PROEMED ERASMUS+

PROGRAMME Handbook

MASTER IN ENERGY EFFICIENCY IN BUILDINGS

INSTITUTIONS: ESSTHS-ISSATS

UNIVERSITE OF SOUSSE

TUNISIA

2017

MASTER : ENERGY EFFICIENCY IN BUILDINGS – S1									
UE	ECUE	half hourly volume			Credits		coefficients		Assess -ment
		Lecture	TC	TP	ECUE	UE	ECUE	*UE*	
MPEEB-1-1: Building electricity and person electrical security	Building Electricity	10,5	10,5		3	7	2	4	CE
	Building and person electrical security	10,5	10,5		2		1		
	Laboratory of building electricity			21	2		1		
MPEEB-1-2: Air conditioning system and Metrology	building heating system	21	10,5		2	7	1	4	CE
	Metrology	21	10,5		3		2		
	Laboratory of Metrology			21	2		1		
MPEEB-1-3: Building materials and integration	Intelligent Building Materials and Integration	21	10,5		3	5	2	3	CE
	Workshop of Materials and envelope			21	2		1		
MPEEB-1-4: Dessin-Architecture	General construction processes	10,5	10,5		4	7	1	3	CE
	DAO(Autocad 2 D)			21	3		1		
MPEEB-1-5: UE transversale 1	French		21		2	4	1	2	CA
	Technical English		21		2		1		
	Total 1	94,5	105	84	30	30	16	16	
	Total 2	283,5							

MASTER : ENERGY EFFICIENCY IN BUILDINGS – S2									
UE	ECUE	Volume Horaire Semestriel			Crédits		coefficients		Assess-ment
		Lecture	TC	PW	ECUE	UE	EC UE	*UE*	
MPEEB-2-1: Thermal building and air quality	Thermal building and moisture transfer	21	21		3	7	2	4	CE
	Indoor environmental comfort	21	10,5		2		1		
	Software 1 (Transys)			21	2		1		
MPEEB-2-2: Hydraulic and aeraulic network	Hydraulic Network	10,5	10,5		2	7	1	3	CE
	Air distribution system	10,5	10,5		3		1		
	Laboratory of air distribution and hydraulic system			21	2		1		
MPEEB-2-3: Automation and Network	Electronics and automation for the building	10,5	10,5		2	6	1	3	CE
	Bus and network in building	10,5	10,5		2		1		
	Laboratory of electronics and automation			21	2		1		
MPEEB-2-4: Integration of new and renewable energy into the building	Thermal and Photovoltaic Solar	21	21		3	5	2	3	CE
	Software 2 (PV Sys)			21	2		1		
MPEEB-2-5: Transvrsal teaching unit	Creation and management of a company		10,5		2	5	1	2	CA
	Construction site organization	10,5	10,5		3		2		
	Total 1	115,5	115,5	84	30	30	16	15	
	Total 2	315							

MASTER : ENERGY EFFICIENCY IN BUILDINGS – S3

	ECUE	Volume Horaire Semestriel			Crédits		coefficients		Assess-ment
		Lecture	TC	PW	ECUE	UE	ECUE	*UE*	
MPEEB-3-1: Green Building	**Bioclimatic Building Design**	10,5	10,5		2	7	1	4	CE
	Audit in buildings	10,5	10,5		2		1		
	Building life cycle assessment	10,5	10,5		2		1		
	Software3 (Tun-eQuest-software)			21	1		1		
MPEEB-3-2: Cold Production and refrigeration technology	**Cold production**	10,5	10,5		2	6	1	3	CE
	Refrigeration Technology	10,5			2		1		
	Laboratory of cold production and refrigeration technology			21	2		1		
MPEEB-3-3: Efficient Building	**Building management systems**	21	10,5		3	7	2	4	CE
	Daylighting and Lighting of Buildings	10,5	10,5		2		1		
	Laboratory of Lighting / BMS			21	2		1		
MPEEB-3-4: Project	**Workshop**			21	3	5	2	3	CE
	DAO(Autocad 3 D)			21	2		1		
MPEEB-3-5: Transvrsal teaching unit	**French**		21		2	5	1	2	CA
	Soft skills		21		3		1		
	Total 1	84	105	105	30	30	16	16	
	Total 2	294							

MASTER : ENERGY EFFICIENCY IN BUILDINGS – S4

Graduation project : Each student must complete a graduation project in a company or in course office. He will be supervised by a professional and a university teacher. At the end of his project, each student must submit a brief to a jury. He will not graduate until he has validated his project

TC: Tutorial classes
TP: Practical work
CA: continuous assessment
CE : continuous assessment&Final exam

SEMESTER 1

Name	**Building Electricity –S1**
Year / Semester	**First Year- First Semester**

Lecturer	**Olfa Bel Hadj Brahim Kechiche**
Specific learning outcomes	On successful completion of this module students should be able: • To understand the fundamentals of domestic electrical installations; • To interpret schematics of electrical installations; • To analyze electrical requirements of urban building; • To manage available energy sources and propose efficient solutions to limit the energy consumption; • To master intelligent energy management tools;
Contents	**Standardization and reperage of an electrical installation:** • Basic elements of an electrical installation • Vocabularies of the electrical installation • Different sources and different receivers **Domestic lighting installations:** • Different lighting fixtures for living quarters • The different representations of a diagram. • Design of the electrical part of an architectural plan. • The functions of the different elements of a lighting installation. • Different assemblies and understand their operating principle. **The connection of the distribution table:** • The different tools • The different steps • Design of the installation diagram of the distribution table **Connection of the public network and commissioning**: • Supply and metering of energy • Surrounding mode of the neutral point in the connection of residential installations
Schedule	TBD
Teaching and learning	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes**: 10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (10%) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum).To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST

Name	**Building and person electrical security-S1**
Year / Semester	**First year- First Semester**

Lecturer	**Olfa Bel Hadj Brahim-Kechiche**
Specific learning outcomes	On successful completion of this module students should be able to: • Describe faults in domestic electrical systems; • Select the appropriate equipment and devices for the domestic electrical systems protection; • Properly select the selectivity between protective devices to ensure efficient protection of domestic electrical Systems: • Describe the effects of electrical current on the human organism; • Explain the procedures for the persons protection in the event of direct contact and indirect contact; • Properly select personal protection devices; • Identify and classify the different neutral systems.
Contents	This course is organized as follow : **Introduction to building electrical security:** • Terminology • Three-phase alternating current **Protection of instruments in buildings:** • Faults in electrical installations • Protective devices • Selectivity between protective devices **Protection of persons:** • Effects of electrical current on the human organism • The parameters to be taken into account for the risk assessment • Protection of persons in the event of direct contact • Protection of persons in the event of indirect contact **Neutral systems:** • Characteristics of the Neutral • Use of different neutral systems • Identification of a neutral systems • Classification of neutral systems • Protection of installation and persons
Schedule	
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes**: 10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade

Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20. To pass(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST • Mechanical and Electrical Equipment for Buildings [11 ed.], by Walter T. Grondzik, Alison G. Kwok, Benjamin Stein, John S. Reynolds • Web sources

