الجمهورية الجزائرية الديمقراطية الشعبية
Democratic and Popular Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research

University

Logo

L.M.D. TRAINING OFFER

BACHELOR DEGREE

NATIONAL PROGRAM

Institution	Faculty / Institute	Department

Field	Program	Specialization
Sciences and Technology	**Mechanical Engineering**	***Mechanical Construction***

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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا

National Pedagogical Committee of the Sciences and Technology field

عرض تكوين
ل. م . د
ليسانس أكاديمية

برنامج وطني
2022 – 2021

المؤسسة	الكلية/ المعهد	القسم
جامعة		

الميدان	الفرع	التخصص
علوم وتكنولوجيا	هندسة ميكانيكية	انشاء ميكانيكي

University

CPNDST

II – Semester organization sheets for teaching in the specialty

Semester 1

Course unit	Courses	Credits	Coefficient	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 1.1 Credits: 18 Coefficients : 9	Mathematics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Structure of matter	6	3	3h00	1h30		67h30	82h30	40%	60%
TU Methodological Code: UEM 1.1 Credits: 9 Coefficients : 5	PW Physics 1	2	1			1h30	22h30	27h30	100%	
	PW Chemistry 1	2	1			1h30	22h30	27h30	100%	
	Computer Science 1	4	2	1h30		1h30	45h00	55h00	40%	60%
	Writing Methodology	1	1	1h00			15h00	10h00		100%
TU Discovery Code: UED 1.1 Credits: 1 Coefficients : 1	Science and Technology Careers 1	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 1.1 Credits: 2 Coefficients : 2	Ethical and Deontological Dimension (Foundations)	1	1	1h30			22h30	02h30		100%
	Foreign Language 1 (English or French)	1	1	1h30			22h30	02h30		100 %
Total Semester 1		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 2

Course unit	Courses	Credits	Coefficient	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 1.2 Credits: 18 Coefficients : 9	Mathematics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3h00	1h30		67h30	82h30	40%	60%
TU Methodological Code: UEM 1.2 Credits: 9 Coefficients : 5	PW Physics 2	2	1			1h30	22h30	27h30	100%	
	PW Chemistry 2	2	1			1h30	22h30	27h30	100%	
	Computer Science 2	4	2	1h30		1h30	45h00	55h00	40%	60%
	Presentation Methodology	1	1	1h00			15h00	10h00		100%
TU Discovery Code: UED 1.2 Credits: 1 Coefficients : 1	Science and Technology Careers 2	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 1.2 Credits: 2 Coefficients : 2	Foreign Language 2 (English or French)	2	2	3h00			45h00	05h00		100 %
Total Semester 2		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 3

Course unit	Courses	Credits	Coefficient	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 2.1.1 Credits: 10 Coefficients : 5	Mathematics 3	6	3	3h00	1h30		67h30	82h30	40%	60%
	Waves and Vibrations	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fundamental Code: UEF 2.1.2 Credits: 8 Coefficients : 4	Fluid Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Classical Mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Methodological Code: UEM 2.1 Credits: 9 Coefficients : 5	Probability and Statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer Science 3	2	1			1h30	22h30	27h30	100%	
	Technical Drawing	2	1			1h30	22h30	27h30	100%	
	PW Waves and Vibrations	1	1			1h00	15h00	10h00	100%	
TU Discovery Code: UED 2.1 Credits: 2 Coefficients : 2	Basic Technology	1	1	1h30			22h30	02h30		100%
	Metrology	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 2.1 Credits: 1 Coefficients : 1	Technical English	1	1	1h30			22h30	02h30		100%
Total Semester 3		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semester 4

Course unit	Courses	Credits	Coefficien	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 2.2.1 Credits: 6 Coefficients : 3	Thermodynamics 2	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mechanical Manufacturing	2	1	1h30			22h30	27h30		100%
TU Fundamental Code: UEF 2.2.2 Credits: 8 Coefficients : 4	Mathematics 4	4	2	1h30	1h30		45h00	55h00	40%	60%
	Numerical Methods	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fundamental Code: UEF 2.2.3 Credits: 4 Coefficients : 2	Strength of Materials	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Methodological Code: UEM 2.2 Credits: 9 Coefficients : 5	Computer-Aided Design	2	1			1h30	22h30	27h30	100%	
	PW Fluid Mechanics	2	1			1h30	22h30	27h30	100%	
	PW Numerical Methods	2	1			1h30	22h30	27h30	100%	
	PW Strength of Materials	1	1			1h00	15h00	10h00	100%	
	PW Mechanical Manufacturing	2	1			1h30	22h30	27h30	100%	
TU Discovery Code: UED 2.2 Credits: 2 Coefficients : 2	Industrial Electricity	1	1	1h30			22h30	02h30		100%
	Materials Science	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 2.2 Credits: 1 Coefficients : 1	Expression, Information, and Communication Techniques	1	1	1h30			22h30	02h30		100%
Total Semester 4		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semester 5

Course unit	Courses	Credits	Coefficient	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 3.1.1 Credits: 10 Coefficients : 5	Analytical mechanics	6	3	3h00	1h30		67h30	82h30	40%	60%
	Mechanical Construction1	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fundamental Code: UEF 3.1.2 Credits: 8 Coefficients : 4	Strength of materials 2	4	2	1h30	1h30		45h00	55h00	40%	60%
	Elasticity	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Methodological Code: UEM 3.1 Credits: 9 Coefficients : 5	Industrial Drawing	4	2			3h00	45h00	55h00	100%	
	Computer-Aided Design and Manufacturing	4	2			3h00	45h00	55h00	100%	
	PW Metrology	1	1			1h00	15h00	10h00	100%	
TU Discovery Code: UED 3.1 Credits: 2 Coefficients : 2	Control and Regulation	1	1	1h30			22h30	02h30		100%
	Maintenance	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 3.1 Credits: 1 Coefficients : 1	Environment and Sustainable Development	1	1	1h30			22h30	02h30		100%
Total Semester 5		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semester 6

Course unit	Courses	Credits	Coefficient	Weekly time volume			Semester time volume (15 weeks)	Additional work in consultation (15 weeks)	Assessment method	
	Title			**Lectures**	**DW**	**PW**			**Continuous assessment**	**Exam**
TU Fundamental Code: UEF 3.2.1 Credits: 10 Coefficients : 5	Mechanical Construction2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Theory of mechanisms	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fundamental Code: UEF 3.2.2 Credits: 8 Coefficients : 4	Heat transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Structural dynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Methodological Code: UEM 3.2 Credits: 9 Coefficients : 5	End-of-Cycle Project	4	2			3h00	45h00	55h00	100%	
	Internal Combustion Engine	4	2	1h30	1h30		45h00	55h00	40%	60%
	PW Heat transfer	1	1			1h00	15h00	10h00	100%	
TU Discovery Code: UED 3.2 Credits: 2 Coefficients : 2	Hydraulic and Pneumatic Systems	1	1	1h30			22h30	02h30		100%
	Non-Metallic Materials	1	1	1h30			22h30	02h30		100%
TU Transversal Code: UET 3.2 Credits: 1 Coefficients : 1	Entrepreneurship and Business Management	1	1	1h30			22h30	02h30		100%
Total Semester 6		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

The evaluation methods presented in these tables are given as an indication only, the training team of the institution may propose other weightings.

