 2008.
- Pathologie de l'humidité. Parois revêtues en bâtiment Analyse du phénomène, P. Dahan, *Techniques de l'ingénieur, Collection Pathologie de l'humidité des parois - Pathologie des ponts*, article C7144, novembre 2008.
- Pathologie de l'humidité. Parois revêtues en bâtiment Étude d'un cas concret, P. Dahan, *Techniques de l'ingénieur, Collection Pathologie de l'humidité des parois - Pathologie des ponts*, article C7146, mai 2013.
- Pathologie et entretien dans le bâtiment Introduction et évolution, C. Saint-Martin, *Techniques de l'ingénieur, Collection Pathologie générale - Pathologie du béton*, article C7000, novembre 2008.
- Dégradation, durabilité des peintures, T. Lucas, *Techniques de l'ingénieur, collection Matériaux: résistance à la corrosion et au vieillissement*, article COR510, juin 2007.

 BEMS	Anticipation of risks related to the operation of buildings	 POLYTECH ANGERS
	4A / Semester 7	
	10,67h CM + 10,67h TP	Control of risks related to the operation of buildings

Keywords: Work legislation, Sustainability/Maintenance, Security, Safety, Healthcare, post-building operations

Prerequisites: Knowledge in building maintenance

Objectives: Be able to integrate security matters during the conception time in order to facilitate inherent maintenance interventions on buildings



Program:

- **Conception studies overview**
 - Conception steps
 - Actors
- **Legal frame**
 - Worker safety: working legislation
 - Public safety: ERP Fire legislation
 - Environment protection: French regulations
 - People & goods protection: Insurance private rules (APSAD)
 - Norms/Standards
- **Safety integration**
 - Coordinator investigations
 - The 5M's methods
 - Risks and preventions
- **Choice of protection measures**
 - Regulations, legislations
 - Other criteria
- **Conception supports**
 - Bibliography
 - Advice

Examination: Continuous assessment

References:

INRS leaflet
 French working legislation

 BEMS	<i>Fire fundamentals and Fire engineering Phenomenology</i>	
	4A / Semester 7	UE 7-4
	8h CM + 6,67h TD + 9,33h TP	Control of risks related to the operation of buildings

Fire fundamentals

Keywords: Stoichiometric point, flames, pyrolysis, combustive, combustible, exothermy, propagation modes, free radicals.

Prerequisites: triangle and tetrahedron fire

Objectives:

- Becoming familiar with the physical and chemical constants of fire
- Knowing the conditions for fire emergence and propagation modes
- Acquiring a way of thinking anticipating the dynamic conduct of fire.

Program:

- Combustion
 - Triangle and tetrahedron fire
 - Combustible, oxidizer, activation energy
 - Characteristics of fuel
 - Stoichiometric point
 - Pyrolysis
 - Flames premixed and diffusion
 - Power and weight loss
- Fire
 - Fire dynamics and the special case of the explosion
 - Propagation: radiation, conduction, convection
 - Different classes of fire

Learning outcomes:

The student knows the modes of existence of the fire. He perceives the propagation conditions and seizes the differences between the different thermal phenomena that can exist within a volume.

References:

- Physique du feu pour l'ingénieur, M. Curat, Ed. CSTB 2002
- Les phénomènes thermiques de l'incendie de bâtiment, S. Brisebois, M. Fournelle, France sélection, 1993.

Fire engineering Phenomenology

Keywords: Fire, hazards, modelling, structure, smoke extraction, egress

Prerequisites: Fundamentals of fire.

Objectives: - To understand the physical principles of combustion and fire

- To know the hazards due to fires
- To know the main types of fire engineering studies

Program:

- Combustion
 - Combustion and pyrolysis
 - Flames
 - Energy balance
- Fire hazards
 - Fire spread
 - Flashover
 - Orders of magnitude
 - Smoke hazards
 - Thermal hazards
- Fire engineering main principles
 - Fire engineering objectives
 - Fire engineering workflow, interactions with authorities
 - Main fire engineering categories
 - Input data, source terms definition
 - Main parameters, results and limits
 - Examples



Examination: Continuous assessment

Learning outcomes:

The student knows the main physical phenomena leading to fire hazards. He can identify which technical elements affect these phenomena, and how they can be assessed through a fire engineering study. He knows how to specify such a study. He knows the regulatory process of a fire engineering study, and what is expected from him as a building commissioner or operator

References:

- Physique du feu pour l'ingénieur, M. Curat, Ed CSTB, 2002.
- PN-ISI, Guide d'application de la méthodologie, Collectif, 2012.

 BEMS	<i>Building: energy, maintenance, safety</i>	
	4A / Semester 7	UE 7-4
	4h TP	Control of risks related to the operation of buildings

Keywords:

Risks management, safety

Prerequisites:

Basic knowledge of risks management

Objectives:

This course is taught by a guest professor, will allow students to discover the field of risks management of buildings in countries other than France.



Program:

To be defined by the guest professor

Examination: Continuous assessment

Learning outcomes:

References:

 BEMS	<i>Energy transition and sustainability in buildings</i>	
	4A / Semester 7	UE 7-5
	4h CM + 10,67h TP	Energy and environmental transition in the building industry

Keywords: Global performance, Sustainable construction, Energy sobriety, Energy efficiency, Renewable energies, Building occupancy, Optimisation, Performance guarantee.

Prerequisites: Heating and cooling systems, Thermal performances of buildings.

Objectives:

- To strengthen the knowledge about energy performance of buildings;
- To know the main renewable energies used in buildings and their functioning;

Program:

- Objectives of the sustainable construction;
- Energy sobriety in buildings;
- Building energy efficiency;
- Bioclimatism concepts ;
- Building design optimisation;
- Performance gap: effect of occupancy;
- Renewable energy in buildings: thermal solar and photovoltaic;
- Financial return of renewables;
- Energy performance guarantee;
- From an energy to an environmental regulation.



Examination: Continuous assessment (project reports).

Learning outcomes:

The student is able to understand the challenges of energy transition and to mention solutions to improve the global performance of buildings.

References:

- Bruno Peuportier, 2014, Écoconception des bâtiments et des quartiers, Techniques de l'ingénieur
- Association négaWatt, Scénarios négaWatt 2017-2050, Réussir la transition énergétique en France
- T. Recht, 2016, Etude de l'écoconception de maisons à énergie positive, Thèse de doctorat, MINES ParisTech
- S. Ligier et al., 2017, Energy Performance Contracting Methodology Based upon Simulation and Measurement, Conférence BS2017, San Francisco
- E. Vorger et al., 2014, Integration of a comprehensive stochastic model of occupancy in building simulation to study how inhabitants influence energy performance, PLEA 2014, Ahmedabad

 BEMS	<i>Energy manager</i>	
	4A / Semester 7	
	5,33h CM + 6,67h TD	Energy and environmental transition in the building industry

Keywords: energy management, energy regulations, HVAC, energy audit, ISO 50001, ISO 14001, Energy Management System (EMS)

Prerequisites: none

Objectives:

- To know the basic principles of energy management (physical quantities, installations, main uses,...)
- To carry out an energy audit and energy inventory
- To know the main energy regulations and associated standards
- Be able to implement an EMS

Program:



- Basic knowledges on energy
- Main uses and installations
- Regulatory audit: contents, examples
- Energy inventory : case study
- Energy regulations
- ISO 50001 vs Regulatory energy audit : decision-making
- ISO 50001 standards : vocabulary, definitions, framework, decryption
- FOCUS : requirements and conformity assessment
- Implementation of Energy Management System (EMS)

Examination: Final assessment

Learning outcomes:

- The student knows the basic principles of energy management
- The student knows how to carry out an energy audit
- The student knows how to carry and analyze an energy inventory
- The student knows the energy regulations and associated standards
- The student knows to implement an EMS

References:

 BEMS	<i>Performances guarantee - Diagnostics and prognostics</i>	
	4A / Semester 7	UE 7-5
	5,33h CM + 4h TD	Energy and environmental transition in the building industry

Keywords: building energy performance, guaranty, building energy Simulation, measurements

Prerequisites: Building background

Objectives:

- To understand issues of building energy guaranty
- To be able to reason in performance analyses way



Program:

- Building Energy performance definition
- Energy balance of the building
- Measurement
- International Performance Measurement and Verification Protocol
- Building energy simulation: definition, history, practical
- Energy signature
- Concrete example

Examination: continuous assessment

References:

- [1] Parliament, E., of the Council, 2005. *EN 15203:2005 energy performance of building - assessment of energy use and definition of energy rating.*
- [2] ASHRAE, 2002. "ASHRAE guideline 14, Measurement of energy and demand savings". publisher, Atlanta GA
- [3] IPMVP (Ed.), 2002. "International Performance Measurement and Verification Protocol Concepts and Options for Determining Energy and Water Savings, volume 1." US departement of energy, DOE/GO-102002-1554.
- [4] Institut Wallon asbl, « La signature énergétique, interprétation » Ministère de la région wallonne, DGTRE service de l'énergie, fascicule technique

 BEMS	<i>Life cycle analysis</i>	 POLYTECH ANGERS
	4A / Semester 7	
	5,33h CM + 9,33h TD	Energy and environmental transition in the building industry

Keywords: Life cycle, ecobalance, product system, functional unit, impact, life cycle inventory.

Prerequisites: Ecodesign

Objectives:

- To be able to define the function and the functional unit of a product;
- To be able to define a system and its limits;
- To be able to build the life cycle of a product or a service;
- To be able to use a LCA software.

Program:

Since the development of ISO 14000 environmental management standards, LCA of a product or a service are frequently used in industry. The useful data, methods and software are presented.

- LCA principles (origin, method, etc.)
- Application of LCA
- Force and weakness of LCA
- Goal and scope definition
- Life cycle inventory (emission and extraction)
- Environmental impact assessment
- LCA interpretation
- LCA and reduction of product environmental impact
- Environmental product profile

Examination: Continuous assessment



Learning outcomes:

- The student knows how to model a product or process as LCA product system
- The student knows how identify the main functions of the product
- The student knows how to define the functional unit and the reference flow
- The student knows how to do analytically an Eco-balance (consumption of non-renewable energy and CO₂ emissions)
- The student knows how to assess the environmental impact of products based on impact 2002+ method

References:

- GRISEL Laurent, OSSET Philippe (2004) L'Analyse du cycle de vie d'un produit ou d'un service : applications et mise en pratique.
- JOLLIET Olivier, SAADE Myriam, CRETZAZ Pierre (2010) Analyse du cycle de vie : comprendre et réaliser un écobilan

- ROUCOULES Lionel, YANNOU Bernard, EYNARD Benoît (2006) Ingénierie de la conception et cycle de vie des produits.

 BEMS	<i>Commissioning and optimization of building facilities</i>	
	4A / Semester 7	UE 7-5
	5,33h CM + 5,33h TD	Energy and environmental transition in the building industry

Keywords: Energy performance, commissioning, performance monitoring, energy audit, measurement and verification

Prerequisites: Basic knowledge of the management of building technical installations, BMS and CMMS

Objectives: To know the methods and tools to realize the commissioning and the optimization of the building systems.