Name	**Laboratory of Building Electricity-S1**
Year / Semester	**First year-second semester**
Lecturer	**Olfa Bel Hadj Brahim- Kechiche**
Specific learning outcomes	On successful completion of this module student must be able to apply the knowledge acquired during the lessons of building electricity and security.
Contents	Laboratories : • Analyze waveforms and amplitudes of currents, during a "free" short circuit, at the terminals of a single-phase receiver and a three-phase receiver fed by a LV network • Investigate the operation of a magnetothermic circuit breaker • Investigate the trip time of a magnetothermal circuit breaker • Draw the characteristic curve for different classes of magnetothermal circuit breakers • Design of a protected installation based on the TT neutral regime.
Schedule	TBM
Teaching and learning methods	Face to face,
Teaching techniques	Experimental work**: 21 h**
Assessment methods	• All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation. • final written exam are designed.
Assessment criteria	• Class Participation and work report(30%) • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST • Mechanical and Electrical Equipment for Buildings [11 ed.], by Walter T. Grondzik, Alison G. Kwok, Benjamin Stein, John S. Reynolds • Web sources

Name	**Metrology-S1**
Year / Semester	**First year- First semester**
Lecturer	**Mohamed Ali Merghni**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Knowledge and understanding of the fundamentals of metrology; • Ability to introduce students to dimensional metrology; • Ability to provide students with techniques for the evaluation and identification of metrological needs; • Ability to provide students with the tools to assess the variability of measures according to requirements; • Ability to provide students will have the opportunity to practice the theory as seen in the course of exercises and practical exercise.
Contents	This course is organized as follow: **Mechanical measurement: Terminology and definitions** • Introduction to metrology; • Measurement, measurable quantity, measurement methods (direct and indirect); • Measurement units in mechanical measurement; • Measurement system, measurement methods. **Characteristics of a measuring instrument** • Types and characteristics of measuring instruments; • Characteristics of a measuring instrument: Measuring range, capacity, resolution, accuracy, sensitivity, fidelity, accuracy, accuracy class; • Choice of measuring instruments; • Calibration of measuring instruments: procedures for implementation (report calibration / verification report); • Management of measuring facilities and laboratories; • Management of a range of measuring instruments and implementation of the metrological function in the company. **Estimation of uncertainties** • Introduction to measurement uncertainties: types of errors and classification (random errors and systematic errors); • Methods for measuring measurement uncertainties; • Law of composition of measurement uncertainties (Normal, Uniform, Arcsin); • Determination and calculation of different types of errors (random and systematic)
Schedule	TBD
Teaching and learning methods	Face to face,
Teaching techniques	Lectures, **21 h** Tutorial classes : **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above.

	• Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• **ALLISY**, les incertitudes de mesure. Applications pratiques, Bulletin d'information du Bureau National de Métrologie, n°53, 1983. • **AFNOR**, vocabulaire International des termes fondamentaux et généraux de Métrologie (International vocabulary of basic and general terms in Metrology (V.I.M), 2ème édition, 1994 • **AFNOR, guide pour l'expression de l'incertitude de mesure (GUM), NF ENV 13005, 1999.** • **M.HIMBERT, c**ours de Métrologie de D.E.A, du Conservatoire National des Arts et Métiers (depuis 1990) et du MASTERE de l'I.N.S.A.T, Instrumentation et Mesures (2000-2005). • **A.RAZET**, métrologie A et B, collection des cours du Conservatoire National des Arts et Métiers de Paris, 1985. • **O.TOUAYAR**, cours incertitude de mesure et métrologie, Institut National des Sciences Appliquées et de Technologie, 2001. • Norme FD X 07-021 (Octobre 1999) : Métrologie et applications de la statistique - Aide à la démarche pour l'estimation et l'utilisation de l'incertitude des mesures et des résultats d'essais.

Name	**Laboratory of Metrology- S1**
Year / Semester	**First year- First semester**
Lecturer	**Mohamed Ali MERGHENI**
Specific learning	**On successful completion of this module student must be able to apply the knowledge acquired during the lessons metrology electricity and security.**
Contents	This practical work is aims to provide for students a practical knowledge about the basics in the metrology. • Measuring lengths and masses • Measurement of the velocity • Measurement of the temperature
Schedule	TBM
Teaching and learning methods	Face to face,
Teaching techniques	Experimental work: **21 h**
Assessment methods	• All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation. • final written exam are designed.
Assessment criteria	• Class Participation and work report(30%) • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST • Mechanical and Electrical Equipment for Buildings [11 ed.], by Walter T. Grondzik, Alison G. Kwok, Benjamin Stein, John S. Reynolds • Web sources

Name	**Intelligent Building Materials and Integration-S1**
Year /	**First year –First semester**
Lecturer	**Pr. Habib Sammouda**
Specific learning outcomes	On successful completion of this module students should be able : • To understand the different properties on construction new materials • To evaluate the energy quality of the materials used in the building; • To assist the decision-maker in choosing building materials by explaining the issues of energy efficiency through a simple balance sheet • To put in place a new construction and coating process within the construction company; • to improve the building local materials with the new coating materials
Contents	**Building Materials and Envelope** • Classification of building materials • Different characteristics of this material • Highlighting the relationship between structure and properties • Physical properties • The polymers • The Ceramics • Concrete materials • The Metals • Composite materials Cement - Additives - Fibers - Casting of materials and compaction - Finishing and evolution of the microstructure - Analysis of hydration • Energy-materials interaction • Optimization of the mixing and assembly processes of these materials **Intelligent materials and building integration** • New Building Materials • Intelligent materials for energy storage: Intelligent glazing; The Intelligent Façades • New building designs: Integration of ER systems to buildings - New ER heat recovery systems; New ER Refrigeration Systems (HVAC) • The house without heating • Biotechnologies at the controls • Modeling of the concepts and exploitation of the various components (materials - energy systems and sensors) **Workshop: Case Study: Bill Gates' House:** • A home capable of accommodating sophisticated and scalable technology, but without this taking precedence over the rest.
Schedule	TBM
Teaching and learning methods	Face to face
Teaching techniques	Lectures, **21 h** Tutorial classes : **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.

Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Workshop of materials and envelope-S1**
Year /	**First year –First semester**
Lecturer	**Pr. Habib Sammouda**
Specific learning outcomes	• On successful completion of this module student must be able to apply the knowledge acquired during the lessons of Intelligent Building Materials and Integration
Contents	**Workshop: Case Study: Bill Gates' House:** • A home capable of accommodating sophisticated and scalable technology, but without this taking precedence over the rest.
Schedule	TBM
Teaching and learning methods	Face to face
Teaching techniques	Experimental work:: **21 h**
Assessment methods	• All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation. • final written exam are designed.
Assessment criteria	• Class Participation and work report(30%) • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**General construction processes-S1**
Year/Semester	**First year- First semester**
Lecturer	**Ines Jaouadi**
Specific learning outcomes	On successful completion of this module students should know: • Coordinate all needs of construction project (equipment, labor, materials and capital) • To carry out a work in accordance with the execution plans and the regulations • Understand how to implement and control project operations
Contents	Topics covered include: • Progress of construction operations • The construction site and the offer • Construction planning • Organisation of site construction
Schedule	TBD
Teaching and learning methods	Face to Face
Teaching techniques	Lectures : **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A
Educational material of reference	