III - Detailed program by subject.

Semester: 3
Course unit: UEF 2.1.1
Subject 1: Mathematics 3
SHV: 67h30 (Lectures: 3h00, DW: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives :

At the end of this lecture, the student should be able to understand the different types of series and their convergence conditions as well as the different types of convergence.

Recommended prior knowledge

Mathematics 1 et Mathematics 2

Content of the course :

Chapter 1: Simple and Multiple Integrals (3 weeks)
1.1 Review of Riemann integral and primitive functions. 1.2 Double and triple integrals.
1.3 Applications to the calculation of areas and volumes.

Chapter 2: Improper Integrals (2 weeks)
2.1 Integrals of functions defined on an unbounded interval. 2.2 Integrals of functions defined on a bounded interval, infinite at one end.

Chapter 3: Differential Equations (2 weeks)
3.1 Review of ordinary differential equations. 3.2 Partial differential equations. 3.3 Special functions.

Chapter 4: Series (3 weeks)
4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Power series, Fourier series.

Chapter 5: Fourier Transform (3 weeks)
5.1 Definition and properties. 5.2 Application to the solution of differential equations.

Chapter 6: Laplace Transform (2 weeks)
6.1 Definition and properties. 6.2 Application to the solution of differential equations.

Assessment method :

Continuous assessment : 40 % ; Exam final : 60 %.

Bibliographical references:

1- F. Ayres Jr, Théorie et Applications du Calcul Différentiel et Intégral - 1175 exercices corrigés, McGraw-Hill.
2- F. Ayres Jr, Théorie et Applications des équations différentielles - 560 exercices corrigés, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Lectures de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.
4- M. Krasnov, Recueil de problèmes sur les équations différentielles ordinaires, Edition de Moscou
5- N. Piskounov, Calcul différentiel et intégral, Tome 1, Edition de Moscou
6- J. Quinet, Lectures élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.
7- J. Quinet, Lectures élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.
8- M. R. Spiegel, Transformées de Laplace, Lectures et problèmes, 450 Exercices corrigés, McGraw-Hill.

Semester: 3
Course unit: UEF 2.1.1
Subject 2: Waves and Vibrations
SHV: 45h00 (Lectures: 1h30, DW: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

Initiate the student to the phenomena of mechanical vibrations limited to low-amplitude oscillations for 1 or 2 degrees of freedom as well as to the study of the propagation of mechanical waves.

Recommended prior knowledge

Mathematics 2, Physics 1 et Physics 2

Content of the course :

This is a course outline for a course on vibrations and waves, divided into two parts. The first part is on Vibrations, which covers the study of mechanical vibrations with one or more degrees of freedom. The second part is on Waves, which covers the study of wave propagation in one dimension, vibrations in strings, and electromagnetic and acoustic waves.
The course starts with a preamble that explains that the material is divided into two parts, and recommends that students in different fields (electrical engineering, civil engineering, mechanical engineering, and process engineering) should start with different parts of the course. The instructor is advised to cover both parts of the course, but to focus on the practical aspects of the material.

In Part A, the course covers vibrations, starting with an introduction to Lagrange's equations for particles and systems with multiple degrees of freedom. The course then moves on to the study of free and forced vibrations of single and double degree of freedom systems.

In Part B, the course covers waves, starting with the study of one-dimensional wave propagation, including the equation of propagation and the solution to the wave equation. The course then moves on to the study of vibrations in strings and acoustic and electromagnetic waves.

Overall, this course seems to be a comprehensive introduction to vibrations and waves for engineering students, with a focus on the practical aspects of the material.

Assessment method :

Continuous assessment : 40 % ; Exam final : 60 %.

Bibliographical references:

1. H. Djelouah ; Vibrations et Ondes Mécaniques – Lectures & Exercices (site de l'université de l'USTHB : perso.usthb.dz/~hdjelouah/Lecturesvom.html)
2. T. Becherrawy ; Vibrations, ondes et optique ; Hermes science Lavoisier, 2010
3. J. Brac ; Propagation d'ondes acoustiques et élastiques ; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort ; Ondes et Vibrations ; Dunod, 2017
5. J. Bruneaux ; Vibrations, ondes ; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger ; Electromagnétisme Fondements et Applications, Ed. Dunod, 2011.
1. H. Djelouah ; Electromagnétisme ; Office des Publications Universitaires, 2011.

Semester: 3
Course unit: UEF 2.1.2
Subject 1: Fluid Mechanics
SHV: 45h00 (Lectures: 1h30, DW: 1h30)
Credits: 4
Coefficient: 2

Objectif de l'enseignement :

To introduce the student to the field of fluid mechanics, the statics of fluids will be detailed in the first part. Then in the second part, the study of the motion of non-viscous fluids will be considered, and finally, the motion of real fluids will be studied.

Connaissance préalable recommandées :

Content of the course:

Chapter 1: Fluid Properties 3 weeks

- Physical definition of a fluid: States of matter, divided matter (dispersion, suspensions, emulsions)
- Perfect fluid, real fluid, compressible fluid, and incompressible fluid.
- Mass density, density
- Rheology of a fluid, viscosity of fluids, surface tension of a fluid
- Chapter 2: Statics of Fluids 4 weeks

- Definition of pressure, pressure at a point in a fluid
- Fundamental law of fluid statics
- Level surface
- Pascal's theorem
- Calculation of pressure forces: Flat plate (horizontal, vertical, oblique), center of push, instruments for measuring static pressure, measurement of atmospheric pressure, barometer, Torricelli's law
- Pressure for non-miscible superimposed fluids

Chapter 3: Dynamics of Incompressible Perfect Fluids 4 weeks

- Steady flow
- Continuity equation
- Mass flow rate and volume flow rate
- Bernoulli's theorem, cases without exchange of work and with exchange of work
- Applications to flow and velocity measurements: Venturi, diaphragms, Pitot tubes...
- Euler's theorem

Chapter 4: Dynamics of Incompressible Real Fluids 4 weeks

- Flow regimes, Reynolds experiment
- Dimensional analysis, Vashy-Buckingham theorem, Reynolds number
- Linear pressure losses and singular pressure losses, Moody's diagram.
- Generalization of Bernoulli's theorem for real fluids

Assessment method : Continuous assessment : 40 % ; Exam final : 60 %.