- Knowing the main steps of an energy audit
- Know how to identify energy optimization opportunities on a building
- Be able to monitor the energy consumption of a site (metering plan, dashboards ...)
- Know how to check energy savings



Program:

- Context, definition and technical building systems
- Energy management and services to buildings
- Performance monitoring and commissioning
- Measurement and verification of energy performance
- User Awareness of "Good Behavioral Practices"

Examination: continuous assessment

References:

- <http://www.rt-batiment.fr/generalites/organisation-generale-des-differents-dispositifs.html>
- <http://www.batiment-energie.org/index.php?p=29>
- <https://evo-world.org/en/>
- Normes NF EN 16247
- NF EN 15232 Performance énergétique des bâtiments, Impact de l'automatisation de la régulation et de la gestion technique du bâtiment, Janvier 2008

 BEMS	<i>Bibliographic analysis applied to the project</i>	 POLYTECH' ANGERS
	4A / Semester 7	UE 7-6
	24h TD	Project

Keywords:

Project

Prerequisites:

Project management

Objectives:

To be able to analyse a problem and to propose innovative concepts and solutions related to business practices. To use project management tools on an actual project.

Examination:

Continuous assessment

Learning outcomes:

- The student knows how to identify and to analyze the issues of a project
- The student knows how to find relevant information to the framing of a project
- The student knows how to use the project management tools on a practical example
- The student knows how to identify and / or develop innovative solutions to a project related to the real estate management profession

References:





Syllabus

4A BEMS – S8

Version September 2022
Responsible: T. Lemenand



 BEMS	<i>English</i>	
	4A / Semester 8	
	24h TD	General skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment

Prerequisites: Level B2 from the CEFR

Objectives:

- Validating TOEIC minimum score to graduate as an Engineer.
- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Language proficiency level groups are reorganized according to the TOEIC test scores.

Program:



- Practising oral and written communication skills.
- Strengthening grammar skills.
- Regular practise of pronunciation and word stress.
- Communication skills in companies.
- Political, economic and social news
- Presenting industrial projects.

Examination: Continuous assessment

Learning outcomes:

- The student can speak about a technical issue related to his/her field of expertise.
- The student can infer and understand gist, purpose and details in a spoken document related to a general or technical topic.
- The student can infer and understand gist, purpose and details in a written document related to a general or technical topic.
- The student can speak and write in a clear and fairly complex language.

References:

 BEMS	<i>Foreign Languages: German or Spanish</i>	 POLYTECH ANGERS
	4A / Semester 8	
	12h TD	Général skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Basic oral and written communication skills.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group.

A certification in German/Spanish is recommended for advanced students in final year.

Program:

Oral and written communication skills

Communication skills in Companies

Political, economic and social news

Examination: Continuous assessment

Learning outcomes:



Intermediate groups

- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups

- The student can read an article or listen to a program in a standard language and comment on it.
- The student can write an abstract and a report in German/Spanish
- The student can make an oral presentation on professional topics
- The student can argue and justify his/her point of view fluently

References:

 BEMS	<i>Business Games</i>	
	4A / Semester 8	
	24h TD	General skills

Keywords: Challenges, Financial balance, Treasury, profitability, Teams, multidisciplinary

Prerequisites: Fundamentals in management, marketing, human resources, R&D, business strategy, inventory management, project management and corporate finance.

Objectives: In the continuity of the financial analysis course, develop an understanding of the operational and financial management of an international group in a competitive environment that is constantly evolving through the practice of a serious game.

Examination:

Continuous monitoring via enterprise game challenges



The performance of participants is measured and compared by both operational and financial indicators, including net income, market shares, return on capital, earnings per share, capacity utilization rates and employee productivity.

The overall performance of the teams is measured by the return to shareholders, which consolidates all the key success factors into a synthetic indicator that can be used to compare the teams.

Oral presentation

References:

Cesim Global Challenges

 BEMS	<i>Team Management and Operational planning</i>	
	4A / Semester 8	
	28h TD	General skills

Team Management

Keywords: Team management – Leadership

Prerequisites: Knowledge of a company

Objectives:

Understand the challenges of «team management».

Acquire the relational fundamentals within a team.

Know and develop leadership skills.

Program:

- Leadership - Role of the manager - Mission- Objectives - Values.
- Human and managerial skills of the manager - Styles and types of authority
- Motivation - Assertiveness.
- Conflict management.

Examination: 100% during classes - situational assessments

References:

- « Le guide du manager d'équipe » - Jean Louis VIARGUES - Ed. d'Organisation - 2001
- « Encadrer et motiver une équipe » - Arthur PELL - Ed. les Echos - 2000
- « Autodiagnostic des styles de management » - Dominique CHALVIN - Ed. ESF-EME -1990
- « Management situationnel » - Dominique TISSIER - Ed. INSEP - 2011
- « Motiver ses collaborateurs » - Anne BRUCE, James S.PEPITONE - Ed. Maxima - 2002
- « La dynamique des équipes » - Olivier DEVILLARD - Ed. d'Organisation - 2000
- « Les responsables porteurs de sens » - Vincent LEENHARDT - Ed. INSEP - 1992
- « Le kit du manager opérationnel » - Pierre THEPAUT - Ed. d'Organisation - 1998
- « Le manager est un psy » - Eric ALBERT, Jean Luc EMERY - Ed. d'Organisation - 1998
- « Comment manager son équipe » - Denis RIBIERRE - Ed. Masson - 2002
- « Etre leader » - François LAVOIE - Ed. SKF -2004

Operational planning

Keywords: Project Management, PERT, GANTT, Risk Project management, optimization uncertainty modeling, Monte-Carlo simulations, optimization, Knapsack

Objectives: be able, to define a project as a set of stages, to planning taking into account time and resources constrains, to dynamically monitor its evolution and costs. To be able to model the uncertainty in order to reduce the management risks.



Prerequisites: fundamentals of mathematics, statistics and probabilities

Program:

- Project management tools
 - PERT Method
 - GANTT Method
 - Project planning optimization
- Uncertainty modelling
 - Analytical method – beta distribution
 - Numerical method – Monte-Carlo simulations
- Optimization-Knapsack
 - Approximated method
 - Exact method

Evaluation: continuous assessment

References:

 BEMS	<i>Sport</i>	 POLYTECH ANGERS
	4A / Semester 8	
	12h TD	General skills

Keywords: Physical and Sports Education

Prerequisites: None

Objectives:

Sports education courses help train future engineers by promoting physical and psychological development, by facilitating their integration, and by strengthening the team spirit and dynamics of the school.

Having the ability to work as part of a team, to communicate effectively, to build relationships of trust, be healthy and to withstand stress, are all qualities required of future engineers.

The sports activities proposed involve the acquisition of new motor skills, the implementation of individual and collective strategies, the resolution of problematic situations, while simultaneously requiring a constant adaptation of one's effort.

All of these elements contribute to the development of the engineers in the making and will be additional advantages for their training and their socio-professional integration.

Program:

The program of physical sports and artistic activities is built over the first four years of study at the school. Each engineering student must choose a different activity per semester from the five individual and team sports offered.

Examination: Continuous assessment

Learning outcomes:

Each student is expected to participate actively. This requires serious commitment, both physically by "doing" and also reflectively by demonstrating "know how", with a cultural understanding of the activity. Physical investment will be carried out via the management of one's own physical and psychological integrity, and those of others (with adapted muscular, joint and cardio-respiratory warm-ups, and also respect of basic safety precautions).

The student will also have to demonstrate his / her ability to acquire skills specific to each sporting and artistic activity that he / she chooses. These teaching contents are grouped into three types of General Competences:



C1: To progress technically, tactically and / or behaviorally on one's individual and initial level.

C2: Achieve a performance in an enabling context.

C3: Produce the best possible result in a reference situation.

References:

Site UA Moodle : <http://moodle.univ-angers.fr/course/view.php?id=2687>

 BEMS	<i>Refurbishment strategies and techniques</i>	 POLYTECH ANGERS
	4A / Semester 8	
	8h CM + 12h TD	Engineering of the operation-maintenance of the building

Keywords: Feasibility, technical assessment, functional, architectural, social, economic requirements, upgrading, detailed technical program

Prerequisites:

Technical management, comfort and security, pathology, technical assessment, architectural design

Objectives: To be able to make proposals regarding functional programming to submit to the architect in the case of rehabilitation at a known site, from a case study on simple rehabilitation

Program:

- Definition of rehabilitation in relation to the upgrading of functionality of buildings and the integration of new usage needs
- Integration in the project construction : expression of needs by the client: technical, use functions, means functional analysis, functional programming, tools: CdcF, functional and spatial organization, detailed data sheet
- Taking into account the constraints of site (activity ...), disorders and disease.
- Architectural answer brought by the project manager.

Examination: Continuous assessment



Learning outcomes:

The engineering student will be able to use a refurbishment method to audit a building and classify the work priorities according to a diagnosis of physical state, functional and to define the construction work to be carried out.

The engineering student meets the diagnostic methodology

References:

- Prévention des risques en réhabilitation - restructuration de grands ouvrages du bâtiment : guide pratique / Agence Qualité construction, Jean Mottaz, 2012
- Bâtir : manuel de la construction / René Vittone, Presses polytechniques et universitaires romandes, 2010

 BEMS	<i>Programming of maintenance and operation actions and GTPAO</i>	 UE 8-2
	4A / Semester 8	
	9,33h CM + 14,67h TD	Engineering of the operation-maintenance of the building

Programming of maintenance and operation actions

Keywords: Programming, optimization, prioritization, efficiency, decision-making

Prerequisites: Decision and mitigation of risks, Constructions disorders, Data analysis and business intelligence

Objectives: To optimize multi-year operations and maintenance plans under economic constraints and using a criticality vs efficiency approach

Program:

- Proper set of criterion to construction maintenance and enhancement operations
- Prioritization and optimization of operations plans
- Case study

Learning outcomes:

- The student knows how to select characterization criterion dedicated to its assets considering strategic objectives
- The student knows how to characterize its assets according to this set of criterion
- The student estimate effects of enhancement actions
- The student knows how to apply the cost – criticality – efficiency approach in order to optimize its operations plan

References:

- Guide Méthodologique : Comment suivre la performance d'un bâtiment ? Effinergie (<http://www.planbatimentdurable.fr/>)

GTPAO

Keywords: MAO - GTPAO - Computer Assisted Maintenance - GTC - Facility Management

Prerequisites: Knowledge on facility management and maintenance. Have an internship in technical service

Objectives: Be able to build a specification, select, implement and operationalize a tool for computer-aided maintenance. Define the real needs of management function and layout constraints on a site running

Program:



- Types of products MAO (AFIM classification)

- TMAO
- Computerized maintenance management system and GTPAO
- Experts system and Interactive decision aid systems
- Centralized technical management system and supervisors
- Panorama of GTPAO Software
- Main functions covered by GTPAO
 - Contributions of GTPAO
 - Identification of priority features and accessories
 - Dashboard and Report Processing
- Create a specification for a project GTPAO
 - Identify the processes and functions
 - Identify necessary data and computing functions
- Phasing for the GTPAO implementation
 - 5 phases of the project
 - The conditions of implementation, supportive environment
 - project risk analysis
- Presentation software by professionals

Examination: Continuous assessment

References:

Mettre en œuvre une GMAO de Marc Frédéric au éd DUNOD - 2003
 Analyse des produits : mise à jour sur le site : <http://www.afim.asso.fr/>
 La GMAO Pratique, Contrinfor éd : Sociétés et Particuliers - 2010

 BEMS	<i>Case study: Maintenance models and optimization</i>	
	4A / Semester 8	
	16h TD	Engineering of the operation-maintenance of the building

Keywords:

Practical case, modeling, simulation software

Prerequisites:

Real estate engineering, project management, Knowledge of fire safety engineering.

Objectives:

Put into practice the theoretical knowledge through subjects posed by industrial partners.

Program:



- Presentation of the case studies by the professional tutor / teacher tutorial pair
- Realization of the case study by the students.

Examination:

Continuous assessment

References:

Documents provided by the professional tutor for each case study.