Name	**DAO-S1**
Year / Semester	**First Year-First Semester**
Lecturer	**Brahim Taoufik**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Design plans using computer-aided design (CAD) software • Convert the designs of engineers and architects into technical drawings • Design products with engineering and manufacturing techniques • Add details to architectural plans from their knowledge of building techniques • Specify dimensions, materials, and procedures for new products • Build and modify 3D solid models involving wireframe, surface, and solids modelling techniques. • Apply their knowledge of design procedures for developing support project development for building design and construction.
Contents	• Basic Drawing and Editing Commands; • Data and Point Entry Methods; • Basic and Advanced Draw Commands; • Environment and View Controls; • Drawing Management; • Setting Up Drawing Session; • Organizing with Layers; • Creating and Using Library of Blocks and Drawings; • Managing Drawing Files; • Dimensioning and Text; • creating annotation; • Managing Object Properties; • Creating 2D and 3D Drawings; • Plans, Elevations and Isometric Views; • 3D Construction and Perspective View; • Attributes and Polylines, Rendering and Shading; Creating Drawings Layout; Presentation Quality Drawing ; • Drawing Output ; Plotting
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	practical work : **21 h**
Assessment methods	• All students will write a paper dealing with a topic above. • Student's Final written exam are designed.
Assessment criteria	• Class Participation and work report(30%) • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass,the minimum threshold is 10/20.
Preparatory	N.A.

course units	
Educational material of reference	• AutoCAD 2008: Conception, dessin et présentation. • Tous les outils et fonctionnalités avancées technologie, Olivier le Frapper • AutoCAD 3D modélisation et rendu, Jean-Pierre Couwenbergh • Les secrets du dessinateur AutoCAD, Patrick Diver • AutoCAD 2015 pas à pas, André Dagenais

Name	**French-S1**
Year / Semester	**First year-First Semester**
Lecturer	**Pr. Chebbi riadh**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Ability to understand essential content in a complex text or technical discussion in their specialty. • Ability to express oneself orally and in writing clearly on a wide range of topics, • Give an opinion on current topics and communicate with ease and spontaneity with various interlocutors, etc.
Contents	Topics covered include: • News • Modernity • Science
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical work: **21 h**
Assessment methods	• One mid-term and one final written exam are designed. • Student's attendance in lectures and class participation.
Assessment criteria	• Midterm Exam 50% • Final Exam 50%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass,the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Technical english-S1**
Year / Semester	**First year-First Semester**
Lecturer	**Pr. Aida amamou**
Specific learning outcomes	On successful completion of this module students should demonstrate: • An understanding and a mastery of key notions relating to the field of energy. • An ability to write and present papers on such notions. (writing + speaking)
Contents	Topics covered include: • Energy: definition and types • Heat transfer • Fossil fuels: advantages vs drawbacks or problems • The importance and the potential of renewable energy sources • Energy conservation • Smart buildings • Green buildings • Green nanotechnology
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical work: **21 h**
Assessment methods	• One mid-term and one final written exam are designed. • Student's attendance in lectures and class participation.
Assessment criteria	• Midterm Exam 50% • Final Exam 50%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

SEMESTER 2

Name	**Thermal building and moisture transfer-S2**
Year / Semester	**First year- Second semester**
Lecturer	**Pr. Noureddine Boukadida**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Understanding mechanisms of heat and mass transfer in building in stationary and non stationary regime • Understanding and applying the regulatory requirements for energy control in new buildings in Tunisia; • Ability to recognise the thermal behaviour of monozone or multizone building and the effect of many parameters as outdoor temperature, solar flux , occupant, MCP, etc • Evaluate the risks of condensation in the envelope of a building and propose solutions to avoid this phenomenon;
Contents	Topics covered include: **Introduction to the thermal behaviour of building climate** • The building sector is an energy-intensive sector • Brief reminders on heat transfer modes (prerequisites) • Parameters influencing the energy performance of a building **Solar radiation and Method of determining the incident solar flux on a wall** • Solar Energy • Geographical coordinates of a place on land • Earth movement and position of the sun • Received solicitation • CLO direct radiation • CLO diffuse radiation • LLO diffuse radiation • Building envelope and fenestration design: transmission through walls and roof, transmission through windows, window orientation and size, shading coefficient, solar heat gain coefficient, glazing types, surface colour, window size location; **Zoning and thermal directive in Tunisia** • Climate zoning • Principle:Limit the energy requirements of the building related to the thermal comfort "BECTh" (CH / REF requirements of atmospheres). Improvement of the thermal quality of the building envelope. • Legal basis • Technical requirements for the thermal performance of new buildings: • Case of residential, case of offices • .Energy Audit and Energy Audit on Plan • label "écoBAT" • PROMO-ISOL program **Some notions about humid air in relation to the thermal of the building** • Psychrometric diagram

	• Behavior of materials to water vapor • evaporation –condensation of water inside building wall, evaluation • Glaser diagramme **Thermal balance of a building in steady state** • Different types of wastage (transmission loss, loss by thermal bridge, etc • Sakney diagram • contribution of solar gains • internal gains • thermal balance • solution permitting to have economic of energy
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **21 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of module goes from 1 (minimum) up to 20 (maximum). To pass the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• AFPA – DEAT – Froid et climatisation – Ressources formatives – Diagramme Psychrométrique – *F. Cabeza - Mai 2002* • Pierre LAVIGNE en collaboration avec Paul BREJON et Pierre FERNANDEZ, «*Architecture climatique, une contribution au développement durable* », tome 1 :Bases physiques ; EDISUD, Aix-en-Provence. 1997. • Énergétique du bâtiment, *Section de Génie Civil, 4ème/5ème année, Nicolas Morel et Edgard Gnansounou (nouvelle édition du cours précédemment donné par Claude-Alain Roulet et Arnaud Dauriat,* Edition septembre 2009

Name	**Indoor environment comfort-S2**
Year / Semester	**First year-Second semester**
Lecturer	**Noureddine Boukadida**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Understanding mechanisms of heat and mass for occupant • Understanding components and parameters influencing thermal comfort • Understanding components and parameters influencing phonic comfort • Understanding components and parameters influencing hygrometric comfort
Contents	Topics covered include: **Thermal comfort** **Introduction** **Nomenclatures of used notations** **Health of man** • Balance sheet equation • .Average radiant temperature • Main Thermal Powers exchanged by a person • Thermal metabolism • Radiative exchanges • Convective exchanges • Conductive Exchanges • Exchanges of heat by evaporation • Respiratory exchanges: **Skin and clothes temperature** • definitions: • Skin temperature • Temperature of the garment () **Thermal comfort** • Dissatisfaction, Fagner Scale • Thermal comfort model **Influence of the various parameters on the balance sheet** • air speed • Hygrometric influence of air • Influence of activity **Wet air quality and characteristics** • Source of pollution and concentration • Concentration of gaseous compounds (see course M1-) • Odeurs • Aération
	Acoustic comfort **Basics of acoustics** • The sound • Noise and noise sources, Solid and aerial noises • The ear • Frequency bands • Frequencies

	• Sound perception • Propagation: Refraction, Reflection, Diffraction • Sound Pressure • Acoustic power • Intensity • Noise measurements; The decibel, The decibel A, Operations on the decibel, The Sonometers, Standardized noise indicators • Reverb measurements • Insulation measurement **Building acoustics** • Isolation of airborne noise • Law of mass • Double walls • Composite walls • Standardized attenuation indices • Standardized isolation indices • Optimization and defects of airborne sound insulation • Isolation of impact noises • Indices ΔLw and Ln, w • Standardized shock noise pressure level nT, w • Optimization and defects of shock noise insulation • Isolation of equipment noise: Treatment of ventilation noises, Vibration treatment • Reverberation treatment, Absorption coefficient, Equivalent absorption area A, aqbsorption noise reduction • Optimization of room acoustic correction • Regulations
	Hygrométric comfort
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **21 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass, the minimum threshold is 10/20.