Bibliographical references:

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

1- Fundamentals of fluid mechanics 6th Edition, 2009, BR Munson, DF Young TH Okiishi, WW Huebsch 6th Edition John Wiley & Sons

2- Fluid mechanics, YA Cengel - 2010 - Tata McGraw-Hill Education

3- Fluid Mechanics Frank M. White Fourth Edition 2003 McGraw-Hill

4- Mécanique des fluides et hydraulique 2ème édition, Ronald v. Giles, Jack B Evett, Cheng Liu, McGraw-Hill

5- S. Amiroudine, J. L. Battaglia, 'Mécanique des fluides Lectures et exercices corrigés'Ed. Dunod

6- R. Comolet, 'Mécanique des fluides expérimentale', Tome 1, 2 et 3, Ed. Masson et Cie.

7- R. Ouziaux, 'Mécanique des fluides appliquée', Ed. Dunod, 1978

8- B. R. Munson, D. F. Young, T. H. Okiishi, 'Fundamentals of fluid mechanics', Wiley & sons. R. V. Gilles, 'Mécanique des fluides et hydraulique : Lectures et problèmes', Série Schaum, Mc Graw Hill, 1975.

Semester: 3
Course unit: UEF 2.1.2
Subject 2: Classical Mechanics
SHV: 45h00 (Lectures: 1h30, DW: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives :

The student will be able to understand the nature of a problem (static, kinematic or dynamic) in solid mechanics and will have the necessary tools to solve the problem within the framework of classical mechanics. This subject is a prerequisite for the courses: Strength of Materials and Analytical Mechanics.

Recommended prior knowledge

The student must first master the material covered in Physics 1, which deals with point mechanics. In addition, Mathematical Material 2 contains essential tools.

Content of the course :

Chapter 1: Mathematical reminders (elements of vector calculus). 1 week

Chapter 2: Generalities and basic definitions. 2 weeks
2.1 Definition and physical meaning of force
2.2 Mathematical representation of force
2.3 Operations on force (composition, decomposition, projection)
2.4 Types of force: punctual, linear, surface, volumetric
2.5 Classification of forces: internal forces, external forces
2.6 Mechanical models: the material point, the solid body

Chapter 3: Statics. 3 weeks
3.1 Axioms of statics
3.2 Connections, supports, and reactions
3.3 Axiom of connections
3.4 Equilibrium conditions:
3.4.1 Converging forces
3.4.2 Parallel forces
3.4.3 Planar forces

Chapter 4: Kinematics of rigid solids. 3 weeks
4.1 Brief reminders on kinematic quantities for a material point
4.2 Kinematics of the solid body
4.2.1 Translation motion
4.2.2 Rotation motion around a fixed axis
4.2.3 Planar motion
4.2.4 Compound motion

Chapter 5: Mass geometry. 3 weeks

5.1 Mass of a material system
5.1.1 Continuous system
5.1.2 Discrete system
5.2 Integral formulation of the center of mass
5.2.1 Definitions (linear, surface, and volumetric cases)
5.2.2 Discrete formulation of the center of mass
5.2.3 Guldin's theorems
5.3 Moment and inertia product of solids
5.4 Inertia tensor of a solid
5.4.1 Special cases
5.42 Principal axes of inertia
5.5 Huygens' theorem
5.6 Moment of inertia of solids about an arbitrary axis.

Chapter 6: Dynamics of rigid solids. 3 weeks
6.1 Brief reminders on dynamic quantities for a material point
6.2 Element of kinematics of the rigid body:
6.2.1 Quantity of motion
6.2.2 Angular momentum
6.2.3 Kinetic energy
6.3 Dynamics equation for a solid body
6.4 Theorem of angular momentum
6.5 Theorem of kinetic energy
6.6 Applications:
6.6.1 Pure translation case
6.6.2 Rotation case around a fixed axis
6.6.3 Combined case of translation and rotation.

Assessment method : Continuous assessment : 40%; Exam final : 60%.

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

1. Éléments de Mécanique rationnelle. S. Targ. Editions Mir Moscou
2. Mécanique à l'usage des ingénieurs. STATIQUE. Edition Russell. Ferdinand P. Beer
3. Mécanique générale. Lectures et exercices corrigés. Sylvie Pommier. Yves Berthaud. DUNOD.
4. Mécanique générale - Théorie et application, Editions série. MURAY R. SPIEGEL schaum, 367p.
5. Mécanique générale – Exercices et problèmes résolus avec rappels de Lectures, Office des publications Universitaires, Tahar HANI 1983, 386p.

Semester: 3
Course unit: UEM 2.1
Subject 1: Probabilités & Statistiques
SHV: 45h00 (Lectures: 1h30, DW: 1h30)
Credits: 4
Coefficient: 2

Objectifs de la matière

This module enables students to learn the essential concepts of probability and statistics, namely: one and two variable statistical series, probability on a finite universe, and random variables.

Recommended prior knowledge

Mathematics 1 et Mathematics 2

Content of the course:

Part A: Statistics

Chapter 1: Basic Definitions (1 week)

A.1.1 Concepts of population, sample, variables, and modalities

A.1.2 Different types of statistical variables: qualitative, quantitative, discrete, continuous.

Chapter 2: One-variable Statistical Series (3 weeks)

A.2.1 Frequency, Percentage, and Effectives.

A.2.2 Cumulative frequency and cumulative effectives.

A.2.3 Graphical representations: bar charts, pie charts, stem-and-leaf plots, frequency polygons, histograms, and cumulative curves.

A.2.4 Measures of central tendency.

A.2.5 Measures of variability: range, variance, standard deviation, and coefficient of variation.

A.2.6 Measures of shape.

Chapter 3: Two-variable Statistical Series (3 weeks)

A.3.1 Data tables (contingency tables). Scatter plot.

A.3.2 Marginal and conditional distributions. Covariance.

A.3.3 Linear correlation coefficient. Regression line and Mayer's line.

A.3.4 Regression curves, regression band, and correlation ratio.

A.3.5 Functional adjustment.

Part B: Probability

Chapter 1: Combinatorial Analysis (1 week)

B.1.1 Arrangements

B.1.2 Combinations

B.1.3 Permutations.

Chapter 2: Introduction to Probability (2 weeks)

B.2.1 Algebra of events

B.2.2 Definitions

B.2.3 Probabilistic spaces

B.2.4 General theorems of probabilities

Chapter 3: Conditioning and Independence (1 week)

B.3.1 Conditioning,

B.3.2 Independence,

B.3.3 Bayes' formula.

Chapter 4: Random Variables 1 week

B.4.1 Definitions and properties,

B.4.2 Distribution function,

B.4.3 Mathematical expectation,

B.4.4 Covariance and moments.

Chapter 5: Usual Discrete and Continuous Probability Distributions 3 Weeks

Bernoulli, binomial, Poisson, ...; Uniform, normal, exponential,...

Assessment method :
Continuous assessment : 40 % ; Exam : 60 %.

Bibliographical references:

1. D. Dacunha-Castelle and M. Duflo. Probabilités et statistiques : Problèmes à temps fixe. Masson, 1982.
2. J.-F. Delmas. Introduction au calcul des probabilités et à la statistique. Polycopié ENSTA, 2008.
3. W. Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Lectures de statistique mathématique. Economica, 1988.
7. A. Montfort. Introduction à la statistique. Ecole Polytechnique, 1991

Semester : 3
Course unit: UEM 2.1
Subject 2: Computer Science 3
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Objectifs de la matière

Teach the student programming using easily accessible software (primarily: Matlab, Scilab, Mapple...). This subject will be a tool for the completion of numerical methods coursework in S4.

