Semestre 5

Teaching Unit	Subjects	Crédits	Coefficient	Weekly hourly volume			Semester Hourly Volume (15 weeks)	Supplementary Work in Consultation (15 weeks)	Assessment Method:	
	Intitulé			**Lecture**	**Tutorial**	**Lab**			**Continuous assessment**	**Final exam**
UE Fondamentale Code : UEF 3.1.1 Crédits : 10 Coefficients : 5	Power Electronics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Electrical Machines	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mechanical Design / Machine Construction	2	1	1h30			22h30	27h30		100%
UE Fondamentale Code : UEF 3.1.2 Crédits : 8 Coefficients : 4	Heat Transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Control Systems / Automatic Feedback Systems	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Méthodologique Code : UEM 3.1 Crédits : 9 Coefficients : 5	Power Electronics Lab	2	1			1h30	22h30	27h30	100%	
	Electrical Machines Lab	2	1			1h30	22h30	27h30	100%	
	Control Systems Lab	2	1			1h30	22h30	27h30	100%	
	Electrical Diagrams and Equipment	3	2	1h30		1h00	37h30	37h30	40%	60%
UE Découverte Code : UED 3.1 Crédits : 2 Coefficients : 2	Electrical Energy Production	1	1	1h30			22h30	2h30		100%
	Electrical Engineering Materials	1	1	1h30			22h30	2h30		100%
UE Transversale Code : UET 3.1	Electrical Safety	1	1	1h30			22h30	2h30		100%

Crédits : 1 Coefficients : 1										
Total semestre 5		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

Semestre 6

Teaching Unit	Subjects	Crédits	Coefficient	Weekly hourly volume			Semester Hourly Volume (15 weeks)	Supplementary Work in Consultation (15 weeks)	Assessment Method:	
	Intitulé			**Lecture**	**Tutorial**	**Lab**			**Continuous assessment**	**Final exam**
UE Fondamentale Code : UEF 3.2.1 Crédits : 10 Coefficients : 5	Industrial Process Control / Regulation	4	2	1h30	1h30		45h00	55h00	40%	60%
	Control of Electromechanical Drives	4	2	1h30	1h30		45h00	55h00	40%	60%
	Sensors and Measurement Chains	2	1	1h30			22h30	27h30		100%
UE Fondamentale Code : UEF 3.2.2 Crédits : 8 Coefficients : 4	Industrial Automation and Control Systems / Programmable Logic Controllers (PLCs)	4	2	1h30	1h30		45h00	55h00	40%	60%
	Turbomachinery	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Méthodologique Code : UEM 3.2 Crédits : 9 Coefficients : 5	Final Year Project / Capstone Project	4	2			3h00	45h00	55h00	100%	
	Control Systems and Automation Lab	2	1			1h30	22h30	27h30	100%	
	Electric Drive Control Lab	2	1			1h30	22h30	27h30	100%	
	Sensors Lab	1	1			1h00	15h00	10h00	100%	

UE Découverte Code : UED 3.2 Crédits : 2 Coefficients : 2	Maintenance of Electromechanical Systems	1	1	1h30			22h30	02h30		100%
	Introduction to Internal Combustion Engines	1	1	1h30			22h30	02h30		100%
UE Transversale Code : UET 3.2 Crédits : 1 Coefficients : 1	Entrepreneurship and Business Management	1	1	1h30			22h30	02h30		100%
Total semestre 6		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semester: 5
Teaching Unit: UEF 3.1.1
Subject 1: Power Electronics
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Understand the fundamental principles of power electronics.
Learn the operating principles and applications of power components.
Master the operation of main static converters.
Acquire basic knowledge for making technical choices depending on the application field of a power converter.

Recommended Prerequisite Knowledge:
Basic Electronics 1
Basic Electrical Engineering 1

Course Content:
The number of weeks indicated is only an estimate. The course instructor is not strictly bound to follow this schedule or the order of chapters.

Chapter 1. Introduction to Power Electronics **3 weeks**
Introduction to power electronics and its role in electrical energy conversion systems. Overview of static converters. Classification of static converters (based on switching mode, based on conversion type). Non-sinusoidal periodic quantities (RMS value, average value, form factor, ripple factor).

Chapter 2. AC–DC Converters **3 weeks**
Power components (diodes and thyristors), single-phase rectification, types of loads R, RL, RLE. Three-phase rectifiers, types of loads R, RL, RLE. Analysis of commutation phenomena (overlap) in uncontrolled and controlled rectifier converters.

Chapter 3. AC–AC Converters **3 weeks**
Power components (triacs with a quick review of diodes and thyristors), single-phase AC voltage controllers with R and RL loads. Principle of the single-phase cycloconverter.

Chapter 4. DC–DC Converters **3 weeks**
Power components (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), step-down and step-up choppers with R, RL, and RLE loads.

Chapter 5. DC–AC Converters **3 weeks**
Single-phase inverters, half-bridge and full-bridge configurations with R and RL loads.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. L. Lasne, « Electronique de puissance : Cours, études de cas et exercices corrigés », Dunod, 2011.
2. P. Agati et al. « Aide-mémoire : Électricité-Électronique de commande et de puissance–Électro-technique », Dunod, 2006.

3. J. Laroche, « Électronique de puissance – Convertisseurs : Cours et exercices corrigés », Dunod, 2005.
4. G. Séguier et al. « Électronique de puissance : Cours et exercices corrigés », 8e édition; Dunod, 2004.
5. D. Jacob, « Electronique de puissance - Principe de fonctionnement, dimensionnement », Ellipses Marketing, 2008.
6. G. Séguier, « L'électronique de puissance, les fonctions de base et leurs principales applications », Tech et Doc.
7. H. Buhler, « Electronique de puissance », Dunod
8. C.W. Lander, « Electronique de puissance », McGraw-Hill, 1981
9. H. Buhler, « Electronique de Réglage et de commande ; Traité d'électricité ».
10. F. Mazda, "Power Electronics Handbook: Components, Circuits and Application", 3rd Edition, Newness, 1997.
11. R. Chauprade, « Commandes des moteurs à courant alternatif (Electronique de puissance) », 1987.
12. R. Chauprade, « Commandes des moteurs à courant continu (Electronique de puissance) », 1984.

Semester: 5
Teaching Unit: UEF 3.1.1
Subject 2: Electrical Machines
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Understand the fundamental principles of electrical engineering.
Learn the basics of transformers and electrical machines.
Recommended Prerequisite Knowledge:
Basic knowledge of fundamental electricity, electrostatics, and magnetostatics.

Course Content:
Chapter 1. General Concepts **2 weeks**
Single-phase AC current, three-phase AC current, basic properties of magnetic circuits.