Preparatory course units	N.A.
Educational material of reference	• Le confort thermique, J-C Duval, revue physique appliquée, 19(1984), 513-531

Name	**Software 1-S2**
Year / Semester	**First year- second semester**
Lecturer	**Noureddine boukadida**
Specific learning outcomes	On successful completion of this module student must be able • to apply the knowledge acquired during the lessons of thermal building and moisture transfer, indoor environment comfort. • to simulate thermal behaviour of Knowledge and understanding of the fundamentals steps to be followed under "Transys software";
Contents	This course is organized as follow : • Using Transys Software • Main steps • Input in TRANSYS software : ➢ Geographic place parameters ➢ Thermo- pysical properties of component of the building system (thermal conductivité, thermal diffusivity, thermal effusivity, etc) ➢ Dimension of each component ➢ Conditioning air system proprieties,etc • Simulate a thermal behaviour of a wall, or building in permanent or dynamic way • Analysis of main results of simulations
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical classes: **21 h**
Assessment methods	• report of practical work • final written exams
Assessment criteria	• report of practical work 30% • Final exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Hydraulic networks-S2**
Year / Semester	**First year-Second semester**
Lecturer	**Ben Abdelghani Farouk**
Specific learning outcomes	On successful completion of this module students should be able to : • Know and understand the principles of water flow networks, difference between water flow principles, etc.; • Calculate different diameters for cold and hot water pipelines; • Know how to evacuate used water and rainfall water;
Contents	Topics covered include: • **Introduction of water flow networks and main equations governing water flow in pipelines.** • **Different materials used for cold water and hot water inside buildings and their characteristics** • **Network flow calculating methodology** ➢ Principles of DTU standards for water flow calculation inside buildings; ➢ How to calculate pressure at different points and verification condition; ➢ Diameter calculation for different cases with different water types and different systems ➢ How to verify obtained results • **Used water and precipitations evacuation systems** ➢ Principles to calculate diameters for used water evacuation; ➢ How to evacuate rainfall water and to calculate different size for evacuation systems.
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5** h Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass The minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of	• Standards for hydraulic water calculation inside buildings D.T.U 60.11 • Course: Hydraulique des réseaux de chauffage: L.Chatellier et M.Abadie,

reference	Université de la Rochelle. • Guide de dimensionnement des appareils de production d'eau chaude sanitaire: fascicule technique. • Distribution et collecte des eaux, Deuxième édition: Francois G. Brière

Name	**AIR DISTRIBUTION SYSTEMS-S2**
Year / Semester	**First year-Second semester**
Lecturer	**Choaib Olfa**
Specific learning outcomes	On successful completion of this module students should know: • The functions of the components of an air distribution system, including major equipment types and auxiliary components. • The principles of air distribution as they relate to human comfort. • The principal codes and standards affecting air system design • How to layout and size a simple duct system and calculate pressure losses in the system • Common methods for reducing airborne sounds in systems and how to start an air system and diagnose common problems associated with air system start-up.
Contents	•General Duct Design (Single Path Systems-CAV, VAV, CAN and VAV, FPU, ACB FCU- and Dual Path Systems –CAV, VAV), * •Duct Design Fundamentals (Duct Pressure Losses, Duct Pressure Losses-Friction, Friction Chart, Pressure Drop in Fittings, Duct Transitions, Pressure Drop in Branch Fittings, Area Changes, Flex Duct, Dampers, Design Method, Supply Air Duct Total Pressure Drop-AS, Air Density Changes/Altitude Changes), • Terminal Units, Fans (Fans Types and Size Ranges, Fan Construction Classes, Fan Selection Criteria, Fan Terms, AMCA Spark Resistant Construction, Centrifugal Fans, Axial Fans, Installation and Clearance Requirements, Fan Rotation and Discharge Positions, Fan Motor Positions, Fan Drive Arrangements, Centrifugal Fan Inlet Box Positions, Centrifugal Fan Damper Arrangements for Reversible Flow)
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20 (maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.

Educational material of reference	• HVAC Equations, Data and Rules of Thumbs. Arthur A. Bell, JR. ISBN 978-0-07-148242-4 • Price Engineer's HVAC Handbook. Edition1 A comprehensive Guide to HVAC Fundamentals.

Name	**Laboratory of air distribution and hydraulic system -S2**
Year / Semester	**First year-Second Semester**
Lecturer	**Choaib Olfa**
Specific learning outcomes	On successful completion of this module students must work on these different teaching benches: • Air conditioning unit with instrumentation • Reversible water chiller • Study of split system air conditioner with small room • Didactic study bench of an ice water production group
Contents	• Study of the components of an installation • Heating or cooling operation (refrigerant and/or chilled water • Determination of the heat balance • Influence of the new air ratio / recycled air • Influence of the air velocity • Study of psychrometric transformations on the humid air diagram • Effectiveness of exchanges • Pressure losses of different equipment • Study of the regulation. - Temperature / humidity • Free cooling and free Heating • Identification of the components of a water chiller unit • Commissioning and adjusting • Verification of system operation • Study of the thermodynamic cycle of the refrigerant • Evaluation of coefficients of performance • Energy balances to the exchangers. • Study of an air conditioning with separate elements (SPLIT SYSTEM) • Operation of a refrigeration system • Role of various organs • Heat balance • Identification of the components of ice water production group • Verification of system operation • Study of the thermodynamic cycle of the refrigerant • Evaluation of coefficients of performance
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical Works: **21 h**
Assessment	• report of practical work

methods	• final written exams
Assessment criteria	• report of practical work 30% • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Electronics and Automation in buildings-S2**
Year / Semester	**First year- second semester**
Lecturer	**Hatem Boukadida**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Awareness of domestic risks and ability to identify risk factors • Ability to create a personalized safety plan • Ability to manage available energy sources and propose efficient solutions to limit the energy consumption • Ability to master intelligent energy management tools • Ability to participate in class discussions with colleagues and with teachers
Contents	This course is aimed at developing students' holistic perception of Civil construction projects, the acquisition of skills to perform the electrical analysis of an urban living building. The aim of the development of the module is to provide for students a theoretical and practical knowledge about the basics in the field of electrical and electronic design design applied to urban buildings. This course is organized as follow : **Energy availables in a building** • Production • Transport • Risks and Risks' factors • Safety **Centralization of orders** • Networking of equipment • The controls • The communicating house • Residential gateway **Energy savings** • Possible sources of savings • Associated sensors • Energy optimization • Supervision of equipment • History management **Tools for intelligent energy management** • The organization • The grafcet • Programming • o Embedded platforms
Schedule	TBD
Teaching and learning methods	Face to face