 BEMS	<i>Technical monitoring IV</i>	
	4A / Semester 8	
	12h TD	Engineering of the operation maintenance of the building

Keywords: information acquisition, information storing, information disseminating, technical monitoring

Prerequisites: computer basics, technical facilities, building disorders, building maintenance

Objectives:

Developing a scalable digital platform on 'Netvibes' using the web 2.0 technology, which will allow the monitoring of the evolution of technical facilities used in buildings and the techniques of maintenance and rehabilitation of buildings.

Program:

After completing the 'Netvibes' tool and choosing one of the themes below, the students will work in groups of 2 to 3 in order to develop a technical monitoring dashboard.

Topic 1: Power supply and lighting

Topic 2: Vertical traffic

Topic 3: Heating, Ventilation, Air Conditioning (HVAC)

Topic 4: Plumbing



Topic 5: Access control system and video surveillance

Topic 6: Energy efficiency of buildings.

Examination: Continuous assessment

Learning outcomes:

- The student knows how to do technical monitoring using a computers tools
- The student knows the mains technological developments in the technical building management field.

 BEMS	<i>Building: energy, maintenance, safety</i>	
	4A / Semester 8	UE 8-2
	4h TP	Engineering of the operation- maintenance of the building

Keywords:

Risks management, safety

Prerequisites:

Basic knowledge of risks management

Objectives:

This course is taught by a guest professor, will allow students to discover the field of risks management of buildings in countries other than France.



Program:

To be defined by the guest professor

Examination: Continuous assessment

Learning outcomes:

References:

 BEMS	<i>Industrial risks</i>	
	4A / Semester 8	
	6,67h CM + 6,67h TD	Specific risks related to the operation of buildings

Keywords: DREAL ; ICPE ; Seveso ; TMD; prevention, accident, major risks, environmental risks, professional risk BLEVE; danger control risks at source; single document hazard studies and impact

Prerequisites: Fundamentals of fire notions Toxicology

Objectives:

- To know the Program of the regulations on ICPE
- To know the four types of industrial risks and characteristics
- To understand the regulations on the transport of hazardous material
- The classification Seveso
- To be able to initiate measures can control the risk.

Program:

- The installations classified for environmental protection
 - Generalities
 - Definitions
 - Scope of regulation
 - Nomenclature and regimes
- The different types of industrial risks
 - Fire risk (thermal hazard)
 - Explosion risk (risk of overpressure)
 - Air pollution risk
 - Water pollution risk
 - The classification Seveso
 - Transportation of hazardous materials
- The risk treatment
 - Risk reduction at source,
 - The control of urbanization,
 - Rescue organization,
 - The public information,
 - The management tools (authorization to operate; CLIC, PPRT, PPI, PCS ...)

Examination: Continuous assessment

Learning outcomes:



The student understood the philosophy of the Environmental Code. It perceives the main part of the regulation on ICPEs and in particular the articulation of the nomenclature and the various classification schemes. He also knows the specificities of establishments classified SEVESO and those of transport of dangerous materials.

References:

- Prévention des risques professionnels : Concepts fondamentaux, Andéol, Aussage,

Morvan, *Techniques de l'ingénieur*, 2008

- Risques et accidents industriels majeurs. Caractéristiques, réglementation, prévention, N. Margossian, *Technique et ingénierie, série environnement et sécurité*, Ed Dunod 2010.
- Risques industriels. Complexité, incertitude et décision : Un approche interdisciplinaire, Ed. Tec et doc, 2006

 BEMS	<i>Environmental risks and ICPE installations</i>	
	4A / Semester 8	
	10,67h CM + 10,67h TD	Specific risks related to the operation of buildings

Keywords: pollution, risks.

Prerequisites:

Objectives:

- have a basic culture and know the main industrial accidents which have contributed to the regulations on the subject
- know the technical terms in the field
- be able to understand and analyze the various risks linked to industrial activity
- know how to identify, from the causes, the solutions to be considered to reduce the risk
- know the challenges of taking environmental risks into account for a vulnerable company



Program:

- Notions of hazard, issue, vulnerability and risk
- Effects associated with environmental risks: thermal effects, toxic effects and effects related to overpressure
- ICPE regulations
- Human, economic and environmental consequences of accidents
- Domino effect
- Risk prevention
- Technological risk prevention plan
- Danger study

Examination: Continuous assessment

References:

- BOLO Philippe, BRACHET Christophe (2001) SIG et gestion des pollutions agricoles diffuses - Gestion spatiale des risques - Ouvrage collectif aux éditions Hermès
- DESROCHES Alain, LEROY Alain, QUARANTA Jean-François (2006) Dictionnaire d'analyse et de gestion des risques – Hermes Science Publications.
- MARGOSSIAN Nichan (2006) Risques et accidents industriels majeurs : caractéristiques réglementation prévention – Dunod, L'Usine Nouvelle.
- MEUNIER Francis (2005) Domestiquer l'effet de serre : énergies et développement durable – Dunod.
- Ministère de l'Écologie, du Développement et de l'Aménagement durables - Direction générale de l'Énergie et des Matières premières, Caisse des Dépôts (2007) Repères CO2 et énergie.
- RUBISE Patrick, GAUTIER Yves (1995) Les Risques technologiques – Cité des Sciences et de l'Industrie, Presses Pocket.

 BEMS	<i>Safety within establishments open to the public and security</i>	
	4A / Semester 8	UE 8-3
	10,67h CM + 5,33h TD + 8h TP	Specific risks related to the operation of buildings

Safety within establishments open to the public

Keywords:

Code of Construction and Housing; ranking ; Categories; Security regulations; Fire behavior of materials; Clearances; Smoke extraction; Specific hazards; Emergency means; Mayor; Operator; Security committee.

Prerequisites: Fundamentals of Fire

Objectives: Provide an understanding of key public safety concepts in LES.

Program:

- Prevention tools in ERP
 - o The Code of Construction and Housing
 - o Security regulations
 - o The Order of 25 June 1980
 - o The articles GN and GE - Simplified access to CO articles; AM and following ...
- Urban planning acts
- Responsibilities

Learning outcomes:

Students know what an ERP is. They know their essential characteristics and know, without knowing where to go, the main texts applicable; They apprehend the main responsibility for enforcing the rules.

References:

- ERP Security Regulations
- General provisions (France selection, 27th edition)
- Particular dispositions
- Special provisions
- Provisions relating to ERPs classified in 5th category.

Security

Keywords: Security - video surveillance - video protection - detection - intrusion - agent - prevention – malice.

Prerequisites: Real estate engineering modules of the fourth year of the BEMS specialty.

Objectives:

- Define the risk of malicious acts in companies
- Understand the main principles of prevention and fight against malicious acts

- Identify the foundations of the legal security framework
- Identify the main means of prevention and fight against malicious acts

Program:

- Definition of security
- Principle of fight against malicious acts
- Company and associated risks
- Company flows
- Characteristic of a malicious act and of taking action
- Typology of authors
- Security actors / internal and external public and private contacts
- The regulatory framework
- Business sectors of vital importance and associated national safety directives
- Principles of prevention and fight against malicious acts
- Main technical solutions
- Mechanical protection
- Intrusion detection (role, principle, constituent elements, limits)
 - Point, volume and perimeter intrusion detection
 - Central monitoring station
 - Means of transmission
 - The removal of doubt and intervention on alarm
 - Regulatory audits
- Video surveillance (role, principle, building blocks, limits)
 - The National Data Protection Commission (CNIL)
 - The General Data Protection Regulation (GDPR)
 - Organization of the video surveillance station
 - Technical standards for video surveillance installations
 - Obligations
 - Protection of the installation
 - Regulatory audits
- Access control (role, principle, constituent elements, limits)
 - Regulatory audits
- Organizational and human resources
- The safety / security officer
- The security management system (role, principle, challenges, process, certification and standardization)
 - Security tools
- Protection of information
 - Protection of information media (conservation, circulation, destruction)
 - Protection of computer systems
 - Staff recruitment and awareness
 - Legal obligations
 - Regulatory audits
- Private security activities
 - Legal framework and objectives of the legislator
 - Obligations, limits and prohibitions of the functions of a prevention and safety officer (APS)
 - Conditions of exercise and activities concerned
 - Exercise conditions
 - Criminal offense and self-defense
 - Right of apprehension
 - Business card
 - National Council for Private Security Activities (CNAPS)

Examination:

Continuous assessment (Multiple choice questionnaire + plan study + case study)

References:

Code de la sécurité intérieure

Code civil

Code pénal

Code du travail

Traité pratique de sûreté malveillance – 5ème édition – CNPP (mars 2018)

Référentiel CNPP 1008 - Surveillance des risques -

Méthode et outils pour le pilotage du management de sûreté malveillance

Référentiel CNPP 1302 - Système de management de la sûreté -

Lutte contre la malveillance et la prévention des menaces (septembre 2009)

Référentiel APSAD R8 - Surveillance des risques opérationnels d'une entreprise -

Règle d'organisation pour les risques d'incendie, de malveillance et techniques (novembre 2010)

Référentiel APSAD R31 – Télésurveillance - Règle de prescription (septembre 2017)

Référentiel APSAD R81 - Détection d'intrusion - Règle d'installation (septembre 2015)



Référentiel APSAD R82 – Vidéosurveillance - Règle d'installation (février 2016)

Référentiel APSAD D83 - Contrôle d'accès - Document technique pour la conception et l'installation

ISO/IEC 27000 : 2018 - Technologies de l'information — Techniques de sécurité —

Systèmes de management de la sécurité de l'information — Vue d'ensemble et vocabulaire

ISO 28000 : 2007 - Spécifications relatives aux systèmes de management de la sûreté de la chaîne d'approvisionnement

	<i>Asbestos risk</i>	
	4A / Semester 8	
	4h CM + 2h TD	Specific risks related to the operation of buildings

Keywords: asbestos risk, construction site audit, MPCA, operation related to SS3/SS4, risk prevention plan, PGC/PPSPS, DCE

Prerequisites: General knowledge on professional risks prevention

Objectives:

- To know risks related to asbestos
- To be able to consider the asbestos problem in the design stage of a project
- To be able to consider the asbestos problem in the construction stage of a project

Program:

- **Generality**

- To know the requirements of the regulation related to:
 - Abestos ban,
 - Prevention of asbestos risks (make a distinction between SS3 / SS4 operation)
 - Provisions provided by the Public Health Code related to the prevention from asbestos,
 - Asbestos waste removal.
- To know the duties of the contractor, in particular:
 - Identification and tracking of asbestos
 - The organization of prevention (prevention plan, PGC/PPSPS, risks assessment, DUER)
- Consequences of not detected MPAC in the design stage
 - Accidental exposures (workers, other persons)
 - Cost review
 - Schedule review

- **Preliminary design stage**



- To know the documents required for operations, to be able to perform critical review of these documents and to use them to assess the risks.
- To be able to ensure the labelling of MPCA
- Define the project and the scope of the operations
- To know how to anticipate the operation organization (type of operation, specific constraints,)
- To be able to assess hazards related to each operation using a global risks assessment approach

- **Tender Document (TD) stage**

- Documents related to the TD
- Key points related to the CCTP of MPCA operation
- Analysis of technical offers
- To be able to perform critical analysis of a removal, demolition, encapsulation plan, as well as operating process

- ***Operations monitoring stage***
 - Use of audit grid during a worksite visit
 - Facilitate a meeting of MPCA operation progress
- ***End of operations stage***
 - To know visual examinations/release measures of end of operations (Public Health Code, Labor Code)
 - End of operations report (main objective, contents).
- ***Case study***

References:

 BEMS	<i>Smart buildings and Business Intelligence</i>	 POLYTECH ANGERS	
	4A / Semester 8		UE 8-4
	8h CM + 12h TD + 12h TP		Digital transition in building

Smart buildings

Keywords: Smart building, Monitoring, Control, Automation, Sensor, Actuator, Counter, Energy efficiency, Management and Operations, Networks, Communication Protocol.