Recommended prior knowledge

The basics of programming acquired in Computer Science 1 and 2.

Content of the course :

PW 1: Introduction to a scientific programming environment (such as Matlab, Scilab, etc.) - 1 week
PW 2: Script files and data types and variables - 2 weeks
PW 3: Reading, displaying, and saving data - 2 weeks
PW 4: Vectors and matrices - 2 weeks
PW 5: Control statements (for and while loops, if and switch statements) - 2 weeks
PW 6: Function files - 2 weeks
PW 7: Graphics (managing graphic windows, plotting) - 2 weeks
PW 8: Using toolboxes - 2 weeks

Assessment method : Continuous assessment : 100 %.

Bibliographical references:

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

1- Informatique: Programmation et simulation en Scilab 2014 - Auteurs : Arnaud Bégyn, Jean-Pierre Grenier, Hervé Gras.

2- Scilab : De la théorie à la pratique - I. Les fondamentaux. Livre de Philippe Roux 2013.

Semester: 3
Course unit: UEM 2.1
Subject 3 : Technical Drawing
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

This course will enable students to acquire the principles of representing parts in industrial drawing. Furthermore, this subject will allow the student to represent and read plans.

Recommended prior knowledge

In order to follow this course, basic knowledge of general drawing principles is required.

Content of the course

Chapter 1: Generalities. 2 Weeks
1.1 Usefulness of technical drawings and different types of drawings.
1.2 Drawing materials.
1.3 Standardization (Types of lines, Writing, Scale, Drawing and folding format, Title block, etc.).

Chapter 2: Elements of descriptive geometry 6 Weeks
2.1 Notions of descriptive geometry.
2.2 Orthogonal projections of a point - Epure of a point - Orthogonal projections of a line (any and specific) - Epure of a line - Traces of a line - Projections of a plane (any and specific position) - Traces of a plane.
2.3 Views: Choice and arrangement of views - Dimensioning - Slope and conicity - Determination of the third view from two given views.
2.4 Execution method of a drawing (layout, 45° line, etc.)
Application exercises and evaluation (PW)

Chapter 3: Perspectives 2 Weeks
Different types of perspectives (definition and purpose).
Application exercises and evaluation (PW).

Chapter 4: Sections and cuts 2 Weeks
4.1 Cuts, standardized representation rules (hatching).
4.2 Projections and sections of simple solids (Projections and sections of a cylinder, prism, pyramid, cone, sphere, etc.).
4.3 Half-section, partial sections, broken sections, sections, etc.
4.4 Technical vocabulary (terminology of machined forms, profiles, piping, etc.).
Application exercises and evaluation (PW).

Chapter 5: Dimensioning 2 Weeks
5.1 General principles.
5.2 Dimensioning, tolerance, and fit.
Application exercises and evaluation (PW).

Chapter 6: Notions on definition and assembly drawings and nomenclature. 1 Week Application exercises and evaluation (PW).

Assessment method : Continuous assessment : 100 %.

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

1. Guide du dessinateur industriel Chevalier A. Edition Hachette Technique;
2. Le dessin technique 1er partie géométrie descriptive Felliachi d. et Bensaada s. Edition OPU Alger;
3. Le dessin technique 2er partie le dessin industriel Felliachi d. et bensaada s. Edition OPU Alger;
4. Premières notions de dessin technique Andre Ricordeau Edition Andre Casteilla;
5. **المدخل إلى الرسم الصناعي** ماجد عبد الحميد ديوان المطبوعات الجامعية الجزائر
6. **مبادئ أساسية في الرسم الصناعي** عمر أبو حنيك المعهد الجزائري للتقييس والملكية الصناعية طبع الحميد ديوان المطبوعات الجامعية الجزائر

Recommandation : Une grande partie des PW doivent être sous forme de travail personnel à domicile.

Semester: 3
Course unit: UEM 2.1
Subject 4: PW Waves and Vibrations
SHV: 15h00 (PW: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives

The objectives of this program are to introduce students to the practical application of their knowledge on mechanical vibrations phenomena limited to low-amplitude oscillations for one or two degrees of freedom, as well as the propagation of mechanical waves.

Recommended prior knowledge

Waves and vibrations, Mathematics 2, Physics 1, Physics 2.

Content of the course :

PW.1 Mass-spring system
PW.2 Simple pendulum
PW.3 Torsion pendulum
PW.4 Oscillating electrical circuit in free and forced regimes
PW.5 Coupled pendulums
PW.6 Transverse oscillations in vibrating strings
PW.7 Hoffmann's pulley with groove
PW.8 Electromechanical systems (Electrodynamic loudspeaker)
PW.9 Pohl's pendulum
PW.10 Propagation of longitudinal waves in a fluid.

Note: It is recommended to choose at least 5 PW out of the 10 proposed.

Assessment method :

Continuous assessment : 100 %.

Bibliographical references:

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

Semester: 3
Course unit: UED 2.1
Subject 1: Basic Technology
SHV: 22h30 (Lectures: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

This course will allow students to acquire knowledge about the processes for obtaining and manufacturing parts, as well as techniques for their assembly.

Recommended prior knowledge

Content of the course

Chapter 1: Materials 3 Weeks
1.1 Metals and alloys and their designations
1.2 Plastics (polymers)
1.3 Composite materials
1.4 Other materials

Chapter 2: Processes for obtaining parts without material removal 4 Weeks
2.1 Molding, forging, stamping, rolling, drawing, extrusion, etc.
2.2 Cutting, bending, and stamping, etc.
2.3 Sintering and powder metallurgy
2.4 Profiles and pipes (steel, aluminum);
- Workshop visits.

Chapter 3: Processes for obtaining parts by material removal 4 Weeks
Turning, milling, drilling, fitting, etc.

Workshop visits and demonstrations.
Chapter 4: Assembly techniques 4 Weeks

Bolting, riveting, welding, etc.

Assessment method : Examen final: 100 %.

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

- Manuel de technologie mécanique, Guillaume SABATIER, et al Ed. Dunod.
- Memotech : productique matériaux et usinage BARLIER C. Ed. Casteilla
- Sciences industrielles MILLET N. ed. Casteilla
- Memotech : Technologies industrielles BAUR D. et al , Ed. Casteilla
- Métrologie dimensionnelle CHEVALIER A. Ed. Delagrave
- Perçage , fraisage JOLYS R et LABELL R. Ed. Delagrave
- Guide des fabrications mécaniques PADELLA P. Ed. Dunod
- Technologie : première partie, Bensaada S et FELIACHI d. Ed. OPU Alger
- تكنولوجيا عمليات التصنيع خرير ز و فواز د. ديوان المطبوعات الجامعية الجزائر

Semester: 3
Course unit: UED 2.1
Subject 2: Metrology
SHV: 22h30 (Lectures: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

Translation: Teach the student the precision criteria for manufacturing and assembling parts; Know and be able to choose, in different cases, the methods and means of control and measurement of the dimensions and manufacturing defects of mechanical parts.