Teaching techniques	Lectures: **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST • Analog Interfacing to Embedded Microprocessor Systems [2nd ed], by Stuart Ball • Mechanical and Electrical Equipment for Buildings [11 ed.], by Walter T. Grondzik, Alison G. Kwok, Benjamin Stein, John S. Reynolds • Web sources

Name	**Laboratory Electronics and Automation in building-S2**
Year / Semester	**First year- Second semester**
Lecturer	**Hatem BOUKADIDA**
Specific learning outcomes	On successful completion of this module students should be able to : • Build self-contained home automation systems that works on their own, such as : a simple alarm system with a motion sensor • Interface home automation projects wirelessly with your computer. • Get familiar with the world of home automation using open-source hardware
Contents	• Building a Weather Measurement Station. • Building a Smart Lamp • XBee Motion Sensors • Wireless control using Bluetooth and Wifi
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **21 h**
Assessment methods	• One final practical exam. • Student's attendance in lectures and class participation.
Assessment criteria	• Portfolio • Presentation
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Guide de l'installation électrique (Normes internationales CEI et nationales françaises NF), Schneider Electric • L'installation électrique domestique (En toute simplicité), ELECTRO TEST • Analog Interfacing to Embedded Microprocessor Systems [2nd ed], by Stuart Ball • Mechanical and Electrical Equipment for Buildings [11 ed.], by Walter T. Grondzik, Alison G. Kwok, Benjamin Stein, John S. Reynolds • Web sources

Name	**Bus and Network in building-S2**
Year / Semester	**First year- Second semester**
Lecturer	**Gaied Sonia**
Specific learning outcomes	• The term **local area network** (**LAN**) is used to describe a network of devices inside a limited area (in the same room, building…) • On successful completion of this module, students will develop hands-on networking skills and understand the role networks play in our lives. This course introduces students to networking careers and prepares them for further study. • This course is designed to give students a clear understanding of how networks, from (building) in-home local area networks, or LANS, to the massive and global Internet, are built and how they allow us to use computers to share information and communicate with one another. Students will be able to: • Define what Local Area Network (LAN) means • Describe the key devices found on a LAN. • Explain how Hubs, Switches and Routers function • Describe how Ethernet functions • Describe the structure and function of IP Addresses. • List the seven layers of the OSI Model. • Describe the functions of each layer of the OSI Model. • List the four layers of the TCP Model. • Describe the functions of each layer of the TCP Model. • Explain the similarities and differences between the OSI Model and the TCP Model.
Contents	• Topics covered include: • Introduction • Computer network explained • Computer network explained • OSI reference model • TCP/IP reference model • Data encapsulation • Data encapsulation in the OSI model • Local Area Network (LAN) • What is Ethernet? • Ethernet frame • MAC address • Unicast, multicast, broadcast addresses • Half and full duplex • Basic networking • Network hub • Network bridge

	• Network switch • A router • Collision domain explained • Broadcast domain explained • CSMA/CD explained • IEEE Ethernet standards • Cisco three-layered hierarchical model • TCP/IP • TCP/IP suite of protocols • What is an IP address? • IP address classes • IP address types • Transmission Control Protocol (TCP) explained • User Datagram Protocol (UDP) explained • TCP and UDP ports • Subnetting • What is subnetting? • Subnet mask explained • How to create subnets
Schedule	
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass The minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Solar Thermal and Photovoltaics-S2**
Year / Semester	**Second Year-First semester**
Lecturer	**Rachid MECHI**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Ability to calculate solar radiation received at inclined surface; • Ability to explain the principles of the fonctionnement of the solar energy systems; • Ability to understand and evaluate the performance of the different types of solar thermal captors; • Ability to design the solar energy systems for different applications ; • Ability to simulate the solar energy systems and checking out their economical performance; • Ability to estimate the economical, social and environnemental aspects of the use of solar energy; • Ability to participate in class discussions with colleagues and with teachers.
Contents	This course is aimed at developing students' scientific knowledge and basic techniques in the energetic of building, the acquisition of skills to perform the comprehension of the energy efficiency challenge in the sector of building face to constraints of the sustainable development. The aim of the development of the module is to provide for students a theoretical and practical knowledge about the basics in the field of solar thermal and photovoltaics energy and the techniques of design and integration of these systems in urban buildings. This course is organized as follow : **Solar energy** ➢ Solar specter ➢ Solar reserve **Solar therml energy** ➢ Components of solar thermal installation ❖ Solar captor; different types, architectural integration, fundamental equations, productivity,… ❖ Storage tank ❖ Regulation ➢ Different solar thermal installations ❖ independent solar heating water ❖ Collective solar hot water ❖ Combined solar systems ➢ Installation design ❖ Criteria of performance ❖ Design of hot water solar systems ❖ Design of combined solar systems ❖ Tools of design ❖ Sensibility analysis ➢ Economical and social aspects ❖ Financial helps ❖ Quality procedure (guarantee of solar results, chart of quality, environnemental impact,…) **Photovoltaic solar energy** ➢ Photovoltaic electricity production

	❖ Photovoltaic effect phenomenon ❖ Different photovoltaic cells ❖ Caracterisation of photovoltaic module ➢ Different photovoltaic installations and design ❖ Photovoltaic installation connected to the network ❖ Photovoltaic installation in isolated site ➢ Economical and social aspects of photovoltaic ❖ Financial helps ❖ The sale of electricity
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **21 h** Tutorial classes: **21 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass; the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Duffie, J.A., and W. A. Beckman, 2013 – Solar Engineering of Thermal Processes, 4th ed. Hoboken, NJ: Wiley. ISBN 9780-470-87366-3. • Deutsche Gesellshaft für Sonnenenergie, 2010 – Planning and Installing Solar Thermal Systems : A guide for installers, architects and engineers, 2nd ed. London, UK: Earthscan. ISBN: 978-1-84407-760-1. • Weiss, W. (Ed.), 2003 – Solar Heating Systems for Houses: A Design Handbook for Solar Combisystems. London, UK: Earthscan. ISBN 9781902916460. • Scheer, H., 2006 – Energy Autonomy: The Economic, Social and Technological Case for Renewable Energy. London, UK: Earthscan. ISBN: 978-1844073559. • Falk A., C. Dürschner, et K. Remmers, 2010 – Le photovoltaïque pour tous : conception et réalisation d'installations, 2ème ed. ISBN 9782281114706. • Peuser, F.A., K. Remmers, M. Schnauss, 2005 – Installations solaires thermiques : conception et mise en œuvre. Paris, FR : Éditions du Moniteur. ISBN 9782281112665.