Prerequisites: Teachings related to thermal and HVAC engineering ('HVAC engineering' at semester S7, ' Building thermal analysis – Equipments' S7, ' Building thermal analysis – Regulation' S8, ' Building thermal analysis – Simulation' S8) and with electrical engineering (' Electricity energy distribution' at semester S8, 'Low currents' S8) ; 'Data Analysis and Business Intelligence' ; level *N* in automatic and computer elementary knowledge.

Objectives:

- To know the different solutions of smart buildings
- To formulate a request or a technical offer about building automation and control systems, architecture, monitoring, hardware, networks, about their implementation and commissioning.

Program:

- Framework and issues
 - The concept of smart building within the frame of digital transition of new construction and existing building refurbishment sectors
 - New regulations, technological and contractual requirements,
 - (Financial) Market analysis of intelligent building by sectors,
 - SWOT analysis (Strength, Weakness, Opportunity, Threat).
- State-of-the-art
 - What are the existing solutions?
 - Intelligent system architecture: from sensors to the data, including communication protocols, technical standardization,
 - What are the perspectives?
- Designing a smart building
 - Needs identification,
 - Systems selection support,
 - Implementation of these systems (installation, optimization),
 - Smart data analysis,
 - Interest and opportunity of integration within an existing building.
- BACS examples presentation and software monitoring tools demonstration
- Case studies
 - Smart building, key for optimized thermal performances
 - Health and smart buildings.

Learning outcomes:

The student know the general architecture of a smart building
 The student know how to select a smart system
 The student understand relevancy of data smart analysis.

References:

- Mise au point de la régulation et de la gestion technique des bâtiments. MAP Régulation et GTB. COSTIC, Collection des guides de l'AICVF. PYC Edition Livres, Paris, 1998.154p.
- Habitats Intelligents pour la Santé : des environnements “pervasifs” témoins de notre vie quotidienne, N. Noury, *Techniques de l'ingénieur, collection Innovations en technologies de l'information, article IN9*, janvier 2012.
- Électricité dans le bâtiment Mise en œuvre, D. Serre, *Techniques de l'ingénieur, collection Les aménagements intérieurs du bâtiment, article C3751*, février 2013.
- Smart Grid et bâtiments intelligents, même combat !, *Techniques de l'ingénieur, Collection Smart Grid, article 59032*, février 2011.
- Compteur intelligent : un "déluge de données" à gérer, *Techniques de l'ingénieur, article 67405*, novembre 2011.
- La gestion intelligente du bâtiment, clé de l'optimisation énergétique, *Techniques de l'ingénieur, article 7620*, septembre 2010.
- FD CEN/TS 15739. Gestion technique du bâtiment-Terminologie et étendue des services. Septembre 2009.
- NF EN ISO 16484-1. Systèmes d'automatisation et de gestion technique du bâtiment - Partie 1 : spécifications et mise en œuvre d'un projet. Mai 2011.
- NF EN ISO 16484-2. Systèmes d'automatisation et de gestion technique du bâtiment – Partie 2: équipement. Avril 2005.
- NF EN ISO 16484-3. Systèmes de gestion techniques du bâtiment (SGTB)-Partie 3 : fonctions. Décembre 2007.
- NF EN ISO 16484-4. Systèmes de gestion techniques du bâtiment (SGTB)-Partie 4 : Application. 2005.
- NF EN ISO 16484-5. Systèmes d'automatisation et de gestion technique du bâtiment – Partie 5 : Protocole de communication de données. Mars 2010.
- NF EN ISO 16484-6. Systèmes d'automatisation et de gestion technique du bâtiment– Partie 6 : essais de conformité de la communication de données. Décembre 2009.
- NF EN 15232. Performance énergétique des bâtiments – Impact de l'automatisation de la régulation et de la gestion technique du bâtiment. Janvier 2008.
- NF CEN/TS 15810. Symboles graphiques à utiliser sur les équipements d'automatisation intégrée de bâtiment. Octobre 2009.
- NF EN 13321-1. Réseau ouvert de communication de données pour l'automatisation, la régulation et la gestion technique du bâtiment - Systèmes électroniques pour les foyers domestiques et les bâtiments - Partie 1 : spécification des produits et des systèmes. Avril 2006.
- NF EN 13321-2. Réseau ouvert de communication de données pour l'automatisation, la régulation et la gestion technique du bâtiment-Systèmes électroniques pour les foyers domestiques et les bâtiments-Partie 2 : communication KNXnet/IP. Janvier 2007.

Business Intelligence

Keywords: data analysis, Excel tables, Power Map, Power Pivot, Power Query, Power View, Power BI

Objectives: be able to perform data analyzes, to construct adequate graphics and prediction models allowing a better decision making, using the software Power BI.

Prerequisites: fundamentals of mathematic, statistic and probability

Program:

- Connecting and shaping data
- Analyzing and modeling data
- Creating interactive graphics and dashboards
- Exploring data with geospatial maps
- Online data sharing



Evaluation: continuous assessment

References:

[Business Intelligence avec Excel, Power BI et Office 365 \[Jean-Pierre GIRARDOT\]](#) Éditions ENI, 2015.

[Learn Power BI et Office 365 \[Greg DECKLER\]](#) Packt Publishing, 2019.

Analyzing Data with Microsoft Power BI and Power Pivot for Excel [Alberto Ferrari and Marco Russo] Microsoft Press, 2017.

 BEMS	<i>Data Analysis and BI</i>	 POLYTECH ANGERS
	4A / Semester 8	
	8h CM + 8h TD	Digital transition in building

Keywords: Exploratory statistics approach, factor analysis, clustering methods, ANOVA, Business Intelligence, Data visualization, Dashboard

Prerequisites: Knowledge of computer based tools (Excel), the formatting of data (tables ...) and statistics, Process optimization

Objectives:

- To be able to consolidate and analyze a data base (quantitative and qualitative)
- To attain an understanding of the use of information produced by business intelligence tools, learn how to build a cockpit manager and a dashboard.

Program:

- Data analysis
 - To consolidate a data base, Outlier identification
 - Data classification methods (Ascending Hierarchical Classification (AHC), k-means approach)
 - Factor analysis of data base (Principal component analysis (PCA), Correspondence factor analysis (CFA), Canonical variate analysis (CVA), Other factor analysis methods)
 - Applications to case study in real estate and risk engineering
- Business Intelligence
 - What is BI ? Information vs communication, information = anticipation
 - The stakes of BI in real estate, Extract-analyze-understand-act
 - The tools of BI pertinent to real estate
 - Case study: Building a Dashboard Manager and Cockpit
 - KPI and SLA applied to real estate: the challenges of a new performance

Examination: Continuous assessment



Learning outcomes:

- The student knows how to consolidate a data base
- The student knows how to conduct and interpret principal components, simple and multiple factorial analysis and some classification methods
- The student knows how to explain the interest of such data base analysis

References:

- Analyse des données ou statistique exploratoire multidimensionnelle, P. Besse, A. Baccini, *Techniques de l'ingénieur, Collection Probabilités et statistique, article AF620*, Avril 2011.
- Probabilités, Analyse des Données et Statistique, G. Saporta, *Ed. Technip, Paris*, 2011, 622 p.
- Analyses factorielles simples et multiples : Objectifs, méthodes et interprétation, B. Escoufier, J. Pagès, *Ed. Dunod, Paris*, 2008, 318 p.

- Statistique exploratoire multidimensionnelle, L. Lebart, A. Morineau, M. Piron, *Ed. Dunod, Paris*, 2000, 439 p.
- Applied regression analysis, N.R. Draper, H. Smith, *Ed. Wiley, New York*, 1998, 706 p
- Methods and applications of linear models, R.R. Hocking, *Ed. Wiley, New York*, 2003, 741 p.
- Les nouveaux tableaux de bord des managers : Le projet Business Intelligence clés en main, A. Fernandez, *Ed. Eyrolles, 6ème édition*, 2013, 467 p.
- Le data warehouse - Guide de conduite de projet, R. Kimball, L. Reeves, M. Ross, W. Thornthwaite, *Ed. Eyrolles*, 2005, 576 p.
- The Effective Visual Communication Of Data, S. Few, *O'Reilly Media, Inc*, 2006, 223 p.

 BEMS	<i>Decision and mitigation of risks</i>	
	4A / Semester 8	
	8h CM + 8h TD	Digital transition in building

Keywords: Reliability, Safety, Availability, Risk, Decision

Prerequisites: Statistics (distribution laws, probability calculation), data analysis

Objectives:

- To learn the terminology and methods of RAMS so as to be able to introduce reliability and safety requirements within operation contracts of real and industrial estate.
- To know the methods and tools related to decision-making.

Program:

- Introduction – Definitions
- Multicriterion classification of critical equipments of an industrial installation (Risk, criticality, acceptability threshold, organization into a hierarchy)
- Case study - Influence of lightning density (Practical courses on computers, common distribution laws, adequation test)
- Improvement of the availability of a lift fleet and optimization of maintenance costs (characteristic data of RAMS, *a priori* and *a posteriori* costs)
- Optimisation of the conditional preventive maintenance of air-conditioning facilities (Practical courses, Monte Carlo simulation, maintenance and non-maintenance costs)
- Failure mode effects and consequences analysis (Risk analysis tools, deductive and inductive approach, combined probabilities)
- Case study – Identification of reference accident scenarios in SEVESO establishments (failure trees, event trees, bow-tie representation, matrix of risks)
- Probabilistic risk assessment for evacuees in building fires (Event trees, ASET, RSET, Stress vs Strength simulations)

Examination: Continuous assessment



Learning outcomes:

- The student knows how to create a specific sets of risk assessment criteria
- The student knows how to use statistical notions as decision-making tools
- The student knows how to calculate preventive and corrective maintenance costs and how to optimize global cost
- The student is able to carry out a Monte Carlo Simulation for uncertainty propagation
- The student is able to represent accident scenario and know how to estimate their occurrence probabilities
- The student knows fundamentals of human risk during fire modeling.

References:

- La sûreté de fonctionnement : démarches pour maîtriser les risques, Y. Mortureux, *Techniques de l'ingénieur, Collection Management de la sécurité*, article SE1020, avril 2002.
- La sûreté de fonctionnement : méthodes pour maîtriser les risques, Y. Mortureux, *Techniques de l'ingénieur, Collection Généralités et conceptions des systèmes mécaniques*, article BM5008, janvier 2005.

- L'analyse préliminaire des risques : Principes et pratiques, A.Desroches, D. Baudrin, M. Dadoun, *Collection : Management et informatique*, Ed. Hermes Science Publications, septembre 2008.
- Maintenance strategy based on a multicriterion classification of equipments, F.C.G. Leon Hijes, J.J.R. Cartagena, in *Reliability Engineering and System Safety*, vol. 91, 2006, 444-451.
- Decision support in selecting maintenance organization, J. Emblemsvag, L. Tønning, in *Journal of Quality and Maintenance Engineering*, vol. 9(1), 2003, 11-24.
- Development of an optimal preventive maintenance model based on the reliability assessment for air-conditioning facilities in office buildings, R.Y. Kwak, A. Takakusagi, J-Y Sohn, S. Fuji, B-Y. Park, in *Building and Environment*, vol. 39, 2004, 1141-1156.
- Identification of reference accident scenarios in SEVESO establishments, C. Delvosalle, C. Fiévez, A. Pipart, J. Casal Fabrega, E. Planas, M. Christou, F. Mushtaq, in *Reliability Engineering and System Safety*, vol. 90, 2005, 238-246.
- ARAMIS project: A comprehensive methodology for the identification of reference accident scenarios in process industries, C. Delvosalle, C. Fiévez, A. Pipart, B. Debray, in *Journal of Hazardous Materials*, vol. 130, 2006, 200-219.
- Probabilistic risk assessment for evacuees in building fires, G.Q. Chu, T. Chen, Z.H. Sun, J.H. Sun, in *Building and Environment*, vol. 42, 2007, 1283-1290.
- A multiple criteria evaluation of multi-family apartment block's maintenance contractors : I – Model for maintenance contractor evaluation and the determination of its selection criteria, E.K. Zavadskas, T. Vilutiene, in *Building and Environment*, vol. 41, 2006, 621-632.