Recommended prior knowledge

Trigonometry, optics, and others.

Content of the course

Chapitre 1: Generalities on Metrology 2 Weeks
1.1 Definition of different types of metrology (scientific, legal, industrial);
1.2 Metrological vocabulary and definitions;
1.3 National and international institutions of metrology.

Chapitre 2: The International System of Units (SI) 3 Weeks
2.1 Base quantities and their units of measurement;
2.2 Supplementary quantities;
2.3 Derived quantities.

Chapitre 3: Metrological Characteristics of Measuring Instruments 6 Weeks
3.1 Error and uncertainty (accuracy, precision, repeatability, reproducibility of a measuring instrument);
3.2 Classification of measurement errors:
3.2.1 Raw value;
3.2.2 Systematic error;
3.2.3 Corrected raw value.
3.3 Random errors;
3.3.1 Random errors;
3.3.2 Parasitic errors;
3.3.3 Estimated systematic errors.
3.4 Confidence interval;
3.5 Technical uncertainty;
3.6 Total measurement uncertainty;
3.7 Complete measurement result;
3.8 Identification and interpretation of specifications on a drawing for the purpose of control;
3.9 Basic concepts of gauges and simple measuring instruments.

Chapitre 4: Measurement and Control 4 Weeks
4.1 Direct measurement of lengths and angles (use of ruler, caliper, micrometer, and protractor);
4.2 Indirect measurement (use of comparator, gauge blocks);

4.3 Dimensional control (use of gauges, jaws, etc.);
4.4 Measuring and control machines used in mechanical workshops (use of pneumatic comparator, profile projector, roughness meter).

Assessment method : Examen final: 100 %.

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

- Manuel de technologie mécanique, Guillaume SABATIER, et al Ed. Dunod.
- Memotech : productique matériaux et usinage BARLIER C. Ed. Casteilla
- Sciences industrielles MILLET N. ed. Casteilla
- Memotech : Technologies industrielles BAUR D. et al , Ed. Casteilla
- Métrologie dimensionnelle CHEVALIER A. Ed. Delagrave
- Perçage , fraisage JOLYS R et LABELL R. Ed. Delagrave
- Guide des fabrications mécaniques PADELLA P. Ed. Dunod
- Technologie : première partie, Bensaada S et FELIACHI d. Ed. OPU Alger
- تكنولوجيا عمليات التصنيع خرير ز و فواز د. ديوان المطبوعات الجامعية الجزائر

Semester: 3
Course unit: UET 2.1
Subject 1: Technical English
SHV: 22h30 (Lectures: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

This lecture should enable the student to have a level of language proficiency where they can use scientific documents and discuss their field of study with at least ease and clarity in English.

Recommended prior knowledge

English 1 and English 2.

Content of the course

- Oral comprehension and expression, vocabulary acquisition, grammar... etc.
- Nouns and adjectives, comparatives, following and giving instructions, identifying things.
- Use of numbers, symbols, equations.
- Measurements: Length, surface, volume, power... etc.
- Describing scientific experiments.
- Characteristics of scientific texts.

Assessment method : Examen final: 100 %.

Bibliographical references:

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

Semester: 4
Course unit: UEF2.2.1
Subject 1:Thermodynamics 2
SHV: 45h00 (Lectures: 1h30, DW : 1h30)
Credits:4
Coefficient: 2

Teaching objectives :
To establish the general ideas of thermodynamics and highlight their usefulness in engineering sciences. The objective is to be able to analyze energy systems by using the prerequisites of the first year and to demonstrate what needs to be implemented for the study of water vapor, as well as introduce the study of cycles of thermal and refrigeration machines.

Recommended prior knowledge : Basic Mathematics, Thermodynamics in Semester 2.

Content of the course :

Chapter 1: Review of Basic Concepts of Thermodynamics, 1 week
Review of the three principles of thermodynamics.

Chapter 2: Thermodynamic Properties of Pure Substances, 2 weeks
State diagrams (T-s diagram, p-h diagram, h-s diagram), Thermodynamic tables (tables of properties at saturation, tables of properties of superheated vapor), Equations of state (equation of state of a perfect gas, virial expansions, Van Der Waals equation, equations of state derived from the Van Der Waals equation, reduced variables and Corresponding States Law, Semi-Empirical Equations of State)

Chapter 3: Thermodynamics of Vapors and Moist Air, 2 weeks
Thermodynamics of Vapors (Phase Change of a Pure Substance, Calculation of State Variables, Vapor Quality, Thermodynamic Diagrams and Tables), Moist Air (Characterization of Moist Air, Mollier Diagram, Basic Operations with Moist Air)

Chapter 4: Gas Compression, 2 weeks
Classification of Compression Machines, Isentropic Compression, Polytropic Compression, Piston Compressors, Rotary Volumetric Compressors (Definitions).

Chapter 5: Gas Expansion, 2 weeks
Expansion Machines, Adiabatic Expansion, Non-adiabatic Expansion, Work, Efficiency, and Power Produced, Rotary Volumetric Compressors.

Chapter 6: Power Cycles, 3 weeks
Carnot Cycle, Otto Cycle, Diesel Cycle, Brayton Cycle, Steam Turbines, Rankine Cycle (Reheat Cycle, Regenerative Cycle, Cogeneration)

Chapter 7: Refrigeration Cycles, 3 weeks
Gas refrigeration cycle, Single-stage vapor compression cycle, Refrigerants, Cooling load of a cold room, Two-stage compression cycles, Cascade cycles, Heat pumps.

Assessment method :
Continuous assessment : 40%; Examen: 60%.

Références:
1- Y. CENGEL, M. A. BOLES, 'Thermodynamique, une approche pragmatique', Edition De Boeck, la Chenelière, 2008 . Traduit de l'anglais par M. Lacroix de 'Thermodynamics, an Engineering approach'.
2- Andre HOUBERECHTSLa thermodynamique technique, tomes 1 et 2
3- SONNTAG et VAN WYLEN, 'Thermodynamique et applications', traduit de l'anglais, Fundamentalsof classical thermodynamics' ed. Mc Graw Hill.
4- G. BRUHAT, Revue et augmenté par A. KASTLER, 'Thermodynamique', Edition 6, Masson & Cie.
5- R. Kling, 'Thermodynamique et applications', Edition Technip.
6- M. J. MORAN and HOWARD M. SHAPIRO, Fundamentales of engineering Thermodynamic', J. Wyley & sons editors, 2006.
7- RAPIN-JACQUARDInstallations frigorifiques (technologie), Edition Dunod; 2004
8- J. P. PEREZ 'Thermodynamique: Fondements et applications', Dunod, Paris 2001.