Name	**Software 2-S2**
Year / Semester	**First year- second semester**
Lecturer	**Raoudha GARMA**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Knowledge and understanding of the fundamentals steps to be followed under "Pvsyst" for sizing connected and isolated photovoltaic installations as well as solar pumping systems; • Ability to study, analyze and interpret schematics results reached using PVsyst software; • Ability to manage available energy sources and propose efficient solutions to limit the energy consumption • Ability to master renewble energy management software; • Ability to participate in class discussions with colleagues and with teachers.
Contents	This course is aimed to develop students' perception to simulate optimize and better exploit photovoltaic solar energy, the acquisition of skills to perform using PV solar energy for connected zone, isolated zone and for water pumping purpose;. The aim of the development of the module is to provide to students a practical knowledge about the basics in the field of simulating, sizing and incorporating renewable solar energy. This course is organized as follow : • Initaition to PVsyst • Connected installation simulation • Isolated installation simulation • Solar water pumping simulation
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical classes: **21 h**
Assessment methods	• report of practical work final written exams
Assessment criteria	• report of practical work 30% • Final exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• PVsyst sotware • PVsyst user guide and toturial • PCs

	• Web sources

SEMESTER 3

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Name	**Bioclimatic Building Design-S3**
Year / Semester	**Sencond Year-Third Semester**
Lecturer	**Houcem eddine MECHRI**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Knowledge and understanding the principles of bioclimatic design such as passive design strategies, insulation materials …; • Ability to recognise the different factors affecting the energy needs of a building such as indoor and outdoor conditions, occupants and building's form and constitution; • Ability to propose passive strategies for low energy building, in a design project, and in line with Tunisian energy building code; • Ability to apply simplified methods and to understand numerical methods to assess and inform design decisions for enhanced thermal performance; • Ability to demonstrate the economic profitability of the solution design; • Ability to communicate and to defend solutions design in a professional manner;
Contents	Topics covered include: **Climate and site considerations:** • Site analysis: landform, density of existing built area, existing infrastructure, vegetation, urban context; • climate analysis: wind, sun (solar path), rain, temperature; **Building design considerations:** • Built form: layout, orientation, surface area/volume ratio, zoning of internal spaces, buffer spaces, location of openings; • Building envelope and fenestration design: transmission through walls and roof, transmission through windows, window orientation and size, shading coefficient, solar heat gain coefficient, glazing types, surface colour, window size location; • Design of shading devices: fins, overhangs, blinds ...; • Shading by plants and surroundings buildings;

	Insulation materials • Insulation materials and high performance insulation (aerogels, gas-filled panels, vacuum insulation panels, transparent insulative wall ...); • Insulation and thermal inertia; • Phase change materials; Green roofs and walls; **Passive heating strategies**: • Principles and types: direct gain, indirect gain (trombe walls, thermal mass storage), isolated gain (attached sunspaces, greenhouses); • Advantages and disadvantages, control, and operating characteristics for each of the above systems; **Passive cooling strategies:** • Principles and types: ventilation, chimney and stack exhaust, night-sky radiation, direct coupling of soil with buildings, evaporative cooling (roof ponds, roof films, ground based ponds); • Design factors affecting ventilation (opening orientation, size, location, internal subdivision of space, thermal storage), earth cooling (soil temperatures and its variation), night-sky radiation (climatic applicability) • Advantages and disadvantages, control, and operating characteristics for each of the above systems;
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	**Lecture: 10.5 h** **Tutorial classes : 10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Brown, G. Z. and Mark DeKay, (2001) Sun, Wind & Light: architectural design strategies, New York : John Wiley • Lechner, Norbert (2009) Heating, cooling, lighting : sustainable design methods for architects, Hoboken, N.J. : John Wiley & Sons • Crosbie, M. J., 1998. The Passive Solar Design and Construction Handbook, John Wiley & Sons Inc., New York. • Givoni, B., 1994. Passive and Low Energy Cooling of Buildings, John Wiley & Sons Inc., New York.

	• ASHRAE Handbook—Fundamentals. 2013.

Name	**Audit and energy managment in building-S3**
Year / Semester	Second year- Second semester
Lecturer	Mohamed Bechir Ben Hamida
Specific learning outcomes	On successful completion of this module students should demonstrate: • Unfold each step of the energy diagnosis • Carry out an energy mapping of its site • Identify key sources of savings and benchmark key indicators • Pilot the Energy Efficiency Plan and continuous energy improvement • Bringing life to its Energy Management System (EMS) and sustainably changing behavior • Preparing the audit and Valuing the energy audit
Contents	Topics covered include: **Mastering the stakes and objectives of the energy management system** • The requirements of the organization's energy policy, • The energy audit review and analysis of energy performance, • Tools for energy analysis. **Identify priority actions to improve energy efficiency** • Action plans and indicators for monitoring energy performance, • Investments to reduce costs. **Implementation of an energy management system** • The involvement of internal actors in the process, • Information needed for evaluation and monitoring, • The choice of actions on facilities, equipment, practices ..., • Implementation of action plans, management review. **Mastering the regulatory watch in the context of ISO 50001** • Energy efficiency solutions GTB / GTC • Integrated energy efficiency solutions • **Measurement and reporting of actions implemented** • The regulatory framework, • The Protocol of Measurement and Verification, • The choice and follow-up of the IPMVP protocol, • Validation of the achievement of the set objectives • **Energy Audit: Approach and Objectives** • Reminders and definitions: energy, power ... • General principles and major phases of the improvement process • Objectives and deliverables • BP X30-120 normative standards **Preparing the audit and gathering information**

	• Define perimeters • Define actors and team • Plan the audit and resources • Building the communication plan • Finding the right sources of information: • Paper documents: invoices, contracts, procedures ... • Description of facilities • Measurements / Load Curves • **Valuing the energy audit** • Generating new ideas and raising awareness: participatory wastage hunting • Going to an energy management system (diagnosis = energy review) • Keeping the dynamic
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lecture: **10.5 h** Tutorial classes:**10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Life Cycle Analysis (LCA) -S3**
Year / Semester	**Second year-First semester**
Lecturer	**Ben Abdelghani Farouk**
Specific learning outcomes	This module will treat the problematic related to environmental impact of a material or a structure and analysis of life cycle. On successful completion of this module students should demonstrate: • Knowledge and understanding the principles of LCA methodology and its different steps…; • Basis of sustainable aspects and relation between civil structures and environment; • How to evaluate environmental impact of a material such as concrete and cement; • Ability to apply simplified method to estimate an environmental performance for a building; • Application with some codes for LCA modelling and estimation; • ability to apply LCA for specific cases.
Contents	Topics covered include: **Environmental aspects and sustainable development:** • environment contamination and pollution; • concept of sustainable development. • **Life cycle analysis methodology:** • LCA definition and protocole; • Different steps and components for LCA; • Different results for LCA • **LCA application:** • case of a building; • case of a road structure; **An overview of most used models and codes for LCA** **Solutions for decreasing environmental impact**
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lecture: **10.5** Tutorial classes **:** **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment	Attribution of a final grade