Chapter 2. Transformers **3 weeks**
General overview, operating principle of single-phase transformers, ideal transformer, calculation of induced electromotive force (EMF), real transformer, transformer under Kapp's approximation, energy balance and efficiency, three-phase transformers, different types of connections and clock index (vector group).

Chapter 3. DC Machines **3 weeks**
General overview, operating principle, construction, DC generator, characteristic equations, calculation of EMF and torque, different excitation methods, DC motor, operating principle, starting, braking, and speed control, energy balance and efficiency.

Chapter 4. Synchronous Machines **3 weeks**
General overview, operating principle of the machine, rotating field, operation as an alternator, study of various operating diagrams of the alternator, synchronous motors.

Chapter 5. Induction (Asynchronous) Machines **4 weeks**
General overview, operating principle, construction of induction machines, mathematical modeling and equivalent single-phase circuit, mechanical characteristics, simplified circle diagram, energy balance and efficiency, operation as a generator and as a brake, different types of motors, starting methods for induction motors, speed control of induction motors.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. J.P Perez. Electromagnétisme Fondements et Applications, 3eme Edition, 1997.
2. A. Fouillé. Electrotechnique à l'Usage des Ingénieurs, 10e édition, Dunod, 1980.
3. C. François. Génie électrique, Ellipses, 2004
4. L. Lasne.Electrotechnique, Dunod, 2008
5. J. Edminister. Théorie et applications des circuits électriques, McGraw Hill, 1972
6. D. Hong. Circuits et mesures électriques, Dunod, 2009
7. M. Kostenko. Machines Electriques - Tome 1, Tome 2, Editions MIR, Moscou, 1979.
8. M. Jufer Electromécanique, Presses polytechniques et universitaires romandes-Lausanne, 2004.
9. A. Fitzgerald. Electric Machinery, McGraw-Hill Higher Education, 2003.

10. J. Lesenne. Introduction à l'électrotechnique approfondie. Technique et Documentation, 1981.
11. P. Maye. Moteurs électriques industriels, Dunod, 2005.
12. S. Nassar. Circuits électriques, Maxi Schaum.
13. Theodore Wildi.Electrotechniques, de Boeck, 2005
14. Entraînement électrique, J.Fandino., Volume 1, ISBN: 2-7462-1305-2, 2006
15. Machines électriques; Francis Milsant, Ellipses, 1992
16. M.Kostenko et L.Piotrovski. Machine électrique: machine à courant alternatif, Tome II, édition Mir 1979.
17. M.Kostenko et L.Piotrovski. Machine électrique: machine à courant continu, Tome I, édition Mir 1979.
18. Francis Milsant. Cours d'électrotechnique: Machine à courant continu, Tome II, , Eyrolles, Paris 1981.

Semester: 5
Teaching Unit: UEF 3.1.1
Subject 3: Mechanical Design / Machine Construction
VHS: 22h30 (Lecture: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Understand the various assemblies and components used in electromechanical systems: assembly methods, motion transmission systems, etc.
Learn how to use the necessary tools for studying, analyzing, and designing machine elements.

Recommended Prerequisite Knowledge:
Knowledge of materials and general mechanics.
Knowledge of industrial drawing and strength of materials calculations.

Course Content:

Chapter 1. Fundamental Concepts and Design Methodology **2 weeks**
General construction rules, fundamental concepts of systematic design procedure, construction process (planning, design, projection).

Chapter 2. Introduction to Machine Elements Design **2 weeks**
Material selection, allowable stresses and strengths, preferred numbers, surface roughness and fits, design based on manufacturability.

Chapter 3. Joining Techniques / Assemblies **3 weeks**
Adhesive bonding, brazing, welding, riveting, threaded fasteners.

Chapter 4. Shaft Guidance **3 weeks**
Shafts, axles and journals, lubrication, plain bearings, rolling element bearings.

Chapter 5. Couplings and Brakes **3 weeks**
Permanent couplings, temporary couplings, special couplings, brakes.

Chapter 6. Power Transmission Systems **2 weeks**
Friction wheels, chains, belts, gears (spur and helical cylindrical gears, bevel gears, worm gears and worm wheels).

Assessment Method:
Final exam: 100%.

Références bibliographiques:

1. René Basquin. Mécanique: Cinématique Statique-Dynamique, Tome I, Edition Paris 1995.
2. G. Lenormand. Construction mécanique: éléments de technologie.2, la fonction liaison, autres fonctions élémentaires, Paris, Foucher, 1969.
3. Pierre Agati. Liaisons, mécanismes et assemblages: cours, exercices et applications, 2éd, Paris, Dunod, 1994.
4. Philippe Arquès. Transmissions mécaniques de puissance: application aux boîtes de vitesses automatiques, Paris, Ellipses, 2001.
5. I. Artobolevski. Théorie des mécanismes et des machines, Moscou, Mir, 1977.
6. D. Feliachi Le dessin technique.1, la géométrie descriptive, Alger, Office des publications universitaires,1995.

7. D. Feliachi. Le dessin technique.2, le dessin industriel, Alger, Office des publications universitaires, 1995.
8. Michel Georges Dessin technique: comprendre et maitriser la localisation, Paris, Afnor, 1991.
9. Thomas Gmur Eléments de mécanique des structures, 1 éd, Lausanne, Presses Polytechniques et Universitaires Romandes, 2001.

Semester: 5
Teaching Unit: UEF 3.1.2
Subject 1: Heat Transfer
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Understand the three modes of heat transfer: conduction, convection, and radiation.
Learn the calculation methods for heat exchangers.
Recommended Prerequisite Knowledge:
Basic knowledge of thermodynamics.
Course Content:
Chapter 1. Introduction to Heat Transfer 2 weeks
Introduction, definitions, formulation of a heat transfer problem.

Chapter 2. Steady-State Heat Conduction 3 weeks
Heat equation, one-dimensional heat transfer, multi-dimensional heat transfer, fins.

Chapter 3. Transient Heat Conduction 3 weeks
Governing equation; one-dimensional transient conduction without phase change, multi-dimensional transient conduction.

Chapter 4. Radiative Heat Transfer 3 weeks
General overview, definitions, laws of radiation, radiative exchange between multiple surfaces, emission and absorption by gases.

Chapter 5. Convective Heat Transfer 3 weeks
Review of dimensional analysis, convection without phase change, convection with phase change.

Chapter 6. Application: Heat Exchanger Design 1 week

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. Lucien Borel. Thermodynamique et énergétique, diffusion, 1991.
2. Brebes.Thermodynamique, Hachette, 1999.
3. Yves Janniot. Transferts thermiques, cours, 2002.
4. Arnold. Thermodynamique Appliquée, cours, Sommerfeld, 2003.
5. George. G Thermodynamique, Edition Ellipse 2005.
6. Lucien Borel. Thermodynamique, PPUR, 2005.
7. P Amiot. Thermodynamique, Université Laval, Québec, Canada, 2006.