 BEMS	<i>BIM data management</i>	 POLYTECH ANGERS	
	4A / Semester 8		UE 8-4
	8h CM + 12h TP		Digital transition in building

Keywords: numerical model, BIM components, BIM objects families, design constrains,

Prerequisites: CAd of buildings

Objectives:

- Be able to implement a BIM model using Revit
- Be able to manage a project using a BIM environment
- Be able to manage a project based on interoperability between software's

Program:



- Unit 1 : Introduction to Revit
- Unit 2 : Implementation of new architectural projet
- Unit 3 : Handling BIM objects
- Unit 4 : Handling BIM families
- Unit 5 : Parameters and representations
- Unit 6 : Design constrains
- Unit 7 : Handling new BIM components
- Unit 8 : Design using volume components
- Unit 9 : Implementation of MEP model

Examination: Continuous assessment

Learning outcomes:

- The student knows how to implement architectural model
- The student knows how to implement a MEP model
- The student knows how to create BIM objects and families
- The student knows how to manage a project based on interoperability between software's

References:

 BEMS	<i>Project</i>	 POLYTECH ANGERS
	4A / Semester 8	
	40h TD	Project

Keywords:

Project

Prerequisites:

Project management

Objectives:

To be able to analyse a problem and to propose innovative concepts and solutions related to business practices. To use project management tools on an actual project.



Examination:

Continuous assessment

Learning outcomes:

- The student knows how to identify and to analyze the issues of a project
- The student knows how to find relevant information to the framing of a project
- The student knows how to use the project management tools on a practical example
- The student knows how to identify and / or develop innovative solutions to a project related to the real estate management profession

References:

 BEMS	<i>Training period</i>	 POLYTECH ANGERS
	4A / Semester 8	
	14 weeks minimum	Traineeship

Keywords: professional environment, professional experience, practical enforcement

Prerequisites: all teachings of semester 5 to 8, professional experiences

Objectives:

Original production related to industrial needs and more broadly to expectations of profession.

Program:

Deepen knowledge of the professional environment, refine the student's professional project, apply knowledge acquired, and develop new professional skills.

Evaluation:

- Monthly reports, visit by a teacher
- Final report, with oral defense and judgment from the industrial supervisor.

Learning outcomes:

- The student knows how to address a professional problem
- The student is able to work in professional framework

References:





Syllabus

5A BEMS – S9

Version September 2022
Responsible: T. Lemenand



 BEMS	<i>English</i>	
	3A / Semester 9	
	16h TD	UE 9-1 General skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment

Required: TOEIC validation

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment
- Good command of oral techniques

Program:

- Team work skills
- Presenting techniques for the final industrial project presentation (focusing on pronunciation, fluency, idiomatic expressions, etc...)
- Job/internship interview training
- Abstract writing

Examination:

Continuous assessment (Written and spoken)



Learning outcomes:

The student can carry out a job/internship interview.

The student can make a professional oral presentation on a long-term project (5th year industrial project)

The student can write a professional report, an abstract, a professional e-mail and a personal profile.

References:

 BEMS	<i>Foreign Languages: German or Spanish</i>	
	4A / Semester 9	
	12h TD	General skills

Keywords: Communication skills, Cross-cultural skills, Professional Environment.

Prerequisites: Basic oral and written communication skills.

Objectives:

- Meeting the requirements of the CEFR (Common European Framework of Reference for Languages): oral and written comprehension, oral and written expression, interaction
- Cross-cultural skills: knowledge of international environment

Organization of Language proficiency levels whenever it is possible.

The target for the advanced group is CEFR B2 or C1; A2 or B1 for the intermediate group.

A certification in German/Spanish is recommended for advanced students in final year.

Program:

Oral and written communication skills

Communication skills in Companies

Political, economic and social news

Evaluation

100% Continuous assessment

Learning outcomes:



Intermediate groups

- The student can speak for a few minutes on a topical issue or a topic of personal interest.
- The student can take part in a conversation on simple topics that can be related to his/her personal interests.

Advanced groups

- The student can read an article or listen to a program in a standard language and comment on it.
- The student can write an abstract and a report in German/Spanish
- The student can make an oral presentation on professional topics
- The student can argue and justify his/her point of view fluently

References:

 BEMS	<i>Joint sporting event</i>	 POLYTECH ANGERS
	4A / Semester 9	
	4h TD	General skills



Keywords: Physical and Sports Education

Prerequisites: None

Objectives:

Physical education and sports activities contribute to the training of future engineers, promote their physical and psychological balance, facilitate their integration, and strengthen team spirit and the school's dynamic. Being able to work in a team, to communicate, to establish relationships of trust, to be in good health and to resist stress, are qualities that are required of future engineers.

The student is expected to be active in the practice of the activity, requiring a real commitment, both physical (the "Doing") and reflective (the "How to do"), and a cultural relationship to the activity. The physical investment will be made in mastering the management of one's physical and psychological integrity, and that of others (muscular, cardio-respiratory and articular warm-ups, respect for elementary safety criteria).

 BEMS	<i>Employability</i>	 POLYTECH ANGERS
	5A / Semester 9	
	16h TP	General Skills

Keywords: job, employability, hiring, integration, professional watch

Prerequisites: none

Objectives:

- Provide keys to facilitate the professional integration of students upon graduation
- Define your use profile
- Knowing how to value yourself

Program:

1. Prospective method

- . positioning of Polytech Angers students in terms of evolving trends
- . projections

2. The keys to integration into a team:

- . know yourself and have clear objectives to communicate
- . exchange of experiences on the fundamentals (codes, social life...)

3. Focus on skills

- . Evaluation of the individual skills of his specialty based on the expectations of the CTI
- . Convince in 3 minutes for an integration (professional or project)



4. Digital identity

- . Digital capsule to know everything
- . Audit of your online presence to be ranked at the top of the search list

Examination: 100% continuous assessment

References:

- Stéphanie Assante, Les 16 grands types de personnalité - Le MBTI, Dangle Editions, 17 octobre 2012.
- Christophe BLAZQUEZ, Samir ZAMOUM , Développez votre identité numérique, GERESO ÉDITION, 2019.
- Axelle Larroumet, « Quels talents ! », Ed. Diagonart, 2012.
- Isabelle Rouhan en collaboration avec Clara-Doïna Schmelck, Les métiers du futur, First éditions. 2019.

 BEMS	<i>Employment law</i>	 POLYTECH ANGERS	
	5A / Semester 9		UE 9-1
	12 h TD		General skills

Supervisor: Sandrine KWOCALA LECOMTE

Keywords: Labour code, employment contract, Collective Agreements, justice

Prerequisites: None

Objectives:

- Knowing labour law is essential; either you are worker or employer. Nobody can ignore it.
- Labour legislation is in constant discussion. It is therefore important to understand the legal, economic and social issues

Program:

- Introduction to labor law
- Justice in labor law
- Labor Inspections
- Job offer and maintenance
- The employment contract (from the signature to the termination of the employment contract)
- The rights and duties of the parties (employee / employers)
- Union representatives
- Payroll and exam preparation
- The 2020 novelties

Examination:



Table examination with practical case

Learning outcomes:

The student has understood the meaning of law and is able to read and understand a court decision

References:

- Code du travail , ed.Dalloz
- RAY Jean-Emmanuel, « Droit du travail, Droit vivant 2017 », Ed Liaisons, 25^{ème} édition 2016

 BEMS	<i>Project costs mastering</i>	 POLYTECH ANGERS	
	5A / Semester 9		UE 9-1
	12h TD		General Skills

Keywords: Market, investment, budget, cost

Prerequisites: financial analysis

Objectives: Be able to calculate the financial profitability of an industrial project and to monitor and control the costs of this project.



Program:

- Introduction
- Part 1 : Analysis and diagnosis
 - external environment : the PESTLE model
 - industry : the PORTER strenghts
 - market : the SWOT and the success factors analysis
 - firm : the SBU and the BCG matrix
- Part 2 : Investment
 - fundamentals
 - actualization
 - NPV
 - IRR
- Part 3 : Budget and financing plan
 - budget
 - definition and utility
 - building
 - operations vs cash flow
 - financing plan
 - operational cash flows
 - funding
- Part 4 : Costs and profitability
 - full costs
 - partial costs
 - variable costs
 - fixed costs
 - break even

Examination: Continuous assessment (100%)

References:

- Stratégique – Gerry JOHNSON, Kevan SCHOLLES, Frédéric FRÉRY – Ed. PEARSON (10ème édition) – 2017
- Contrôle de gestion DCG 11 Manuel & applications – Ed. Dunod 2017
- Décision d'investissement (incertitude et information) – P. PIGET – Ed. Economica 2019
- Construire et défendre son budget – C. SELMER – Ed. Dunod 2014

 BEMS	<i>RSE et Ethique</i>	 POLYTECH ANGERS
	5A / Semestre 9	
	12h TD	General Skills

Responsible: N. Faisant

Keywords: social responsibility, environment, societal issues, business, skills, ethics, dilemma, values, training, engineer.

Prerequisites: none

Objectives:

- To integrate the impacts of corporate social responsibility internally and externally
- To position oneself
- Know how to promote yourself

Program:

1. **Corporate Social Responsibility (CSR) = an imperative**
 - . CSR to give more meaning to work and innovate
<https://fr.slideshare.net/Amorosx/lb-emergence-croissancedurablexavier-amoros>
 - . Tools to involve employees and stakeholders in a CSR approach CSR to give more meaning to work and innovate.
<https://fr.slideshare.net/Altamire/matinale-rse-altamiremfqm2015toolight>
2. **Definition of ethics: societal approach and IESF's ethical charter for engineers.**
 - the engineer in society
 - the engineer and his skills
 - the engineer and his job
 - the engineer and his missions
 - comparison with the ethical charter for engineers in Belgium <https://www.fabi.be/l-ingenieur-charte>
3. **Ethics and the digital world: definition and legal approach**
4. **Ethics in everyday life**



Actions to choose from :

 - A. The commitment of the citizen-engineer in society: carrying out an "honest engineer" project (organising a blood donation, developing artistic skills with children in difficulty, setting up an artistic and cultural week on the theme of "art and science", going to meet sick children, running to collect vaccine doses, etc.)
 - B. To be a creative scientist with an open mind and the ability to question oneself: through the history of technology, the sociology of work and geopolitics, the student is led to weave links between his or her future profession as an engineer and the associated activities, considered in their historical, sociological and geopolitical context.
 - C. To be a relevant, honest, tolerant and fair professional: zetetics workshop (art of rational doubt). The student is brought to rub shoulders with critical analysis in a concrete way, seeking to distinguish scientific content from pseudo-scientific content, to detect lies with a commercial or propaganda aim, or to prevent the intrusion into the scientific method of ideologies such as racism or creationism.
 - D. To be an efficient, vigilant, forward-looking, rigorous and reactive leader: a force for proposals for the school and/or training Actions au choix : <https://www.innovation-pedagogique.fr/article245.html>

Assessment: 100% continuous assessment

Bibliography:

NF ISO 26000 Novembre 2010, AFNOR.