metrics	
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Software 3-S3**
Year / Semester	**Second year- First semester**
Lecturer	**Houssemeddine Mechri**
Specific learning outcomes	On successful completion of this module student must be able • to apply the knowledge acquired during the lessons of bioclimatic building systems • to simulate bioclimatic thermal behaviour and to know Tunisian thermal application low by using Tun-eQuest software
Contents	Practical Evaluation and verification of the compliance of the new buildings of an architectural configuration
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical classes: **21 h**
Assessment methods	• report of practical work final written exams
Assessment criteria	• report of practical work 30% • Final exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	**Cold production-S3**
Year / Semester	**Second Year-First semester**
Lecturer	**Kechiche JAMEL**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Knowledge and understanding of the different cold production technologies. • Knowledge and understanding of the characteristics of a single-stage refrigeration system with vapor compression and phase change. • Knowledge and understanding of the characteristics of a refrigeration system with particular steam compression and phase change. • Ability to Study a single-stage refrigeration system with several cold stations • Knowledge and understanding the principle of operation and ability to determine the thermodynamic characteristics of multi-stage compression refrigeration machines. • Ability to propose solutions to the various fluidic and electrical breakdowns of the refrigeration systems
Contents	• Compression refrigeration systems, • Ejector refrigeration systems, • Absorption refrigeration, adsorption refrigeration, • Mechanical characteristics and qualitative characteristics of a single-stage refrigeration machine with vapor compression and phase change; • Graphical representation of the circuit of a single-stage refrigeration system with several cooling stations and calculation of flow rates; • Study the refrigeration system with two cold stations; methods of compressor power reduction; • Single-stage refrigerating machines with a heat exchanger; • Refrigerating machines for serving an installation comprising a circulation pump; • Comparative study between single-stage compression and two-stage compression; • Two-stage compression installation without intermediate cooling; • Ttwo-stage compression installation with compression temperature control of the high-pressure compressor by injection of refrigerant fluid at the intermediate pressure; • Two-stage compression system with partial injection without sub-cooling; two-stage compression system with partial injection and with under-cooling; • Two-stage compression system with intermediate bottle with total injection; • Two-stage compression system with intermediate cooler and low pressure separator; • Two-stage compression installation with cold production in the intermediate stage; • Cascade refrigerating machine; procedure to follow in troubleshooting; • Typical failures and possible causes for refrigeration machine.

Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Industrial refrigeration Handbook, Wilbert F. Stoecker • Théorie des machines frigorifiques • - Machines à compression mécanique, • Techniques de l'ingénieur

Name	**Refrigeration Technology-S3**
Year / Semester	**Second Year- Third Semester**
Lecturer	**Kechiche JAMEL**
Specific learning outcomes	On successful completion of this module students should be able: • To identify the major components of the vapour compression and absorption cycles: evaporator, compressor, condenser, expansion devices, absorber, generator, etc.. • To identify the auxiliary elements of the vapour compression cycle: oil separator; liquid reservoir; dehydrator; liquid separator; heat exchanger, etc... • To select appropriate components for a refrigeration installation of vapour compression or an absorption machine from commercial catalogues or from software data basis. • To design and to select pipes • To know the role of automatic control and safety devices.
Contents	• Compression of refrigerant; • typology of piston compressors; • Calculation of piston compressors; • Rotary compressor DAIKIN; • Scroll rotary compressors; description of screw compressors; • Operation with economizer; • Comparative table of different compressors; • selection of compressors at commercial catalogs; • selection of compressors from some software provided by manufacturers; • air-cooled condensers; water-cooled condensers; • evaporative condensers; • selection of condensers from some software supplied by the manufacturers; air-cooled evaporators; • liquid cooler evaporators; • evaporator selection software; • capillary regulators; thermostatic expansion valves; • electronic regulators; selection of a DANFOSS regulator; • oil separator; liquid reservoir; dehydrator; liquid separator; heat exchanger; copper pipes; steel pipes; • dimensioning of pipes; • vibration and expansion of piping; • Regulating and safety equipment; • protection equipment; equipment control.
Schedule	TBD
Teaching and learning methods	Face to face,
Teaching techniques	Lectures: **10.5 h**

Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Technologie des installations frigorifiques, Pierre Rapin, Patrick Jacquard, jean Desmons. • Etude des installations frigorifiques, Jean CROISY • Pratique des installations frigorifiques, H. NOACK, R. SEIDEL, J. CAUCHEPIN • Le Pohlmann Manuel technique du froid, W. MAAKE, H.-J. ECKERT, Jean Louis Cauchepin

Name	**Laboratory of cold production/ refrigeration technology-S3**
Year / Semester	**Second year- third semester**
Lecturer	**Kechiche Jamel**
Specific learning outcomes	On successful completion of this module student must be able to apply the knowledge acquired during the lessons cold production and refrigeration technology through the following practical exercises: • Refrigeration installation with two stage compressor • Study of a heat pump water-water or air-water • Fault simulation in refrigeration system • Compressor rack - 3 compressors • Cascade refrigeration system
Contents	• Identify the components of a refrigeration installation with exchanger water/ water or air / water • Establish an energy balance on the various elements of the thermodynamic cycle (compressor, condenser, expansion valve and evaporator) • Simulation of 18 conventional refrigeration failures • Study of the basic concept of a refrigeration installation with R134A, with double evaporator. • Identification of the components of a refrigerating system with two cold rooms • Commissioning and verification of operation • Study of the basic concept of a refrigeration installation R404A, with triple evaporation. • Preventive and curative maintenance • Identification of the components of a refrigerating system with two stage compressor • Study of the basic concept of a refrigeration installation R404A, with two stages. • Identification of components of a cascade refrigerating system • Study of the basic concept of a refrigeration plant to R404A and to R134s in cascade.
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical Works: **21 h**
Assessment methods	• report of practical work • final written exams
Assessment criteria	• report of practical work : 30% • final written exams : 70%
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation

Assessment criteria	
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	

Name	Building Management Systems (BMS) -S3
Year / Semester	Second Year, First Semester
Lecturer	Hatem Boukadida- Mechri Houssemeddine
Specific learning outcomes	On successful completion of this module students should demonstrate: • Qualifications to implement a Building Management System (BMS) • Ability to interact with a BMS • Ability to measure and monitor a building performance using a BMS • Ability to reduce energy costs and ensure comfort conditions using a BMS • Ability to tune, optimize and perform system maintenance of a BMS
Contents	This course is aimed at developing students' holistic perception of civil construction projects, the acquisition of skills to perform the electrical analysis of an urban living building. The aim of the development of the module is to provide for students a theoretical and practical knowledge about the basics in the field of electrical and electronic design applied to urban buildings. This course is organized as follow : **What is a BMS?** • Terminology and acronyms • Building Management and Controls System • BMS suppliers and integrators • System Components • User Interface Options **What Does a BMS Do?** • Role of the BMS in building operation • Building Control Applications • Measuring and Monitoring building performance • Interaction with other building systems **Benefits of Having a BMS** • The advantages of a BMS versus stand alone control • Improved comfort conditions • Energy Management and reduced operational costs • Management of building ratings **Operational Considerations** • Tuning and optimisation • Importance of System Documentation • System Maintenance • Life cycle expectations and considerations
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures: **10.5 h** Tutorial classes, **10.5 h**
Assessment	• One mid-term and one final written exam are designed.

methods	• All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Luis Rocha-Lona, Building Quality Management Systems: Selecting the Right Methods and Tools • Christophe Lavergne, La gestion technique du bâtiment - Le protocole • KNX pour une performance énergétique optimal • Web sources