Semester: 5
Teaching Unit: UEF 3.1.2
Subject 2: Control Systems / Automatic Feedback Systems
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Review the properties of control structures for continuous linear systems.
Introduce models of basic dynamic systems.
Explore tools for time and frequency domain analysis of basic systems.
Recommended Prerequisite Knowledge:
Basic mathematics (algebra, differential and integral calculus, complex numbers).
Fundamentals of signal processing and basic electronics (linear circuits).

Course Content:
Chapter 1. Introduction to Control Systems 2 weeks
Historical background of automatic regulation systems, Terminology and definitions, Concept of systems, Dynamic behavior, Static behavior, Static systems, Dynamic systems, Linear systems, Introductory examples, Open-loop systems, Closed-loop systems, Main components of a control loop, Principle of feedback control, Performance criteria of control systems.

Chapter 2. Modeling of Systems 4 weeks
System representation through differential equations, Laplace transforms, From differential equation to transfer function, From transfer function to state-space model, Functional blocks and simplification rules, Representation of dynamic systems using signal flow graphs, Mason's rule, Calculating transfer functions of closed-loop systems.

Chapter 3. Time Response of Linear Systems 3 weeks
Definition of system response, Transient response, Steady-state response, Concepts of stability, speed, and static accuracy, Impulse response (1st and 2nd order), Time-domain characteristics, Step response (1st and 2nd order), Identification of first and second-order systems from time response, Higher-order systems, Influence of poles and zeros on system response.

Chapter 4. Frequency Response of Linear Systems 3 weeks
Definition, Bode and Nyquist diagrams, Frequency characteristics of basic dynamic systems (1st and 2nd order), Phase and gain margins.

Chapter 5. Stability and Accuracy of Control Systems 3 weeks
Definitions, Stability conditions, Routh-Hurwitz algebraic criterion, Reversibility criterion in Nyquist and Bode plots, Stability margins, Accuracy of control systems, Static accuracy, Calculation of steady-state error, Dynamic accuracy, Characterization of transient response.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:
1. E. K. Boukas, Systèmes asservis, Editions de l'école polytechnique de Montréal, 1995.

2. P. Clerc. Automatique continue, échantillonnée : IUT Génie Electrique-Informatique Industrielle, BTS Electronique- Mécanique-Informatique, Editions Masson (198p), 1997.
3. Ph. de Larminat, Automatique, Editions Hermes 2000.
4. P. Codron et S. Leballois, Automatique : systèmes linéaires continus, Editons Dunod 1998.
5. Y. Granjon, Automatique : Systèmes linéaires, non linéaires, à temps continu, à temps discret, représentation d'état, Editions Dunod 2001.
6. K. Ogata, Modern control engineering, Fourth edition, Prentice Hall International Editions 2001.
7. B. Pradin, Cours d'Automatique. INSA de Toulouse, 3ème année spécialité GII.
8. M. Rivoire et J.-L. Ferrier, Cours d'Automatique, tome 2 : asservissement, régulation, commande analogique, Editions Eyrolles 1996.
9. Y. Thomas, Signaux et systèmes linéaires : exercices corrigées, Editions Masson 1993.
10. Y. Thomas. Signaux et systèmes linéaires, Editions Masson 1994.

Semester: 5
Teaching Unit: UEM 3.1
Subject 1: Power Electronics Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Complement, reinforce, and verify the knowledge acquired in the theoretical course.
Recommended Prerequisite Knowledge:
Basic electrical and electronic circuits.

Course Content:
TP 1: Single-phase and three-phase uncontrolled rectifiers (R, L, E loads).
TP 2: Single-phase and three-phase controlled rectifiers (R, L, E loads).
TP 3: Switching components (IGBT, MOSFET).
TP 4: Chopper circuit using thyristors.
TP 5: Single-phase inverter (resonant, current-source type).
TP 6: Single-phase AC voltage controller (R, L load).
TP 7: Three-phase AC voltage controller.

Assessment Method:
Continuous assessment: 100%

Références bibliographiques:

Semester: 5
Teaching Unit: UEM 3.1
Subject 2: Electrical Machines Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Complement, reinforce, and verify the knowledge acquired in the theoretical course.
Recommended Prerequisite Knowledge:
Electrical machines.

Course Content:
TP 1: Transformers
Setting up the wiring diagram for different coupling modes and verification of nominal data,
No-load, load, and short-circuit tests.
TP 2: DC Generator
Setting up the wiring diagram and verification of nominal data,
Verification of the influence of commutating poles,
Measurement of no-load, external, regulation, and short-circuit characteristics for different excitation methods.
TP 3: DC Motor
Setting up the wiring diagram and verification of nominal data,
Study of starting methods,
Study of various speed control techniques,
Measurement of electromechanical and mechanical characteristics.
TP 4: Synchronous Machine
Setting up the wiring diagram and verification of nominal data,
No-load and short-circuit tests,
Load operation and determination of alternator parameters.
TP 5: Squirrel-Cage Induction Motor
Setting up the wiring diagram and verification of nominal data,
No-load and short-circuit tests,
Load operation and measurement of electromechanical and operational characteristics.

Assessment Method:
Continuous assessment: 100%.

Références bibliographiques:
Notes du cours, Brochures du labo.

Semester: 5
Teaching Unit: UEM 3.1
Subject 3: Control Systems Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Complement, reinforce, and verify the knowledge acquired in the theoretical course.
Recommended Prerequisite Knowledge:
Control systems / Automatic feedback systems.
Course Content:
TP 1: Simulation using MATLAB
Solving differential equations with MATLAB software, using commands such as ode45, ode23, dsolve, diff, int, etc., determining the transfer function of a system and plotting time and frequency responses, identification using graphical methods, using commands such as ident, step, impulse, lsim, ltiview, bode, nyquist, etc., open-loop and closed-loop systems, time and frequency characteristics, and stability analysis.

TP 2: Study of First-, Second-, and Third-order System Behaviors
Analog and digital simulation, measuring parameters that characterize different responses: rise time, settling time, maximum overshoot, peak time, and accuracy.
Observing the response of an unstable system.

TP 3: Frequency Response and System Identification
Determining the frequency characteristics of a control system in order to identify its transfer function. Application on an electric motor.

TP 4: Position Control of a DC Motor – Difference Between Position and Speed
Study of the effect of gain on system stability and steady-state error, and the impact of speed feedback on system behavior.

TP 5: Speed Control of a DC Motor
Understanding the operation of components and the overall system in both open-loop and closed-loop configurations, analyzing the effect of gain on system stability, studying the influence of gain and load on steady-state error, and examining the impact of current feedback on the dynamic behavior of the system.