 BEMS	<i>Methods and tools for decision-making</i>	 POLYTECH ANGERS	
	5A / Semester 9		UE 9-2
	9,33h CM + 4h TD +4h TP		Building Operations- Maintenance Engineering

Keywords: Decision-making, criteriology, outranking methods,

Prerequisites: Decision reliability, Project management

Objectives: - To know the stages of the main decision-making methods
 - To be able to develop and to implement a decision-making tool

Program:

- Introduction (definitions, decision-making terminology, treated issues, fundamental stages, objectives)
- Criteria definitions (relevancy of criteria, reduction of criteria number, influence of stakeholder perception differences)
- Single synthesis index methods
 - Evaluation of alternatives vs criteria
 - Numerical measure of relative importance between criteria
 - Aggregation and synthesis score
- Methods based on outranking synthesis approach considering incomparability
 - PROMETHEE method
 - ELECTRE method
- Tutorials and practical courses: State and treat a problem in real estate engineering using decision-making model

Examination:

Continuous assessment 100%

Learning outcomes:

The student has understood the decision-making tool creating process.



The student knows how to use current decision-making methods (AHP, Utilities, TOPSIS, Outranking).

The student can convince of the interest to use decision-making tools and is able to develop a simple but specific tool.

References:

- Aide à la décision, une approche par les cas, Gestion, mathématiques, informatique, P. Vallin, D. Vanderpooten, Ed. Ellipses, mai 2002.
- Décider face à la complexité: Une approche analytique multicritère d'aide à la décision, T.L. Saaty, Esf Editeur, 1984 - 231 pages.
- Décider sur plusieurs critères: Panorama de l'aide à la décision multicritère, A. Schärli, Ed. PPUR Presses Polytechniques et Universitaires Romandes, 1985 - 304 pages
- Pratiquer Electre et Prométhée: un complément à "Décider sur plusieurs critères", A. Schärli, Ed. PPUR Presses Polytechniques et Universitaires Romandes, 1996 - 173 pages

- Méthodes multicritères ELECTRE : Description, conseils pratiques et cas d'application à la gestion environnementale, L.Y. Maystre, J. Pictet, J. Simos, *Ed. PPUR Presses Polytechniques et Universitaires Romandes*, 1994 - 323 pages
- Multiple Criteria Decision Analysis: State of the Art Surveys, *Ed. by J. Figueira, S. Greco, and M. Ehrgott*, Springer, 2005.
- Multicriteria Methodology for Decision Aiding, Bernard Roy, *Ed. Kluwer Academic*, 1996.

 BEMS	<i>Project management assistance in real estate engineering</i>	
	5A / Semester 9	
	10,67h CM + 6,67h TD	Building Operations- Maintenance Engineering

Keywords:

Real estate engineering, maintenance and services, program management assistance, Global cost optimization, Operation organization, Needs analysis, Specifications writing, Tendering analysis, Monitoring and control of performances

Prerequisites: Functionality of building installations / Principles and stakeholders of construction and operation & maintenance process

Objectives:

- To know and to develop analysis and diagnosis of real estate operation & maintenance.
- To comprehend the organization of real estate management and conservation

Program:

- Challenges of operation & maintenance
 - related to health and safety of people and assets
 - environmental challenges
 - economic challenges
 - Service quality and social costs
- Project global cost analysis at the design stage
 - Analysis criteria
 - Stage by stage objectives
- To organize the operation & maintenance stage
 - Requirements, good practices, major repairs and renewals, needs analysis and organizational approach
 - Specifications for actual contracts
 - Tendering analysis and decision tools
- To monitor and control the operation & maintenance stage
 - Performance measurement, key performance indicators, service level agreement
 - Monitoring organization, reporting tools.

Examination:



Continuous assessments based on examination of tutorial class works

Learning outcomes:

The student can apprehend links between construction and future operations on a building.
The student understands issues and develop analytical capabilities for building service engineering.

References:

- Norme NF-P 60-000 - Fonction maintenance, AFNOR :
- Calcul du Coût Global - Objectifs, méthodologie et principes d'application selon la Norme ISO/DIS 15686-5, MEDDAT.

 BEMS	<i>Digitalization of performance monitoring</i>	 POLYTECH ANGERS	
	5A / Semester 9		UE 9-2
	8h CM + 4h TP		Building Operations- Maintenance Engineering

Keywords: Sensors and measures, Internet of Things, Data exchange and security, Building 4.0.

Prerequisites: Improvement of the overall performance of buildings; Building intelligence; Performance guarantee - S8 semester diagnostics and forecasts.

Objectives: Know the potential offered by the digital transition in the technical and service management of buildings and be able to support a transformation project.

Program:

- State of the art in digital monitoring of the performance of buildings in operation
 - o Measurements (optimization of the choice and location of sensors and other measurement objects);
 - o Data exchange / Internet of Things;
 - o Human-machine interfaces;
 - o Data security (Blockchain).



- Case studies:
 - o Monitoring and guaranteeing the energy performance of buildings;
 - o Improvement of the quality of services within buildings.

- Analysis of the conduct of a digital transformation project in the building.

Examination: Continuous assessments

Learning outcomes:

- The student knows the challenges and innovations in the field of digital monitoring of the performance of buildings in operation;
- The student can define the milestones of a digital transformation project to monitor the performance of his real estate heritage;
- The student exploits the potential of digital performance monitoring to decline various technical or service contractual offers.

 BEMS	<i>Behaviours and uses</i>	 UE 9-2 Building Operations- Maintenance Engineering
	5A / Semester 9	
	8h CM + 12h TD	

Keywords: Occupants behaviours, Building global performance, Optimal building design and operation, Simulation, Energy performance guarantee, Comfort, Smart Building, Machine learning.

Prerequisite: Basic knowledge of physics and mathematics, Building thermal analysis, Performance guarantee: diagnosis and forecast.

Objectives:

- Knowing the influence of occupants in different building types;
- Taking into account occupant comfort (and well-being) in real estate project design and operation;
- Knowing methods to understand occupants' behaviours and uses and to optimise building performance taking occupancy into account.

Program:

- Influential factors on building performance: focus on the effect of occupancy;
- Tools to understand occupancy, to recognise behaviours and uses and to generate occupancy scenarios (surveys, interviews, measurements, combined with machine learning or stochastic models);
- Taking occupants into account in real estate operation;
- Taking advantage of the knowledge on occupancy: adjusted energy performance guarantee, performance optimisation and prediction.

Evaluation:



100% Continuous assessment (project reports, oral presentations, written exam).

Learning outcomes:

The student knows the influence of occupancy on building performance. He has a good knowledge of the tools available to involve occupancy in the improvement of building global performance.

References:

- Eric Vorger, 2014, Étude de l'influence du comportement des occupants sur la performance énergétique des bâtiments, Thèse de doctorat, École des MINES de Paris.
- Simon Ligier, 2018, Développement d'une méthodologie pour la garantie de performance énergétique associant la simulation à un protocole de mesure et vérifications, Thèse de doctorat, MINES ParisTech PSL.
- M. Amayri, S. Ploix, N. Bouguila and F. Wurtz, "Estimating Occupancy Using Interactive Learning with a Sensor Environment: Real-Time Experiments", in *IEEE Access*, vol. 7, pp. 53932-53944, 2019.

 BEMS	<i>Fire safety engineering</i>	 POLYTECH ANGERS
	5A / Semester 9	
	8h CM + 4h TD + 4h TP	Building Operations- Maintenance Engineering

Keywords: Occurrence probability, the effect of gravity, ISI, modelling, scenarios, qualitative analysis, simulation software, safety level, regulations; iterative steps.

Prerequisites: Fire fundamentals, physical risk modelling.

Objectives:

- To know the key aspects of the ISI and well perceive the interest,
- To know how to implement technical engineering of fire safety,
- To be able to propose alternative solutions when the strict application of the regulation is impossible or problematic.

Program:

- Reminders on FSE
 - The engineering of fire safety: An alternative process to the prescriptive approach
 - Scenarios, probability of failure, serious consequences
 - Corrective or compensatory measures
- Principe of fire modelling
 - State-of-the-art of numerical simulation of fire
 - Models of Zone, of Field
 - Combustion, Radiation, Turbulence models
 - Example of existing tools
 - Evacuation models
 - Behaviour model of structures
- Simulations with dedicated software
 - Fire and smoke propagation simulations
 - Parametrical studies
 - Evacuation simulations
 - Parametrical studies

Examination:

Continuous assessment

Learning outcomes:



The student knows how to simulate a fire scenario with a dedicated software

The student can compare the results obtained from simulations and from regulatory specifications.

The student knows how to revisit validity of specification approach and to debate on the relevancy of compensatory measure.

References:

- Projet cyndinique, définition d'une méthode de sélection des scénarios d' incendie d' un ouvrage- Analyse critique et mise en application, M. Ducros et M. Moncollin . *Dossier WEB*.
- Incendies en milieu confiné, B. Debray, N. Gobeau, F. Waymel, *Rapport d'études INERIS-DRA- INVE n° 46055- C700- 50*, dossier WEB, Janvier 2007.

 BEMS	<i>Building: energy, maintenance, safety</i>	
	4A / Semester 9	UE 9-2
	4h TP	Engineering of the operation- maintenance of the building

Keywords:

Risks management, safety

Prerequisites:

Basic knowledge of risks management

Objectives:

This course is taught by a guest professor, will allow students to discover the field of risks management of buildings in countries other than France.



Program:

To be defined by the guest professor

Examination: Continuous assessment

Learning outcomes:

References:

 BEMS	<i>Health audit of a building</i>	 POLYTECH ANGERS
	5A / Semester 9	
	5,33h CM + 4h TD	Maintaining the Performance and Value of Built Heritage

Keywords:

Risk, health care cost, indoor air quality, how to prevent healthy disorders in buildings

Prerequisites:

Building thermal performance, functionality and comfort, environmental performance of buildings

Objectives:

- To comprehend the health risks impacting accommodation occupant
- To integrate control of health risks for the building's operation stage
- To carry out health audit of sick building et to propose solutions to evaluate health risks and adapted corrections toward energetic and health challenges.

Program:

- Health care cost due to building occupancy : the current report.
- Health through the five senses, homeostasis and chronobiology
- The various pollutants and their origin
- Surveys of the "Observatoire de la qualité de l'air intérieur" and and the "Grenelle de l'environnement" : new developments and legal prospects
- Public establishments and Indoor air quality :
- Constructions with low health impacts : expectations (materials, systems)
- Are evolutions of legal thermal regulations and energy savings compatible with comfort and welfare of occupants ?
 - Low consumption (BBC) and positive energy buildings (BEPOS) : health issues
 - Air exchange
 - HVAC installations and utilities maintenance : key item of future energy and health expenditures

Examination:

Continuous assessment (100%)

Learning outcomes:



The student can:

- identify indoor air pollution sources in constructions
- choose accurate investigation and pollutants evaluation methods
- propose solutions to solve healthy disorders
- propose solutions to prevent future disorders

References:

- Bâtir éthique et responsable - Chap 6. "Diminuer les coûts sanitaires du bâti : une urgence éthique de la responsabilité", S. Déoux, *Ed. du Moniteur*, avril 2007.
- Bâtiments, santé, le tour des labels, S. Déoux, C.S. Coeudevez, *Médiéco éditions*, 2011, 176 p.