Semester: 4
Course unit: UEF2.2.1
Subject 1:Mechanical Manufacturing
SHV: 22h30 (Lectures: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Provide the student with knowledge of manufacturing techniques for mechanical products in particular.

Recommended prior knowledge:

Basic Technology, Materials Science,

Content of the course :

I- Metal Cutting Theory
1.1 Cutting Materials (1 week)
1.2 Cutting Tool Geometry (1 week)
1.3 Chip Formation Mechanisms (1 week)
1.4 Cutting Forces (1 week)
1.5 Heat Generation (Cutting Temperature)
1.6 Cutting Tool Wear (1 week)
1.7 Methodology for Choosing Cutting Parameters (1 week)

II- Machine Tool Technologies
2.1 Cutting Movements (1 week)
2.2 Machine Tool Characterization (Main Components) (2 weeks)
• Spindle
• Frame
• Slides
2.3 Kinematic Chains (6 weeks)
• Mechanisms for transmitting movements
• Lathes, planers and shapers, drills, milling machines, broaching machines, cylindrical and surface grinders, etc.

Assessment method : Exam : 100%.

Bibliographical references:

1- Techniques de l'ingénieur 2000 B.BM.BT. Janvier 2000 Printed in France by Imprimerie Strasbourgeoise Schiltighein- ISTRAIN
2- Roger Bonetto les ateliers flexibles de production 2ème édition Hermes 1987-Paris
3- G. Levallant ; M.Dessoly ; P.Géodossi ; P.Leroux ; J.C.Moulet ; G.Poulachon ; P.Robert Usinage par enlèvement de copeaux- de la technologie aux applications industrielles Ensam. Edition Eyrolles N° 7211- Juin 2005 Paris

4- Eléments de Fabrication Edition Ellipses. Copyright 1995 Paris
5- Michel Ahby, Choix de Matériaux en Conception Mécanique ; Dunod, 1999
6- Claude Hazard, La Commande Numérique des M O, édition Foucher, Paris 1984
7- Gonzalez, CN par calculateur, édition Foucher Paris 1985.
8- Philippe DEPEYRE, Lectures « Fabrication mécanique », Faculté des Sciences et Technologies,
Université de la Réunion, Année 2004-2005

Semester: 4
Course unit: UEF2.2.1
Subject 1:Mathématique 4
SHV: 45h00 (Lectures: 1h30,DW : 1h30)
Credits: 4
Coefficient:2

Teaching objectives :
This course covers the differential and integral calculus of complex functions of a complex variable. The student must master the different techniques for solving complex variable functions and integrals, including special cases.

Recommended prior knowledge :
Mathematics 1, Mathematics 2 et Mathematics 3.

Content of the course :

Functions of complex variables and Special Functions

Chapter 1: Holomorphic functions. Cauchy-Riemann conditions 3 weeks

Chapter 2: Power series 3 weeks
Radius and domain of convergence. Development in power series. Analytic functions. Laurent series and development in Laurent series.

Chapter 3: Cauchy's theory 3 weeks
Cauchy's theorem; Cauchy's formulas. Singular point of functions, general method for calculating complex integrals.

Chapter 4: Applications 4 weeks
Equivalence between holomorphy and analyticity. Maximum theorem. Liouville's theorem. Rouché's theorem. Residue theorem. Calculation of integrals by the residue method.

Chapter 5: Special Functions 2 weeks
Euler's special functions: Gamma and Beta functions, applications to the calculation of integrals.

Assessment method :
Continuous assessment : 40%; Exam: 60%.

Bibliographical references:
1- Henri Catan, Théorie élémentaire des fonctions analytiques d'une ou plusieurs variables complexes. Editeur Hermann, Paris 1985.
2- Jean Kuntzmann, Variable complexe. Hermann, Paris, 1967.Manuel de premier cycle.
3- Herbert Robbins Richard Courant. What is Mathematics ?, Oxford University Press, Toronto,1978. Ouvrage classique de vulgarisation.
4- Walter Rudin, Analyse réelle et complexe. Masson, Paris, 1975. Manuel de deuxième cycle.

Semester: 4
Course unit: UEF2.2.2
Subject : Numerical Methods
SHV: 45h00 (Lectures: 1h30, DW : 1h30)
Credits: 4
Coefficient: 2

Teaching objectives : : Familiarization with numerical methods and their applications in the field of mathematical calculations.

Recommended prior knowledge : Math1, Math2, Computer Science1 et Computer Science 2

Content of the course :

Chapter 1: Solving nonlinear equations f(x)=0 **(3 weeks)**

1. Introduction to calculation errors and approximations,
2. Introduction to methods for solving nonlinear equations,
3. Bisection method,,
4. Method of successive approximations (fixed point),
5. Method of Newton-Raphson.

Chapter 2: Polynomial Interpolation **(2 weeks)**

1. General introduction,
2. Lagrange polynomial,
3. Newton's polynomials.

Chapter 3 : Approximation of function: **(2 weeks)**

1. Approximation method and quadratic mean..
2. Orthogonal or pseudo-Orthogonal systems. Approximation by orthogonal polynomials
3. Trigonometric approximation

Chapter 4: Numerical Integration **(2 weeks)**

1. General introduction,
2. Trapeze method,,
3. Simpson's method,
4. Quadrature formulas..

Chapter 5: Solving Ordinary Differential Equations **(2 weeks)**
(problem of the initial condition or of Cauchy).

1. General introduction,
2. Euler method,
3. Improved Euler method,,
4. Runge-Kutta method..

Chapter 6: Direct method resolution of systems of linear equations **(2 weeks)**

1. Introduction and definitions,
2. Gauss method and pivoting,
3. LU factorization method,
4. Cholesky factorization method, MM^t,
5. Thomas algorithm (TDMA) for tri-diagonal systems.

Chapter 7: Approximate solving method for linear equations system **(2 weeks)**

1. Introduction and definitions,
2. Jacobi Method,
3. Gauss-Seidel Method,
4. Use of relaxation.

Assessment method :
Continuous assessment : 40%; Exam: 60%.

Références:

1. BREZINSKI (C.), Introduction à la pratique du calcul numérique. Dunod, Paris (1988).
2. G. Allaire et S.M. Kaber, 2002. Algèbre linéaire numérique. Ellipses.
3. G. Allaire et S.M. Kaber, 2002. Introduction à Scilab. Exercices pratiques corrigés d'algèbre linéaire. Ellipses.
4. G. Christol, A. Cot et C.-M. Marle, 1996. Calcul différentiel. Ellipses.
5. M. Crouzeix et A.-L. Mignot, 1983. Analyse numérique des équations différentielles. Masson.
6. S. Delabrière et M. Postel, 2004. Méthodes d'approximation. Équations différentielles. Applications Scilab. Ellipses.
7. J.-P. Demailly, 1996. Analyse numérique et équations différentielles. Presses Universitaires de Grenoble,1996.
8. E. Hairer, S. P. Norsett et G. Wanner, 1993. Solving Ordinary Differential Equations , Springer.
9. CIARLET (P.G.). Introduction à l'analyse numérique matricielle et à l'optimisation. Masson, Paris (1982).