Assessment Method:
Continuous assessment: 100%

Références bibliographiques:

Semester: 5
Teaching Unit: UEM 3.1
Subject 4: Electrical Diagrams and Equipment
VHS: 37h30 (Lecture: 1h30, Lab: 1h00)
Credits: 3
Coefficient: 2

Course Objectives:
Learn about the different types of electrical protection and control equipment used in electrical installations.
Understand how to design and implement an electrical installation.
Recommended Prerequisite Knowledge:
Basic knowledge of fundamental electricity, electrostatics, and magnetostatics.

Course Content:
Chapter 1. Introduction to Electrical Equipment 3 weeks
Faults and anomalies in operation, functions and classification of protective devices, basic functions of electrical equipment: isolation, control, protection. Classification of electrical equipment, selection criteria for equipment, characteristics of electrical devices, protection of equipment, electrical equipment classes, protection arrangements.
Phenomena related to current and voltage: overcurrents, electrodynamic forces, arc resistance calculation, effects of arcs on contacts, overvoltages, insulation, breakdown, dielectric strength, gas ionization.

Chapter 2. Electrical Current Interruption Phenomena 2 weeks
Arc initiation (in air and oil), arc interruption principle (in air and oil), conditions for arc extinction, recovery voltage, various arc quenching techniques.

Chapter 3. Connection and Switching Devices 3 weeks
Contacts, terminals and connections, power outlets, disconnectors, switches (definition, function, characteristics), changeover switches (definition, function, characteristics), contactors (definition, function, characteristics).

Chapter 4. Protective Devices 2 weeks
Fuses (function and operation, types), thermal relays (definition, function, type, characteristics), circuit breakers (definition, function, types, characteristics).

Chapter 5. Development of Electrical Diagrams 2 weeks
Symbols used in electrical installations, conventions and standardization, examples of reading power and control diagrams, practical determination of minimum conductor cross-sections for wiring.

Chapter 6. Application of Diagrams and Equipment 3 weeks
Applications in lighting circuits:

Simple switching
Double switching
Two-way (toggle) switching
Switching using a relay
Switching using a timer

Timer with 4-wire connection
Timer with 3-wire connection
Applications in motor control:

Direct-on-line starting in one direction
Reversible direct-on-line starting
Star-delta starting

Laboratory Work (TP):
TP1: Main Lighting Circuits
Installation of power outlets, simple switch, double switch, toggle switch, relay-controlled switch, timer-controlled switch.

TP2: Contactor Control

Contactor control using switches, push buttons, remote control with two push buttons, remote control with multiple push buttons.
Control of two contactors using switches and push buttons.
TP3: Starting a Three-phase Squirrel-Cage Induction Motor

TP4: Forward/Reverse Starting of an Induction Motor

TP5: Protection of an Induction Motor

Thermal circuit breaker
Magnetic circuit breaker

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. Christophe Prévé. Protection des réseaux électriques, Hermès, Paris,1998.
2. S.-H. Horowitz & A.-G.Phadke, John Wiley & Sons. Power System Relaying, 2nd edition, 1995.
3. Féchant L., Appareillage électrique à BT, Appareils de distribution, Techniques de l'Ingénieur, traité, Génie électrique, D 4 865.

Semester: 5
Teaching Unit: UED 3.1
Subject 1: Electrical Energy Production
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Understand, master, and acquire the basic principles of various methods of electrical energy production.
At the end of this course, students should be aware of general energy challenges and the specific impact of electrical energy on socio-economic life.
Recommended Prerequisite Knowledge:
Basic knowledge of thermodynamics and fluid mechanics.
Fundamental knowledge of electrical engineering (electricity and circuits, electric and magnetic fields, power, three-phase systems, alternators, motors, transformers).

Course Content:
Chapter 1. Introduction to Electrical Energy Production 2 weeks
History of electricity generation. Evolution of electrical energy production in Algeria. Eco-design and sustainable development, renewable and non-renewable energy sources, economic aspects.

Chapter 2. Thermal Power Plants 2 weeks
Chapter 3. Diesel Generators / Emergency Power Units 2 weeks
Chapter 4. Nuclear Power Plants 2 weeks
Chapter 5. Hydroelectric Power Plants 2 weeks
Chapter 6. Wind Energy 2 weeks
Principles of aerodynamics and types of wind turbines, operating principle, grid connection, voltage regulation and protection.

Chapter 7. Solar Energy 2 weeks
Operating principles and technologies, characteristics and maximum power point tracking.

Chapter 8. Fuel Cells 1 week
Types of fuel cells and operating principles.

Assessment Method:
Final exam: 100%.

Références bibliographiques:

1. Sabonnadière Jean Claude, Nouvelles technologies de l'énergie 1: Les énergies renouvelables, Ed. Hermès.
2. Gide Paul, Le grand livre de l'éolien, Ed. Moniteur.
3. A. Labouret, Énergie Solaire photovoltaïque, Ed. Dunod.
4. Viollet Pierre Louis, Histoire de l'énergie hydraulique, Ed. Press ENP Chaussée.
5. Peser Felix A, Installations solaires thermiques: conception et mise en œuvre, Ed. Moniteur, Dunod/L'Usine nouvelle, 2013.

6. B. Robyns et al, Production d'énergie électrique à partir des sources renouvelables (Coll. Sciences et technologies de l'énergie électrique), Lavoisier, 2012.
7. G. Laval, La fusion nucléaire : de la recherche fondamentale à la production d'énergie ?, EDP Sciences, 2007.
8. V. Crastan, Centrales électriques et production alternative d'électricité, Hermès-Lavoisier, 2009.

Semester: 5
Teaching Unit: UED 3.1
Subject 2: Electrical Engineering Materials
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Understand the physical, mechanical, and chemical properties of materials used in electrical engineering.
Master the phenomena that determine the properties of materials used in industrial applications.
Recommended Prerequisite Knowledge:
Basic knowledge of mechanics and atomic physics.
Fundamental knowledge of electrical engineering (electricity and circuits, electric and magnetic fields).

Course Content:
Chapter 1. Magnetic Materials
2 weeks
Classification of magnetic materials, technical characterization of magnetization.

Chapter 2. Ferromagnetic Materials
4 weeks
Hard ferromagnetic materials and their applications, soft ferromagnetic materials and their applications; characterization of permanent magnets.

Chapter 3. Dielectric Materials
4 weeks
Polarization phenomena, dielectric resistivity, dielectric strength, dielectric losses, physicochemical properties.

Chapter 4. Conductors and Superconductors
3 weeks
General overview and applications.

Chapter 5. Semiconductors
2 weeks
General overview and applications.

Assessment Method:
Final exam: 100%.