Name	**Daylighting and Lighting of Buildings-S3**
Year / Semester	**Second year-first Semester**
Lecturer	**Houssemeddine Mechri**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Knowledge and understanding physical and technical terms on light, daylight and lighting systems and control strategies; • Knowledge and understanding of conventional and emerging lighting technologies in terms of energy efficiency, appropriate applications and light quality. • Ability to identify, qualify, select and integrate efficient electric lighting and control systems in a new or existing building; • Ability to identify and evaluate daylighting strategies to optimize energy performance and occupant comfort in a new or existing building. • Ability to carry out basic lighting hand calculations as well as more advanced annual daylight analyses; • Ability to demonstrate the economic profitability of the lighting solution design; • Ability to communicate and to defend solutions design in a professional manner;
Contents	Topics covered include: **Terminology for light.** • Photometric properties; Lighting units • Light and vision; Solar radiation and light; • Lighting requirements for places: codes and standards (EN 15193); • Colour temperature & colour Rendering **Electric light sources and auxiliary devices** • Traditional lamps, emerging lighting technologies. Properties of components. • Luminaires and other light fittings, electrical devices requirements of different lighting technologies. Properties of components. • Lighting control devices and strategies : Occupancy sensors, **Efficient lighting design** **Lighting Design, function and properties of components in glass facades such as glazings and windows, solar shadings and daylight directing systems.** **Daylighting:** • Design considerations: reflection and absorption Direct, diffuse and reflected components Glare, critical indoor and outdoor illuminance, daylight factor and its calculation and distribution • Desig: Window, Placement/Window Size / Window Location • Techniques of incorporating daylight in buildings: galleries, atria, light-pipe, window-to-wall ratios, shading devices – fixed and movable ...; **Methods and programmes to calculate light and energy performance of lighting systems.** • Programmes to calculate the dynamic interaction between the lighting system, • Daylight and solar shading system.

	• Calculation of energy demand for lighting (Dialux - European lighting software)
Schedule	
Teaching and learning methods	Face to face
Teaching techniques	Lecture: **10.5 h** Tutorial classes: **10.5 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (**10%**) or paper (**10%**) or personal work(**10%**) • Midterm Exam **20%** • Final Exam **70%**
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Ander, G. D., 2003. Daylighting Performance and Design (second edition), John Wiley & Sons Inc., New Jersey. • Guzowski, M., 2000. Daylighting for Sustainable Design, McGraw-Hill, New York.

Name	**Practical work: BMS /lighting-S3**
Year / Semester	**Second year- First Semester**
Lecturer	**Houssemeddine Mechri-Hatem Boukadida**
Specific learning outcomes	On successful completion of this module students should be able to : • Choose the suitable light for each area of a building and to optimize the use of daylight • Discover some home automation possibilities. • Understand the technologies used in this field. • Compare these technologies according to installation constraints.
Contents	• Simulate and program functions in a domotised dwelling. • DIALux software : practical tasks on simple lighting designs and daylighting • Grafcet Simulation using automation studio • Practical work BMS available at the institute
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Practical work: **21 h**
Assessment methods	• report of practical work • One final practical exam.
Assessment criteria	• report of practical work : 30% • final practical exams : 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	• Luis Rocha-Lona , Building Quality Management Systems: Selecting the Right Methods and Tools • Christophe Lavergne, La gestion technique du bâtiment - Le protocole KNX pour une performance énergétique optimal • Web sources

Name	**Autocad (3D Drawing) -S3**
Year / Semester	**Second year –First semester**
Lecturer	**.....**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Recognize hardware components of the AutoCAD • Create mulitviews with an additional isometric view • Save drawings in different formats and set up software parameters • Dimension drawings using associative dimensioning • Create 3 dimensional solids and create multiviews from these models • Attach materials to models and Plot drawings • Create and insert a block with attributes • Design project and fabricate it on the rapid prototype
Contents	Students will draw in two CAD programs during this course. • -Dimensioning Drafting • Iso commands, • 3D Shapes, • User Coordinate System, • Elevation, Thickness, Viewpoint, • Viewports, 3D Polylines, 3D Face, 3D Surfaces of Revolution, • World Coordinate System, X/Y/Z Filters • Creating 2D drawings from 3D models • Plotter Hardware and Plotting Exercises • Advanced Display Modes: AutoCAD Rendering and Material Attachment
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Lectures, 10,5 hours Practical classes, 21 hours
Assessment methods	Regular attendance is necessary for successful completion of this course. Students with perfect attendance will earn 3 percentage points towards their final grade. One absence will earn the student 2 percentage points towards one's final grade. Two tardiest will count as one absence. Leaving early will be considered a tardy. Quizzes given during class cannot be made up if the student is absent but will be permitted if the student is tardy.
Assessment criteria	Students will be expected to maintain complete honesty and integrity in their academic work in this class. Acts of academic dishonesty, such as cheating, plagiarism, or inappropriately using the work of others to satisfy course requirements, will not be tolerated and may result in failure of the affected assignments and/or failure of this class.
Assessment metrics	Attribution of a final grade
Criteria of attribution of	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.

the final grade	
Preparatory course units	N.A.
Educational material of reference	• AutoCAD For Dummies, 17 edition, Bill Fane • Mastering AutoCAD Civil 3D 2015: Autodesk Official Press, Cyndy Davenport and Ishka Voiculescu • Autocad Civil 3d 2016 Essentials: Autodesk Official Press, Eric Chappell

Name	**French-S3**
Year / Semester	**Second year-First Semester**
Lecturer	**Pr. Chebbi riadh**
Specific learning outcomes	On successful completion of this module students should demonstrate: • Ability to use the language effectively and flexibly in professional or academic life, to write long texts with control of the tools of organization, articulation and cohesion of speech. • Ability to speak fluently in public, to give oral presentations, to defend memoirs with powerpoint. • etc
Contents	Topics covered include: • Globalization • The environment • Ecology
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Tutorial classes :**21 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (10%) or paper (10) or personal work(10%) • Midterm Exam 20% • Final Exam 70%
Assessment metrics	Attribution of a final grade
Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold to pass is 10/20.

Preparatory course units	N.A.
Educational material of reference	

Name	**Soft skills-S3**
Year / Semester	**Secon dyear-First Semester**
Lecturer	**Pr. Aida amamou**
Specific learning outcomes	On successful completion of this module students should demonstrate: • An understanding of the meaning and importance of soft skills as opposed to hard skills. • An ability to write and present papers on a variety of soft skills. (writing + speaking)
Contents	Topics covered include: • Soft skills vs hard skills • The importance of soft skills • Significant soft skills: • Communication • Self motivation • responsibility • Teamwork • Leadership • Time management • Problem solving • Negotiation and conflict resolution • Highlighting and evidencing one’ s soft skills in a CV and throughout an interview.
Schedule	TBD
Teaching and learning methods	Face to face
Teaching techniques	Tutorial classes: **21 h**
Assessment methods	• One mid-term and one final written exam are designed. • All students will write a paper dealing with a topic above. • Student's attendance in lectures and class participation.
Assessment criteria	• Class Participation (10%) or paper (10) or personal work(10%) • Midterm Exam 20% • Final Exam 70%
Assessment metrics	Attribution of a final grade

Criteria of attribution of the final grade	The grade of a module goes from 0 (minimum) up to 20(maximum). To pass, the minimum threshold is 10/20.
Preparatory course units	N.A.
Educational material of reference	