- Santé et qualité de l'environnement intérieur dans les bâtiments, C.A. Roulet, *Ed. PPUR Presses Polytechniques Universitaires Romandes; Collection : Ingénierie de l'environnement*, 2008, 362 p.
- Qualité de l'air intérieur des locaux de travail et autres lieux de vie : cadre réglementaire national, L. Prat, *Techniques de l'ingénieur; Collection Air, bruit et odeurs dans l'environnement*, article G1512, janvier 2012.
- Les aérosols microbiens dans l'air du temps : le point sur la microbiologie de l'air intérieur, M. Moletta-Denat, *Techniques de l'ingénieur; Collection Air, bruit et odeurs dans l'environnement*, article G1988, janvier 2012.
- Traitement de l'air et climatisation Généralités, C. Terrant, A. Bailly, M. Clerc-Renaud, E. Rutman, *Techniques de l'ingénieur*, article BE9270, janvier 2011.

 BEMS	<i>Technical audit of a building</i>	 POLYTECH ANGERS
	5A / Semester 9	
	5,33h CM + 10,67h TP	Maintaining the Performance and Value of Built Heritage

Keywords: Audit, pathology, functionality, cave, immersion, interaction

Prerequisites: Pathology, Building Information Modeling, Technical and Safety Regulation

Objectives: Training of students in auditing and performance-based diagnostics (comfort, safety, accessibility, stability).

Strengthen skills of engineering students in this field through simulation and immersion.
Theoretical cases and real situations

Program:

Immersion situations with the use of a CAVE Automatic Virtual Environment:

- Manipulation, realization
- Individual and collective custom correction
- Advanced Pedagogy

Examination:

Continuous assessments: cases study



Learning outcomes:

The engineering student will be able to take in account typological and regulatory parameters in the analysis of the situation.

The engineering student must be able to master and correct his anomaly finding situation: analysis, approach, logic and interpretation

References:

- Cahier des charges « Réalisation d'un serious game pour l'apprentissage d'un audit technique de bâtiment » Projet Elèves Ingénieurs – ISTIA – Université d'Angers
- Scénario of technical audits, user manual plate-forme Unity 3D - ISTIA – Université d'Angers
- Sanchez, E., Ney, M., & Labat, J. (2011). Jeux sérieux et pédagogie universitaire : de la conception à l'évaluation des apprentissages. *Revue internationale des technologies en pédagogie universitaire*, 8(1-2), 46-57.

 BEMS	<i>Design and integration of a real estate information system</i>	 POLYTECH ANGERS
	5A / Semester 9	
	12h CM + 4h TD	Maintaining the Performance and Value of Built Heritage

Keywords: Information system, requirements specification, scoreboards, prospective analysis

Prerequisites: Computer aided technical management of building (EI4 – S7), Data analysis and Business Intelligence (EI4 – S8), Support in real estate engineering project management (EI5 – S9).

Objectives:

- Know how to define, in connection with business intelligence, the databases adapted to different decision levels.
- Know how to create relevant indicators from databases to measure the state of its built estate
- Know how to choose and integrate a real estate information system

Program:

- Master real estate data
 - Identification of indicators adapted to tactic and strategic decision levels
 - Transformation of indicators and scale effects (between levels, between professions)
 - Cost, relevancy and availability of real estate data.
- Select and integrate a real estate database
 - Support needs identification
 - Write its requirements specification
 - Panel of available solutions
 - Accommodate the real estate database integration
- Exploit real estate databases to measure, compare and optimize performances
 - FM performance
 - Value of buildings

Examination:

Continuous assessment (100%)



Learning outcomes:

The student knows how to choose accurate indicators to create technical and strategic scoreboards for management.

The student is able to choose its real estate database system.

References:

- Hamza Bellakhdar, Gestion des biens immobiliers Broché, Ed. Université Européenne, 2011, 68 pages.
- Caisse des dépôts, Livre blanc Maquette numérique et gestion patrimoniale - Préparer la révolution numérique de l'industrie immobilière, 2014, 100 pages.
- Planon, Livre Blanc - Patrimoine Immobilier d'Entreprise : pas de benchmark sans données correctes, 2016, 28 pages.

 BEMS	<i>Maintenance and operation of public buildings (ERP)</i>	 POLYTECH ANGERS
	5A / Semester 9	UE 9-3
	6,67h CM + 9,33h TD	Maintaining the Performance and Value of Built Heritage

Keywords: Safety regulations ERP, general provisions; specific measures; technical checks; reference frames APSAD; register of security; qualified technician; approved organization; follow-up; contracts.

Prerequisites: Standards and regulation of fire protection; technical equipment and of security; fundamental of fire.

Objectives: -To maintain the security level initial of the exploitation
 - To organize the follow-up of the lawful technical checks
 - To make safe the action of the owner legally speaking

Program:

- Lawful constraints and obligations
 - articles GE6 at GE 10
 - specific measures concerning technical assessment
- Possible insurance obligations
- Constraints related to the standards of obligatory application
- To write or modify a contract
- The follow-up technical checks

Examination:



Continuous assessment (100%)

Learning outcomes:

The student knows the obligations concerning technical assessments or can quickly find the characteristics of these constraints. He is aware of the importance of the contracts, can follow the whole of the verifications and can intervene with the inspectors.

References:

- Règlement de sécurité ERP (France Sélection) ;
- Différentes normes relatives à la maintenance des moyens de secours (AFNOR Editions) ;
- La maintenance des bâtiments en 100 fiches pratiques (Le Moniteur, collection « méthodes ») ;

 BEMS	<i>Maintenance and operation of social housing</i>	
	5A / Semester 9	UE 9-3
	6,67h CM + 5,33h TD	Maintaining the Performance and Value of Built Heritage

Keywords:

Technical and regulatory diagnostics, Technical building management, maintenance contract, multi-year maintenance plan, rehabilitation project.

Prerequisites:

- Project-based working
- Knowledge of technical building management.

Objectives:

- To define relevant key performance indicators related to real estate maintenance,
- To establish a multi-year maintenance plan for a social landlord, based on a significant sampling of housings,
- To define the rehabilitation program of a collective residential real estate.

Program:

- How to define key performance indicators of real estates,
- Secondary visit of real estates,



Examination:

Continuous assessment

- Two projects are evaluated on:
 - o Multi-year maintenance plan,
 - o Rehabilitation program.

Learning outcomes:

References:

 BEMS	<i>Maintenance and operation of logistics and industrial real estate</i>	
	5A / Semester 9	
	5,33h CM + 4h TD	Maintaining the Performance and Value of Built Heritage

Keywords: logistic real estate

Prerequisites: Real estate engineering courses of 4th year BEMS cursus

Objectives:

- To apprehend specificity and complexity of logistic buildings operations
- To identify the domain regulatory context (prefectorial order)

Program:

- Global evolution of logistic real estate
- Presentation of a logistic platform
 - Technical aspects
 - Surfaces
 - Equipements and Properties
 - Consumption data
 - Operations aspects
 - Function
 - Organization
- Real estate operation compliancy toward:
 - French regulations
 - Intern processes
 - Insurance prescriptions
 - Prefectorial orders
- Case study: maintenance weekly planning under operational constraints. Estimation of operational times for staff members. Consideration of unexpected events.

Examination:

Continuous assessment

Learning outcomes:



The student has understood the technical and operational specifications of logistic buildings maintenance. He knows how to manage his internal resources and can respond to the unexpected.

The student has a global view about prefectorial decrees (context, role, application) and about the regulatory context.

References:

Internal guidelines

Prefectorial orders

 BEMS	<i>Fundamentals of Real Estate Asset Management</i>	 POLYTECH ANGERS
	5A / Semester 9	UE 9-3
	8h CM + 8h TD	Maintaining the Performance and Value of Built Heritage

Keywords:

Asset management fundamentals: Property management, corporate real estate, service sector property, logistic property management, residential real estate, rental management process, assets valuation, sustainable real estate, risk management.

Objectives:

Understand the profession of property manager.

Be able to understand client needs of the investor client in order to adapt its services responses.



Program:

- Property management
 - Definition
 - French market
 - Type of contracts
- Profession
 - Asset management
 - Technical management
 - Accounting and financial management
- Health – Safety - Environment
 - Risk management
 - Certification
 - Sustainable real estate
- Mandate
 - Management
 - Trustee
 - Hub's restaurant
 - Remuneration
- Services
 - Panoramic view of real estate services
 - Communication tools

Examination: Continuous assessment (100%)

Learning outcomes:

References:

 BEMS	<i>Legal aspects of real estate valuation</i>	
	5A / Semester 9	
	12h CM + 4h TD	Maintaining the Performance and Value of Built Heritage

Keywords:

Property legislation, commercial lease, tenancy, joint ownership

Prerequisites:

None

Objectives:

To be able to read a lease contract, to detect its advantages and its drawbacks for tenants and landlords, to read, a co-ownership regulation text, to know the different stakeholders of real estate legislation, to understand the importance of legal context in a building or management project, to know the necessary documents, to acquire the reflexes of real estate management

Program:



- 1- Property rights and asset management firms
- 2- Premises occupancy
- 3- Construction

Examination:

Continuous assessment

References:

Commercial code, civil code, Law of 10 July 1965, Law of 6 July 1989.

 BEMS	<i>Case study</i>	
	5A / Semester 9	
	10,67h CM + 16h TP	Maintaining the Performance and Value of Built Heritage

Keywords: Practical application

Prerequisites: theoretical elements about technical management of real estate.

Objectives:

- Allow the student to play the role of a building services engineer with an actual case study. Customer validation of service will conclude the study.
- Develop good practices for project reviewing at design stage in order to anticipate and reduce the constraints during operation stages.
- Identify the financial impacts of a project on the operation budget with a life cycle cost analysis

Program:

Several case studies

Case study #1:

- Presentation of current missions of building services engineer and of the case study context,
- First common milestone: validation of planning, sites numbers, inspection visits to schedule,
- Conclusion milestone on vigilance points and presentation of actual case study,
- Collection of pictures taken during the inspection visits.

Case study #2:



- Presentation of project reviewing process with an operational view,
- Case study with documentary study and groups feedbacks → synthesis of good practices.
- Estimation of provisional budget → consideration and estimation of financial impacts of actions identified in the previous steps.

Examination: Continuous assessments

Learning outcomes:

- The student knows to put himself in the customer place so as to provide an accurate advice, in particularly about the planning aspects.
- The student has identified the main operation costs estimation methods.

References: documents provided during the session by the instructors.

 BEMS	<i>Civic Prevention and Rescue Certificate Level 1 (PSC1)</i>	
	5A / Semester 9	UE 9-4
	2h CM + 4h TP	Control the operating risks of the built heritage

Keywords: First aid; accident ; peoples' security ; to alert ; bleeding; suffocation; Discomfort; trauma.

Prerequisite: None

Objectives: Allow candidates for the SSIAP 3 exam to have the mandatory prerequisite;

Program:

The following points are successively addressed :



- Protection;
- alert;
- the victim suffocates;
- the victim is bleeding profusely;
- the victim is unconscious;
- the victim is not breathing;
- the victim complains of discomfort;
- the victim complains after a trauma.

Examination:

In practical cases followed by the delivery of a certificate

References:

Teaching the unit "PSC 1" published by the Directorate General for Security and Crisis Management.