Références bibliographiques:
1. P.Robert. Matériaux de l'électrotechnique, Dunod
2. F.Piriou. Matériaux du génie électrique, MGE 2000, Hermès
3. Breal. Traité des matériaux 3 : caractérisation expérimentale des matériaux II.
4. Gérald Roosen. Matériaux semi-conducteurs et nitrures pour l'optoélectronique, Hermès
5. P. Tixador. Matériaux supraconducteurs, Hermès.
6. Traité d'électricité, vol II, "Matériaux de l'électrotechnique

Semester: 5
Teaching Unit: UET 3.1
Subject 1: Electrical Safety
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
The objective of this course is to inform future graduates about the nature of electrical accidents, emergency procedures for victims of electric shock, and to provide them with sufficient knowledge to properly design protection systems for both equipment and personnel working in industrial environments and other fields involving electrical devices.

Recommended Prerequisite Knowledge:
Basic knowledge of electricity.

Course Content:
Chapter 1: Electrical Hazards **2 weeks**
Definition and purpose of workplace safety, History and background of electrical risks, Standardization organizations, Statistics on electrical accidents.

Chapter 2: Nature of Electrical Accidents and Dangers of Electric Current **3 weeks**
Classification (direct and indirect effects of electric current), Human body impedance, Parameters influencing electric current effects, Pathophysiological effects of electric current flow through the body, Electric shock without loss of consciousness, Electric shock with loss of consciousness (ventricular fibrillation).

Chapter 3: Protection Measures **6 weeks**
Introduction, Protection of persons, Regulations, Safety measures, Working without voltage (de-energized work), Working near live electrical installations, Individual and collective protective equipment, Protection against direct and indirect contact, Safe voltage levels, Earthing systems (Grounding arrangements), Effects of electric and magnetic fields, Equipment protection, Protective devices (types and reliability), Low voltage (LV), Medium Voltage (MV), and High Voltage (HV) indoor installations, Portable low-voltage equipment, Inspections and testing.

Chapter 4: Safety Measures Against Indirect Effects of Electric Current **2 weeks**
Fires, harmful substances, explosions, noise and vibrations (definition, standards, and noise control techniques).

Chapter 5: Emergency Response and First Aid **2 weeks**
Procedures to follow in case of electrical accidents, First aid, Assisted ventilation (mouth-to-mouth and Sylvester method), External cardiac massage, Care for burns.

Assessment Method:
Final exam: 100%.

Références bibliographiques:
1-V. Semeneko, Prescriptions Générale de Sécurité Technique dans une Entreprise, Université de Annaba, 1979.

2- A.Novikov, Cahier de Cours de Protection de Travail, Université de Annaba, 1983.
3- Edgar Gillon, Cours d'Electrotechnique, Dunod, Paris 1966.
4- Encyclopédie des Sciences industrielles, Quillet, Paris, 1983.
5- L.G. Hewitson, Guide de la protection des équipements électriques, Dunod, 2007.

Semester: 6
Teaching Unit: UEF 3.2.1
Subject 1: Industrial Process Control / Regulation
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Understand the principles and structure of control loops.
Learn how to select the appropriate controller for an industrial process to achieve required performance criteria (stability, accuracy).
Recommended Prerequisite Knowledge:
Knowledge of linear continuous control systems and general electricity.

Course Content:
Chapter 1. Introduction to Industrial Regulation 2 weeks
Definition of industrial processes, Components of a control loop (process, actuators, sensors, controllers, signal conditioners, setpoint, measurement, disturbance), Block diagram of a controlled system, Elements of a control loop, symbols, functional diagrams and loops, performance criteria for regulation.

Chapter 2. On-Off Controllers 2 weeks
On-off controller, On-off controller with threshold, On-off controller with hysteresis, On-off controller with threshold and hysteresis.

Chapter 3. System Identification in Open and Closed Loop 2 weeks
Purpose of identification, model selection, open-loop identification (S-shaped curves, integrator-type responses, oscillatory responses), closed-loop identification (oscillation methods).

Chapter 4. Standard Controllers: P, PI, PD, PID 2 weeks
Characteristics, Structures of PID controllers (parallel, series, mixed), Electronic and pneumatic implementations.

Chapter 5. Selection and Tuning of Controllers 4 weeks
Selection criteria, Tuning methods (flatness criterion, symmetry criterion, Ziegler-Nichols method, etc.), Controller tuning based on reference model tracking.

Chapter 6. Industrial Applications 3 weeks
Temperature, flow rate, pressure, and level control applications.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. E. Dieulesaint, D. Royer, "Automatique appliquée", 2001.
2. P. De Larminat, "Automatique: Commande des systèmes linéaires. Hermes 1993.
3. K. J. Astrom, T. Hagglund, "PID Controllers: Theory, Design and Tuning", Instrument Society of America, Research Triangle Park, NC, 1995.
4. A. Datta, M. T. Ho, S. P. Bhattacharyya, "Structure and Synthesis of PID Controllers", Springer-Verlag, London, 2000.
5. Jean-Marie Flaus, "La régulation industrielle", Editions,Hermes, 1995.
6. P. Borne, "Analyse et régulation des processus industriels tome 1: Régulation continue". Editions Technip.
7. T. Hans, P. Guyenot, "Régulation et asservissement" Editions,Eyrolles.
8. R. Longchamp,"Commande numérique de systèmes dynamiques cours d'automatique", Presses Polytechniques et universitaires romandes, 2006.
9. http://www.technologuepro.com/cours-genie-electrique/cours-6-regulation-industrielle/.

Semester: 6
Teaching Unit: UEF 3.2.1
Subject 2: Control of Electromechanical Drives
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Understand and master the different types of control methods for variable-speed drives.
Recommended Prerequisite Knowledge:
Electrical machines, machine modeling, power electronics, mechanics fundamentals, control systems, and regulation.

Course Content:
Chapter 1. Introduction to Electric Drives **2 weeks**
Electric drive with variable speed (definition, interest in speed variation, characteristics, application examples); General structure of an electric drive (electric machines, static converters, control and regulation unit, driven loads); Equation of motion and mechanical characteristics (fundamental dynamic equation, mechanical characteristics of electric machines and driven loads, operating quadrants); Stability of an operating point.

Chapter 2. Speed Control of DC Motors **4 weeks**
Review of DC motors (principle of operation, equations and equivalent electrical circuit, types of DC motors); Speed control techniques for separately excited DC motors and their characteristics (variation of armature resistance, variation of excitation flux, variation of armature supply voltage); Association of static converters and DC motors (operation in 1, 2, and 4 quadrants, voltage and current reversibility, rectifier/DC motor association, chopper/DC motor association); Speed regulation and control of separately excited DC motors (general speed control structure, speed control with and without current regulation).