Semester: 4
Course unit: UEF2.2.3
Subject 1:Strength of Materials
SHV: 45h00 (Lectures: 1h30, DW : 1h30)
Credits: 4
Coefficient: 2

Teaching objectives :
This lecture is about the calculation methods for the strength of construction elements and determining the variations in shape and dimensions (deformations) of the elements under the action of loads.

Recommended prior knowledge :
Analysis of Functions ; Classical Mechanics.

Content of the course :

Chapter 1: INTRODUCTION AND GENERALITIES (2 weeks)
1.1 Objectives and assumptions of strength of materials 1.2 Classification of solids (beam, plate, shell) 1.3 Different types of loads 1.4 Connections (supports, fixed supports, hinges) 1.5 General equilibrium principle - Equilibrium equations 1.6 Cutting principles - Reduction elements 1.7 Definitions and sign conventions for:
Normal force N,
Shear force T,
Bending moment M
Chapter 2: TENSION AND COMPRESSION (3 weeks)
2.1 Definitions 2.2 Normal stress of tension and compression 2.3 Elastic deformation in tension/compression 2.4 Tension/compression resistance condition
Chapter 3: SHEAR (2 weeks)
3.1 Definitions 3.2 Simple shear - pure shear 3.3 Shear stress 3.4 Elastic deformation in shear 3.5 Shear resistance condition
Chapter 4: GEOMETRIC CHARACTERISTICS OF CROSS-SECTIONS (3 weeks)
4.1 Static moments of a cross-section 4.2 Moments of inertia of a cross-section 4.3 Formulas for transforming moments of inertia
Chapter 5: TORSION (2 weeks)
5.1 Definitions 5.2 Tangential or sliding stress 5.3 Elastic deformation in torsion 5.4 Torsion resistance condition
Chapter 6: PLANE BENDING (3 weeks)
6.1 Definitions and assumptions 6.2 Shear forces, bending moments 6.3 Shear force and bending moment diagrams 6.4 Relationship between bending moment and shear force 6.5 Deflection of a beam under simple bending (sagging) 6.6 Calculation of stresses and dimensioning.

Assessment method :
Continuous assessment : 40%; Exam: 60%.

Références:

- Mécanique à l'usage des ingénieurs – statique. Ferdinand P. Beer et Russell Johnston, Jr.,McGraw-Hill, 1981.
- Résistance des matériaux, P. STEPINE, Editions MIR ; Moscou, 1986.

- Résistance des matériaux 1, William A. Nash, McGraw-Hill, 1974.
- Résistance des matériaux, S. Timoshenko, Dunod, 1986

Semester: 4
Course unit: UEM2.2
Subject 1:Computer-Aided Design
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives :
This course will enable students to acquire the principles of representing parts in industrial drawing. Furthermore, this subject will allow the student to represent and read plans.

Recommended prior knowledge : Technical Drawing..

Content of the course :

PRESENTATION OF THE CHOSEN SOFTWARE (4 weeks)
(SolidWorks, Autocad, Catia, Inventor, etc.) 1.1 Introduction and history of CAD software; 1.2 Configuration of the chosen software (interface, shortcut bar, options, etc.); 1.3 Reference elements of the software (software aids, tutorials, etc.); 1.4 Saving files (part file, assembly file, drawing file, backup procedure for submission to the teacher); 1.5 Communication and interdependence between files.
SKETCHING NOTIONS (3 weeks)
2.1 Sketching tools (point, line segment, arc, circle, ellipse, polygon, etc.); 2.2 Sketch relations (horizontal, vertical, equal, parallel, collinear, fixed, etc.); 2.3 Sketch dimensioning and geometric constraints.
3D MODELING (3 weeks)
3.1 Notions of planes (front plane, right plane and top plane); 3.2 Basic functions (extrusion, removal of material, revolution): 3.4 Display functions (zoom, multiple views, multiple windows, etc.): 3.5 Modification tools (Erase, Offset, Copy, Mirror, Adjust, Extend, Move): 3.6 Creation of a cross-sectional view of the model.
DRAWING OF THE 3D MODEL (3 weeks)
4.1 Editing the drawing and the title block: 4.2 Choice of views and drawing arrangement: 4.3 Embellishments and object properties (Hatching, dimensioning, text, tables, etc...
ASSEMBLIES (2 weeks)
5.1 Assembly constraints (parallel, coincidence, coaxial, fixed, etc.): 5.2 Preparation of assembly drawings: 5.3 Preparation of assembly drawings and parts list:
Exploded view.

Assessment method :
Continuous assessment : 100%.

Références:

- Solidworks bible 2013 Matt Lombard, Edition Wiley,
- Dessin technique, Saint-Laurent, GIESECKE, Frederick E. Éditions du renouveau pédagogique Inc., 1982.
- Exercices de dessins de pièces et d'assemblages mécaniques avec le logiciel SolidWorks, Jean-Louis Berthéol, François Mendes,
- La CAO accessible à tous avec SolidWorks : de la création à la réalisation tome1 Pascal Rétif,
- Guide du dessinateur industriel, Chevalier A, Edition Hachette Technique,

Semester: 4
Course unit: UEM2.2
Subject 2:PW Fluid Mechanics
SHV: 22h30 (PW: 1h30)
Credits:2
Coefficient: 1

Teaching objectives :
This course focuses on the practical application of the knowledge in the subject of fluid mechanics taught in the third semester.

Recommended prior knowledge :
Lectureses : Fluid Mechanics et Physics 1.
Content of the course :

- Viscosimeter
- Determination of linear and singular pressure losses
- Flow rate measurement
- Water hammer and mass oscillations
- Verification of Bernoulli's theorem
- Jet impact
- Flow through an orifice
- Visualization of flows around an obstacle
- Determination of Reynolds number: laminar and turbulent flow

Assessment method :
Continuous assessment : 100%.

Semester: 4
Course unit: UEM2.2
Subject 3:PW Numerical Methods
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives :
Programming of various numerical methods for their applications in mathematical computations using a scientific programming language (Matlab, Scilab...).
Recommended prior knowledge : Numerical Method, Computer Science 2, and Computer Science 3.

Content of the course :

Nonlinear equation solving (3 weeks)
1.1 Bisection method 1.2 Fixed-point method 1.3 Newton-Raphson method
Interpolation and approximation (3 weeks)
2.1 Newton interpolation 2.2 Chebyshev approximation
Numerical integration (3 weeks)
3.1 Rectangle method 3.2 Trapezoidal method 3.3 Simpson's method
Differential equations (2 weeks)
4.1 Euler's method 4.2 Runge-Kutta methods
Linear equation systems (4 weeks)
5.1 Gauss-Jordan method 5.2 Crout decomposition and LU factorization 5.3 Jacobi method
5.4 Gauss-Seidel method

Assessment method :
Continuous assessment : 100%.