 BEMS	<i>Security Law</i>	
	5A / Semester 9	
	6,67h CM + 4h TD	Control the operating risks of the built heritage

Keywords: occupational injury, occupational disease, inexcusable conduct, reclassification, legal risk, security requirement, safety formation, risk evaluation

Prerequisites: None

Objectives:

- To highlight security stakeholders to legal, social, financial risks related to occupational injury/disease.
- To think about firms safety policy
- To explain civil and penal procedures

Program:

Session #1: Introduction

- 1- Evolution of laws (compensation / prevention)
- 2- Community influence
- 3- Safety stakeholders:

Session #2: Civil and social consequences

Civil consequences:

- 1- Occupational injury / disease
- 2- Fixed compensation for occupational injury / disease
- 3- Inexcusable conduct of employer:

Social consequences

- 1- Reclassification of unfit employee
- 2- Dismissal of unfit employee
- 3- Complementary compensation of dismissed employee

Session #3: Penal consequences

- 1- Infringements against
- 2- Criminally liable persons
- 3- Prosecutions
- 4- Imposed sanctions

Session #4 & #5: Practical cases

- 1- Cases study
- 2- Simulations



Examination: Continuous assessment 100%.

Learning outcomes:

The student must be able to draw on the general notions learned to identify a situation presenting a legal risk and adopt the right behavior. The student must understand the challenge of persons safety in a firm.

References:

References are posted on the university intranet and yearly updated. It mainly consists of articles.

 BEMS	<i>Fire safety standards and regulations</i>	 POLYTECH ANGERS
	5A / Semester 9	
	8h CM + 8h TD	Control the operating risks of the built heritage

Keywords: Code de la Construction et de l’Habitation ; Code du travail ; Règlement de sécurité dans les ERP, classified installations, NF, EN, safety commissions, police powers; Prevention

Prerequisites: Fundamentals of Fire, Physical modeling of risks (including aspects of behavior Fire materials)

Objectives:

- To know as precisely as possible the regulations applicable to ERP
- To have a good knowledge of Part 4th of the Code du travail
- To be aware of items of interest to the fire safety in the CCH
- To know the supervisory board and the police authority (safety commissions) and their operation
- To have a good knowledge of the means of protection (active and passive)
- To know the fire safety engineering
- To know the operation of public emergency services (especially SP)
- To understand the operation of the post-fire expertise
- To know the functioning of insurance for fire risk

Program:

- Tools and references for fire prevention
 - Codes:
 - ERP:
 - ERT:
 - ICPE:
 - IGH:
- The control exerted by the administration in the ERP
 - Policing powers of the mayor
 - The prefect role
 - The decree of March 8th, 1995 and circular
 - Different commissions of security and their respective competences
- Active and passivate protection against the fire
 - The means of passive protection
 - The means of active protection
- Engineering of fire protection
 - An alternative approach with the prescriptive access of the risk
 - Bases of the EFP
 - Get the security level higher, thanks to the EFP
 - Fire modeling
- Fire expertise
 - RCCI, history and base
 - Legal Aspects
 - Methodology

- The fire insurance in the company
 - Direct Risks: general arrangements
 - Operating losses
 - Analytical tarification
 - Action items after disaster
 - Procedure of evaluation of the damage: the expertise
- Functioning of the fire brigade
 - DGSCGC
 - Zonal Organization
 - Code general des collectivités territoriales
 - Departmental Organization
 - SDIS
 - Operational Organization, SDACR, RO.



Examination:

Continuous assessment

Learning outcomes: The student is familiarized with the principal texts organizing fire protection. He can find the answer to his questions there. Moreover, he knows the close and remote environment in which he exerts his missions (structures; procedures...).

References:

- Les assurances dommage aux biens de l'entreprise, P. Laroche, Série les fondamentaux de l'assurance, *Ed L'Argus de l'assurance*, novembre 2011
- Recherche des causes d'incendie : Pratiques et analyses, JY Delannoy, R. Bardot, *Ed. du Papyrus*, 2008
- Règlement de sécurité contre l'incendie dans les ERP, collection commentée, *Ed. France sélection* 2013.

 BEMS	<i>Technical security elements</i>	
	5A / Semester 9	
	16h TP	Control the operating risks of the built heritage

Keywords: SSI security lighting, alarm, smoke extraction, automatic water extinguishing; rescue means, technical audits; getting way ok security

Prerequisites: Fundamentals of fire

Objectives:

- To know the configuration and functioning of the systems and technical equipments contributing to fire safety;
- To be the main referent in its technical and financial questions;
- To know the rules for technical verification;
- To know how to manage external actors charged of scrutineering (approved by the Interior Ministry or competent technicians organizations).

Program:

- Smoke extraction
 - DF Articles of safety regulations ERP (Object, principles, applications; scrutineering ...);
 - Smoke extraction in others institutions (Generalities of smoke extraction in the Labour Code; EPCI; IGH);
 - IT 246, 247 and 263.
- Security lighting
 - Articles EC in ERP regulation security (Objective, definitions, maintenance and servicing ...).
- Elevators for physically disabled evacuation
 - Article AS 4 in ERP regulation safety (order min. September 24, 2009).
- Rescue means
 - MS Articles in ERP Safety Regulations
 - Provisions to facilitate firemen actions;
 - SSI (generalities; definitions, standards different SSI functioning, scrutineering);
 - Alarm systems (generalities, classification, IT 248);
 - Maintenance and checking of safety extinction means;
- Internal security service
 - Composition and responsibilities;
 - Instructions;
 - Training and qualification;
 - Three special cases: The security service in the L- type, the T- type, the U-type.

Examination:



Continuous assessment

Learning outcomes:

The student has a good knowledge of the backup facilities, smoke clearing and lighting emergency used in the Establishment Receiving Public like in the industrial world. He can organize and follow the lawful technical checks.

References:

- Règlement de sécurité contre l'incendie relatif aux ERP, dispositions générales et dispositions particulières, *Edition France sélection*, novembre 2012.
- SSIAP 1, formation des agents de sécurité incendie et d'assistance aux personnes, *Edition France sélection*, mars 2012.
- SSIAP 2, formation des chefs d'équipes de services de sécurité incendie et d'assistance aux personnes, *Edition France sélection*, mars 2012.
- SSI- Systèmes de sécurité incendie, détection incendie- *Dossier technique*, Ed. CNPP, juillet 2005.

 BEMS	<i>Fire safety during operation</i>	
	5A / Semester 9	
	6,67h CM + 5,33h TD	Control the operating risks of the built heritage

Keywords: Fire, awareness, training, technical audits, security protocols, prevention, analysis and prioritization of risk based security, traceability prevention.

Prerequisites: Standards and regulations for fire safety , Safety technical equipments, Basic knowledge on fire

Objectives:

- To ensure the establishment with the highest level of fire safety
- To implement and maintain a true safety policy

Program:

- The factors affecting fire safety
 - Human Factors
 - Materials technical and organizational factors
 - Economic Factors
- Risk analysis and vulnerability
 - The regulatory gap (diagnosis of existing)
 - Risk analysis and prioritization
 - The Existing vulnerability.
- Daily prevention specialist
 - Maintenance of monitoring materials contributing to safety and security
 - Technical verification material
 - Communication with staff
 - Crisis anticipation

Examination:



Continuous assessment

Learning outcomes:

The student can apprehend in a global way the factors likely to generate the risk in an establishment. He can distinguish and treat the risks on a hierarchical basis.

References:

- La fonction sécurité, CNPP, collection technique et ingénierie, *Ed. DUNOD* , 2010.
- Maîtriser et gérer le risque d'incendie, JM d' Hoop, *Ed. AFNOR*, novembre 2005.
- Traité pratique de sécurité incendie, *Ed. Normadoc*, mai 2013.

 BEMS	<i>Design, validation and monitoring of operational safety processes</i>	 POLYTECH ANGERS
	5A / Semester 9	UE 9-4
	8h CM + 8h TD	Control the operating risks of the built heritage

Keywords: Security, traceability, quality

Prerequisites: Occupational safety, safety within buildings

Objectives: To elaborate, to use and to keep alive procedures and documentary tools related to security in operation

Program:



- Context: Security in operation
- Organisation and design of documents
- Security guides
 - reference documents
 - operation documents
 - traceability and tracking documents
 - crisis management documents
- Practical cases

Examination:

Continuous assessment

Learning outcomes: The student knows the whole technical documents of safety. He can integrate their exploitation into the life of the establishment

References: template provided by teacher.

 BEMS	<i>Issues of accessibility of buildings</i>	 POLYTECH ANGERS
	5A / Semester 9	
	8h CM	Control the operating risks of the built heritage

Keywords: Accessibility, disability

Prerequisites: Building plan reading

Objectives: To consider the regulations related to accessibility of persons with disability with a focus on sustainable development policy.

Program:

Awareness to various disability situations in public-access buildings



Applicable regulation in various building types

Process and administrative follow-up

Examination: Continuous assessment

Learning outcomes: The student knows the disability problems. He knows how to consider it within the building operations.

References: Documents provided by the instructor.

 BEMS	<i>Improved safety and security in operation</i>	 POLYTECH ANGERS
	5A / Semester 9	
	8h CM + 16h TP	Control the operating risks of the built heritage

Keywords: Fire; malevolence awareness, training, technical audits, security protocols and surety interest, prevention, risks analysis and prioritization, safety function; security interest function; traceability.

Prerequisites: Standards and regulations for fire safety, safety technical equipments; fundamentals of fire.

Objectives:

- To be able to imagine and implement all actions to reduce the risk level
- To know how to develop a prevention plan in extension of the existing diagnosis and risk analysis
- To be able to create protocols for safety and security
- To be a good communicating sensitizing his employer and staff
- To know how to motivate staff and launch a training program
- To be able to manage a dashboard and a record of safety.

Program:

- Optimization of human behavior
 - awareness of the employer
 - Staff awareness
 - Training and motivation
- Optimizing the organization's safety and security
 - Manage a service
 - Regulatory watching
 - Creating security protocols and surety interest
 - Create and administrate management tools and decision support
 - Traceability
- Improvement and optimization of the physical aspects
 - Organization and maintenance of premises
 - Renewal technical equipment involved in fire safety

Examination:



Continuous assessment

Learning outcomes:

The student knows how to position itself in the system core. He can design the setting in security of a site, can sensitize his employer and optimize the operation of his service.

References:

- La fonction sécurité : CNPP, *collection technique et ingénierie*, Ed. DUNOD , 2010.
- L'accident et l'organisation : Michel Llory, René Montmayeul , *collection Synthèse*, Ed *Préventique*, décembre 2012.
- Traité pratique de sûreté- malveillance, CNPP Ed, 2009.

 BEMS	<i>Project Graduation</i>	 POLYTECH ANGERS	
	5A / Semester 9		UE 9-5
	80h TP		Project

Keywords: Project

Prerequisites: Project management + aggregation of teachings received during the three-year engineering training.

Objectives: To be able to develop a project from need analysis to implementation

Examination: continuous assessment (100%): 25% for literature review + 25% for mid-term short oral defense + 25% for final report + 25% for final oral defense.

Learning outcomes:

The student is able to establish a state-of-the-art, a literature review.

The student can identify technological and methodological barriers related to an industrial issue.

The student shows a good-level conceptualization.

The student can identify the necessary resources to implement new developed tools or approaches.

The student is able to build specific arguments to convince his authority and his collaborators of his results (tool or method) soundness.





Syllabus

5A BEMS – S10

Version June 2022
Responsible: T. Lemenand



 BEMS	<i>Traineeship</i>	 POLYTECH ANGERS
	5A / Semester 10	
	20 weeks minimum	Traineeship

Keywords: employability

Prerequisites: all teachings of semester 5 to 9

Objectives: - Original production related to industrial needs and more broadly to expectations of profession.

Program: Internship in industry, laboratory or business incubator for a period of 5 months at least or 4 months for research internship

Examination:

- Monthly reports, visit by a teacher
- Final report, with oral defense and judgment from the industrial supervisor.

Learning outcomes:

The student is able to :

- Address completely a professional problem
- Incorporate business world