Chapter 3. Speed Control of Induction Motors **5 weeks**
Review of induction motors (construction, principle of operation, steady-state model, electromechanical characteristics); Speed control techniques for induction motors (adjusting rotor equivalent resistance, adjusting stator voltage, recovering rotor energy – subsynchronous cascade –, changing the number of poles, varying the supply frequency); Inverter / induction motor association (PWM technique, frequency and voltage variation); Introduction to decoupling between flux and torque control (V/f control, scalar control, vector control).

Chapter 4. Control of Synchronous Machines **4 weeks**
Review of synchronous machines (construction, principle of operation, types of synchronous machines, steady-state model); Starting of synchronous machines (loss of synchronism, starting methods); Self-control of synchronous machines supplied by a current source inverter; Overview of scalar control combined with self-control using a voltage source inverter; Introduction to vector control of smooth-pole synchronous machines.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. Jean-Paul Louis, Bernard Multon, Yvan Bonnassieux, Michel Lavabre, "Commande des machines à courant continu (mcc) à vitesse variable", Techniques de l'Ingénieur, traité Génie électrique, D3 610, 2002
2. Jean-Paul Louis, Bernard Multon, Yvan Bonnassieux, Michel Lavabre, "Convertisseurs statiques pour la variation de vitesse des mcc", Techniques de l'Ingénieur, traité Génie électrique, D3 611, 2003.
3. B. De Fornel, "Alimentation des machines asynchrones", Techniques de l'Ingénieur, traité Génie électrique, D 3 621, 1990.
4. Michel LAJOIE-MAZENC, Philippe VIAROUGE "Alimentation des machines synchrones", Techniques de
5. l'Ingénieur, traité Génie électrique, D 3 630, 1991
6. Michel Pinard , "Commande électronique des moteurs électriques" , DUNOD 2004
7. Gay Sturtzer, "Modélisation et commandes des moteurs triphasés", Ellipses 2000
8. Gay Séguier, " Introduction à l'électrotechnique approfondie". (Tec&Doc).
9. Jean Bonal, "Entraînements électriques à vitesse variable", Lavoisier Tec&Doc, 1997.
10. Dominique Bareille, Jean-Pierre Daunis, " Electrotechnique (transformateurs et machines tournantes) -Cours et exercices corrigés-" , Dunod, Paris 2006. Cote : 03-04-585
11. Pierre Mayé, "Moteurs électriques industriels", Dunod, Paris 2005.
12. Guy Seguier, Francis Notelet, "Electrotechnique Industrielle",

Semester: 6
Teaching Unit: UEF 3.2.1
Subject 3: Sensors and Measurement Chains
VHS: 22h30 (Lecture: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
After completing this unit, students should be able to understand the different components of a measurement chain, grasp the basic operating principle of a sensor, and identify the key metrological characteristics to consider when selecting and using a sensor.

Recommended Prerequisite Knowledge:
General electricity
Electrical and electronic measurements

Course Content:
Chapter 1. Introduction to Measurement Chains **1 week**
Definition, block diagram of an industrial control system, active and passive sensors, classification of sensors.

Chapter 2. Metrological Characteristics of Sensors **1 week**
Definition, sensor calibration, sensitivity, linearity, accuracy, dynamic sensitivity.

Chapter 3. Sensor Signal Conditioning Circuits **3 weeks**
Basic operational amplifier circuits (inverting, non-inverting, differential, summing), instrumentation amplifiers, isolation amplifiers, bridge conditioning circuits, linearization of static sensor characteristics.

Chapter 4. Temperature Measurement **3 weeks**
Introduction to thermometry, resistance-based temperature measurement, thermocouples, thermistors, pyrometers.

Chapter 5. Pressure Measurement **2 weeks**
Pressure concepts: absolute pressure, relative pressure, differential pressure. Piezoresistive pressure sensors.

Chapter 6. Level and Flow Measurement **3 weeks**
Float sensors, ultrasonic Doppler effect sensors.

Chapter 7. Displacement and Speed Measurement **2 weeks**
Optical encoders, incremental encoders, variable reluctance sensors.

Assessment Method:

Final exam: 100%.

Références bibliographiques:

1. George Asch et Coll, « les capteurs en instrumentation industrielle », 6ème édition Dunod, 2006.
2. Pascal Dassonvalle, « Les capteurs : 50 exercices et problèmes corrigés », Dunod, 2004.
3. Georges Asch, Patrick Renard, Pierre Desqoutte, Zoubir Mammeri, Eric Chambérod, Jean Gunther, « Acquisition de données », 3ème édition, Dunod, 2011.
4. Fèrid Bélaïd, « Introduction aux capteurs en instrumentation industrielle », Centre de Publication Universitaire 2006.
5. J. P. Bentley, "Principles of measurement systems", Pearson education 2005.
6. J. Niard et al, « Mesures électriques », Nathan, 1981.

Semester: 6
Teaching Unit: UEF 3.2.2
Subject 1: Industrial Automation and Control Systems / Programmable Logic Controllers (PLCs)
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

Understand the operating principles of PLCs (Programmable Logic Controllers) and their implementation in automated systems.

Recommended Prerequisite Knowledge:

Combinational and sequential logic
Basic computer programming languages

Course Content:

Chapter 1. Introduction to Automated Systems and Industrial Computing 3 weeks

Automation and structure of automated systems, classification of automated systems, methods for analyzing system operation, the key role of computing in industry, specification of requirement levels, performance and challenges.

Chapter 2. GRAFCET 3 weeks

Definition and basic concepts, rules for creating a GRAFCET diagram, transitions and directed links, evolution rules, sequence selection and simultaneous sequences, physical realization of a GRAFCET.

Chapter 3. Programmable Logic Controllers (PLCs) 6 weeks

Introduction to computers, architectural study of microprocessors, architectural study of microcontrollers, internal structure and components of a PLC, selecting an appropriate PLC, input/output interfaces, graphical and textual programming tools, implementation of PLCs, introduction to communication buses and principles of PLC networks, industrial applications.

Chapter 4. Electromechanical Applications 3 weeks

Automatic start-stop control of asynchronous and synchronous motors, conveyor automation, elevator automation, lift automation.

Assessment Method:

Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. Ronald J. Tocci, ReynaldGoulet. Circuits Numériques: Théorie et Applications. Edition 1996.
2. Mouloud Sbai. Logique combinatoire et composants numériques, Cours et Exercices Corrigés, Edition Ellipses, 2013.
3. Jean-Yves Fabert. Automatismes et Automatique: Cours et Exercices Corrigés. Edition Ellipses, 2003.
4. René David, Hassan Alla. Du Grafcet aux Réseaux de Pétri. Edition Hermès, 1992.
5. Simon Moreno, Edmond Peulot. Le Grafcet: Conception-Implantation dans les automates programmables industriels. Edition Casteilla, 2009.
6. G. Michel. Les API: Architecture et applications des automates programmables industriels. Edition Dunod 1988.
7. William Bolton. Les Automates Programmables Industriels. Edition Dunod 2010.

8. Frederic P.Miller, Agnes F.Vandome, John McBrewster.Automates Programmables Industriels: Programmation informatique. Edition Alphascript Publishing 2010.
9. KhushdeepGoyal and Deepak Bhandari. Industrial Automation and Robotics. Katson Books. 2008.
10. Gérard Boujat et Patrick Anaya. Automatique industrielle en 20 fiches. Dunod. 2013.

Semester: 6
Teaching Unit: UEF 3.2.2
Subject 2: Turbomachinery
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Introduce the different types of machines and turbomachines used in industry and their operational characteristics.

Recommended Prerequisite Knowledge:
Thermodynamic cycles
Thermal machines
Rotating flow dynamics

Course Content:

Chapter 1. Principles of Turbomachinery **3 weeks**
Operation, working fluid, characteristic curves, efficiency, similarity laws, application areas.

Chapter 2. Incompressible Fluid Turbomachines **3 weeks**
Pumps, centrifugal and axial fans.

Chapter 3. Hydraulic Turbines **2 weeks**
Chapter 4. Compressible Fluid Turbomachines **2 weeks**
Chapter 5. Gas Turbines **3 weeks**
Gas turbine cycle, efficiency, turbojets, turboprop engines, ramjets.

Chapter 6. Steam Turbines **2 weeks**
Steam turbine cycle, efficiency, extraction steam turbines.

Assessment Method:
Continuous assessment: 40% ; Final exam: 60%.

Références bibliographiques:

1. Patrick H. Oosthuizen, William E. Carscallen. Compressible fluid flow, McGraw-Hill editions, 1997.
2. H. W. Liepmann, A. Roshko. Elements of Gasdynamics, John Wiley & Sons, 1957.
3. Roger Ouziaux. Mécaniques des fluides appliqués ; 2004, Dunod.

Semester: 6
Teaching Unit: UEM 3.2
Subject 1: Final Year Project / Capstone Project
VHS: 45h00 (Lab: 3h00)
Credits: 4
Coefficient: 2

Course Objectives:
Provide students with a comprehensive and integrated understanding of the knowledge acquired throughout their studies.
Allow them to apply theoretical concepts in practical, real-world contexts.
Encourage autonomy, initiative, and critical thinking.
Teach students how to work collaboratively while fostering intellectual curiosity.
Recommended Prerequisite Knowledge:
All subjects covered during the undergraduate program (Bachelor's level).

Course Content:
The topic of the Final Year Project must be jointly chosen by the student (or a group of two or three students) and their academic supervisor. The subject must align with the objectives of the academic program and take into account the student's actual capabilities (at Bachelor's level). It is also recommended that the project reflects the local socio-economic context of the institution. If necessary, the project can be divided into several parts.

Note:
During the initial weeks when students are familiarizing themselves with the purpose and feasibility of the project (literature review, search for software or equipment, revision of relevant course materials), the instructor should use this time to remind students of key points from the two courses "Academic Writing Methodology" and "Presentation Methodology," which were covered during the first two semesters of the common core curriculum.

At the end of the project, students must submit a written report detailing:

A thorough presentation of the study topic, emphasizing its relevance to the socio-economic environment.
The resources used: methodological tools, bibliographic references, contacts with professionals, etc.
Analysis of the results obtained and comparison with the initial objectives.
Critical evaluation of discrepancies and inclusion of any additional details.
Identification of encountered difficulties, highlighting the limitations of the work and possible future developments.
Finally, the student or group presents their project (either through an oral presentation or poster) in front of their supervisor and an examining instructor. Questions may be asked, and the completed work will be evaluated both technically and in terms of presentation skills.

Assessment Method:
Continuous assessment: 100%

Références bibliographiques:
(Selon la disponibilité de la documentation au niveau de l'établissement, Sites internet...etc.).

Semester: 6
Teaching Unit: UEM 3.2
Subject 2: Control Systems and Automation Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Perform hands-on experiments to deepen understanding of industrial automation.
Observe the behavior of controlled systems and the influence of controller parameters.
Recommended Prerequisite Knowledge:
Content of courses on automation and industrial control.

Course Content:
Industrial Automation Lab (TP d'Automatismes Industriels):
In this lab, students are expected to master a PLC programming software such as STEP7 for Siemens PLCs or PL7 for Schneider PLCs (or other brands depending on availability).

The following practical works are proposed:

Introduction to PLC programming software (depending on the available brand in each institution),
Traffic light control system,
Reversible starting of an induction motor,
Speed control of a DC motor,
Control of a stepper motor.

Control Systems Lab (TP de Régulation):
TP1: Time and frequency responses and system identification.
TP2: On-Off control of temperature or humidity.
TP3: Analog (PID) control of fluid level.
TP4: Speed control of a DC motor.
TP5: Pressure regulation.
TP6: Temperature regulation.

Assessment Method:
Continuous assessment: 100%

Références bibliographiques:
Notes du cours sur l'automatisation industrielle; Brochures du labo.

Semester: 6
Teaching Unit: UEM 3.2
Subject 3: Electric Drive Control Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Discover various types of variable-speed electric drives and their electromechanical characteristics.

Recommended Prerequisite Knowledge:
Fundamental principles of electrical engineering and knowledge of electric machine characteristics.

Course Content:
TP1: Speed control of a DC motor by varying the armature resistance, supply voltage, and field excitation.
TP2: Rectifier / DC motor system.
TP3: Chopper / DC motor system.
TP4: Speed control of an induction motor by varying rotor resistance and supply voltage.
TP5: Inverter (constant V/f) / Induction motor system.
TP6: Inverter (constant V/f) / Synchronous motor system.
TP7: Self-control of a synchronous motor.

Assessment Method:
Continuous assessment: 100%

Références bibliographiques:
Notes des cours: machines électriques, électronique de puissance ; commande des systèmes;

Semester: 6
Teaching Unit: UEM 3.2
Subject 4: Sensors Lab
VHS: 15h00 (Lab: 1h00)
Credits: 1
Coefficient: 1

Course Objectives:
Perform hands-on experiments to deepen understanding of sensors and their calibration.
Recommended Prerequisite Knowledge:
Electrical and electronic measurements.

Course Content:
TP1: Photometric sensors.
TP2: Strain and force sensors.
TP3: Position sensors (capacitive and inductive).
TP4: Temperature sensors.
TP5: Rotational speed sensors.
TP6: Piezoelectric vibration sensors.

Assessment Method:
Continuous assessment: 100%.

Références bibliographiques:
Notes du cours sur les capteurs et conditionneurs, Brochures du labo.

Semester: 6
Teaching Unit: UED 3.2
Subject 1: Maintenance of Electromechanical Systems
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Ensure continuity of operation in industrial installations.
Identify functions and components of electrical and electronic equipment.
Diagnose system failures and perform repairs.
Recommended Prerequisite Knowledge:
Statistics, instrumentation, measurement techniques, and basic electrical/electronic equipment.

Course Content:
Chapter 1: Introduction to Maintenance 6 weeks
Definition of maintenance (according to ISO, ANSI, DIN, AFNOR); Different types of maintenance; Essential maintenance functions; Maintenance operations and levels; Objectives of maintenance; Role and strategies of maintenance; Related activities; Corrective maintenance; Preventive maintenance; Machine diagnostics; Application of preventive maintenance for mechanical systems; Application of preventive maintenance for electrical systems.

Chapter 2: Fundamentals of System Reliability and Availability 6 weeks
Fundamentals of operational safety and reliability; Parameters used in reliability measurement; Main probability distributions used in reliability engineering (discrete and continuous random variables); Reliability of systems; Methods of reliability analysis [Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), etc.]; Exercises and applications.

Chapter 3: Introduction to Computer-Aided Maintenance (CAM) 3 weeks

Assessment Method:
Final exam: 100%

Références bibliographiques:

1. Zwingelstein G, Diagnostic de défaillance, Hermès, paris 1997;
2. Jean Henq. Pratique de la maintenance préventive, Dunod, 2000.
3. Raymond Magnan. Pratique de la maintenance industrielle, Dunod, 2003.
4. Yves Lavina.Maintenance industrielle, Fonction de l'entreprise, 2005.
5. François M. Maintenance: méthode et organisation,Dunod, Paris 2000.
6. Boulenger A &Pachaud C. Diagnostic vibratoire en maintenance préventive, Dunod. Paris 2000.
7. Jean Henq. Pratique de la maintenance préventive, Dunod, Paris 2002.
8. Cuigent R. Management de la maintenance, Dunod, Paris 2002.
9. Robert S & Stéphane S. Maintenance: la méthode Maxer, Dunod, Paris 2008.
10. J.F.D. Beaufort. Emploi des relais pour la protection des installations, 1972.
11. Michel Pierre Villoz. Protection et environnement,; Technique et ingénieur, 2006.

12. Nichon Margossian.Risques professionnelle, Technique et ingénieur, 2006.
13. Rachid Chaib. La maintenance et la sécurité industrielle dans l'entreprise, Dar El Houda, Alger, 2007.

Semester: 6
Teaching Unit: UED 3.2
Subject 2: Introduction to Internal Combustion Engines
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Provide an analytical description of the operation of internal combustion engines.
Introduce the principles for calculating their performance and basic sizing.
Recommended Prerequisite Knowledge:
General knowledge of fundamental mechanics, applied thermodynamics, kinematics, and dynamics of machines is recommended.

Course Content:
Chapter 1. Evolution of Internal Combustion Engines
Chapter 2. Technology of Internal Combustion Engines
Chapter 3. Theory of Thermodynamic Cycles
Otto (Beau de Rochas), Diesel, and Sabathé cycles.
Chapter 4. Carburetion
Chapter 5. Fuel Injection
Chapter 6. Combustion
Chapter 7. Turbocharging / Supercharging

Assessment Method:
Final exam: 100%

Références bibliographiques:

1. R. Van Basshuysen, F. Schäfer, Internal Combustion Engine Handbook. Basics, Compontents, Systems, and Perspectives, SAE International, 2002.
2. C. R. Ferguson, Internal Combustion Engines. Applied Thermosciences, John Wiley & mp; Sons, 1986.
3. J. B. Heywood, Internal Combustion Engine Fundamentals, McGraw-Hill Book Company, 1988.
4. R. Stone, Introduction to International Combustion Engines, 4th Edition, Palgrave Macmillan, 2012.

Semester: 6
Teaching Unit: UET 3.2
Subject: Entrepreneurship and Business Management
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:

Prepare students for professional integration upon graduation.

Develop entrepreneurial skills in students.

Raise awareness about the opportunities, challenges, procedures, characteristics, attitudes, and skills required in entrepreneurship.

Equip students with the knowledge to one day start their own business or better understand how SMEs operate.

Recommended Prerequisite Knowledge:

No specific prior knowledge is required, except proficiency in the language of instruction.

Targeted Skills:

Ability to analyze and synthesize information

Teamwork and communication skills (oral and written)

Autonomy, planning ability, and time management

Proactive and reactive behavior

Awareness of entrepreneurship through an overview of essential management knowledge for starting a business

Course Content:

Chapter 1 – Job Search Preparation 2 weeks

Writing motivation letters and CVs, job interviews, research on sector-related jobs, conducting interviews with professionals, simulating job interviews.

Chapter 2 – Entrepreneurship and the Entrepreneurial Spirit 2 weeks

What it means to be an entrepreneur, businesses around you, entrepreneurial motivation, setting goals, taking calculated risks.

Chapter 3 – The Profile of an Entrepreneur and the Role of an Entrepreneur 3 weeks

Entrepreneurial qualities, negotiation and listening skills, the role of SMEs and micro-enterprises (TPE) in Algeria, key success factors in creating a TPE/SME.

Chapter 4 – Finding a Good Business Idea **2 weeks**

Creativity and innovation, identifying and evaluating business opportunities.

Chapter 5 – Launching and Running a Business **3 weeks**

Choosing the right market, selecting a location, legal forms of businesses, finding support and funding, hiring staff, choosing suppliers.

Chapter 6 – Developing a Business Project **3 weeks**

Understanding the Business Model and Business Plan, developing your project using the Business Model Canvas.

Assessment Method:

Final exam: 100%

Références :

- FayolleAlain, 2017. Entrepreneuriat théories et pratiques, applications pour apprendre à entreprendre.Dunod, 3e éd.

- LégerJarniou, Catherine, 2013, Le grand livre de l'entrepreneur. Dunod, 2013.

- PlaneJean-Michel, 2016, Management des organisations théories, concepts, performances. Dunod, 4ème éd.

- LégerJarniou, Catherine, 2017, Construire son Business Plan. Le grand livre de l'entrepreneur. Dunod,.

- Sion Michel, 2016, Réussir son business Méthodes, outils et astuces plan.Dunod ,4èmeéd.

- Patrick Koenblit, Carole Nicolas, Hélène Lehongre, Construire son projet professionnel, ESF, Editeur 2011.

- Lucie Beauchesne, Anne Riberolles, Bâtir son projet professionnel, L'Etudiant 2002.

- ALBAGLI Claude et HENAULT Georges (1996), La création d'entreprise en Afrique, ed EDICEF/AUPELF ,208 p.