Références :

1. Algorithmique et calcul numérique : travaux pratiques résolus et programmation avec les logiciels Scilab et Python / José Ouin, . - Paris : Ellipses, 2013 . - 189 p.
2. Mathématiques avec Scilab : guide de calcul programmation représentations graphiques ; conforme au nouveau programme MPSI / Bouchaib Radi, ; Abdelkhalak El Hami . - Paris : Ellipses, 2015 . - 180 p.

Méthodes numériques appliquées : pour le scientifique et l'ingénieur / Jean-Philippe Grivet, . - Paris : EDP sciences, 2009 . - 371 p

Semester: 4
Course unit: UEM2.2
Subject 4:PW Strength of Materials
SHV: 15h00 (PW: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives :
Apply the various loads studied in the module on mechanics of materials and determine the material characteristics based on simple mechanical tests.

Recommended prior knowledge : Strength of materials; Materials Science.

Content of the course :

PW N°1 : Tensile-compression tests
PW N°2: Torsion test
PW N°3: Simple bending test
PW N°4: Resilience test
PW N°5: Hardness test

Assessment method :
Continuous assessment : 100%.

Semester: 4
Course unit: UEM2.2
Subject 5:PW Mechanical Manufacturing
SHV: 22h30 (PW: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives :
Apply the different machining processes.

Recommended prior knowledge :
Mechanical Manufacturing Lectures; Technical Drawing.

Content of the course :

PW n° 1: Turning of a cylindrical piece with 2 diameters using facing and turning operations

Preparation of the rough and final drawings.
Determination of cutting speeds and development of the machining process for the piece.
Preparation of tools, machine and measuring instruments.
Positioning, clamping of the rough piece, machine setup and adjustment.
Execution of the operations and the piece.

PW n° 2: Milling and drilling of a prismatic piece mainly using milling and drilling phases.
Definition of the shape, dimensions, tolerances and surface conditions of the piece (final drawing).
Preparation of the rough drawing.
Determination of cutting speeds and development of the machining process for the piece (without grinding phase).
Cutting of the rough piece.
Preparation of tools, machine(s) and measuring instruments.
Positioning, clamping of the rough piece, machine setup and adjustment.
Execution of the operations and the piece.

PW n° 3: Flat grinding and examination of surface conditions (using the piece from PW n° 2)
Analysis of the rough and final drawings from PW n° 2.
Determination of grinding speeds and development of the complete machining process for the piece (including grinding phase).
Preparation of tools, machine and measuring instruments for surface condition (roughness) control.
Positioning, clamping of the rough piece, machine setup and adjustment.
Execution of the grinding phase and surface condition control.

PW n° 4: Welding
Preparation of the parts to be assembled.
Choice of filler metal.
Execution of the welding bead.

Cleaning and inspection.

Assessment method :
Continuous assessment : 100%.

Semester: 4
Course unit: UED2.2
Subject 1:Industrial Electricity
SHV: 22h30 (Lectures: 1h30)
Credits:1
Coefficient: 1

Teaching objectives :
The objective of the program is to provide Mechanical Engineering students with a set of essential and necessary knowledge for understanding the physics of most electrical phenomena.

Recommended prior knowledge :
The fundamental teachings of physical sciences acquired in the common core of science and technology.

Content of the course :

Chapter 1 - Electrical Circuits (4 weeks)
1.1 Introduction
1.2 Current and voltage in electrical circuits
1.3 Resistances and equivalent circuit
1.4 Work and power
1.5 Single-phase and three-phase electrical circuits

Chapter 2 - Magnetic Circuits (3 weeks)
2.1 Magnetism and electricity
2.2 Fundamental laws
2.3 Materials and magnetic circuits

Chapter 3 - Transformers (2 weeks)
3.1 Description
3.2 Equivalent circuits
3.3 Measurement transformers
3.4 Special transformers

Chapter 4 - Electrical Machines (3 weeks)
4.1 Direct current machines (shunt, separate, series excitation)
4.2 Synchronous machines
4.3 Induction machines
4.4 Special machines
4.5 Connection of three-phase motors

Chapter 5 - Electrical Measurements (3 weeks)
5.1 Measurement in physics
5.2 Measurement quality - errors
5.3 Structure of digital display devices
5.4 Measurement of currents and voltages
5.5 Measurement of power and energy
5.6 Wiring diagrams of an electrical installation - Calculation of wire section.

Assessment method :
Exam: 100%.

Références:

- Exercices et problèmes d'électrotechniques notions de base, réseaux et machines électriques ; Luc Lasne ; édition Dunod 2011.
- Electrotechnique : modélisation et simulation des machines électriques ; Rachid Abdessemed ; édition Ellipse 2011.
- Circuits électriques : régime continu, sinusoïdal et impulsionnel, Jean-Paul Bancarel , édition Ellipse 2001.
- Analyse des circuits électriques, Charle K. Alexander et Matthew Sadiku ; édition de boeck. 2012.

Semester: 4
Course unit: UED2.2
Subject 2: Materials Science
SHV: 22h30 (Lectures: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives :
This subject allows the student to learn about the classification of materials as well as the basic concepts of crystallography, equilibrium diagrams, and heat treatments.

Recommended prior knowledge :
The fundamental courses of the first and second semesters.
Content of the course :

Chapter 1: Generalities (03 weeks)
1.1 Classification of materials: 1.1.1 Metals and alloys 1.1.2 Ceramics and glasses 1.1.3 Polymers 1.1.4 Composite materials 1.2 Fields of application 1.3 Structure of materials: amorphous materials and crystalline materials 1.4 Notions of crystallography

Chapter 2: Equilibrium diagrams (04 weeks)
2.1 Crystallization of materials 2.1.1 Principle of crystallization and cooling curves 2.1.2 Crystallization of a pure metal 2.1.3 Crystallization of an alloy 2.2 Equilibrium diagram of two completely miscible metals 2.3 Equilibrium diagram of two partially miscible metals

Chapter 3: Iron-carbon equilibrium diagram (04 weeks)
3.1 Characteristics of iron and carbon 3.2 Iron-carbon equilibrium diagram 3.3 Iron-cementite equilibrium diagram 3.4 Standard designation of steels and cast irons 3.5 Standard designation of other alloy steels

Chapter 4: Heat treatment and thermochemical diffusion treatment (03 weeks)
Heat treatments Annealing Quenching Tempering
Thermochemical treatments Carburizing Nitriding Carbonitriding

Assessment method :
Exam: 100%.

Références:

- Science et génie des matériaux ; De William D. Callister.Dunod.
- Matériaux. T1 Propriétés, applications et conception, Michael F. Ashby, David R. H. Jones Collection: Sciences Sup, Dunod
- Matériaux. T2 Microstructures, mise en œuvre et conception ; Michael F. Ashby, David R. H. Jones Collection: Sciences Sup, Dunod
- Des matériaux, Jean-Marie Dorlot, Jean-Paul Baïlon. Presses internationales Polytechnique.
- Structures et matériaux : L'explication mécanique des formes, James Gordon

Semester:4
Course unit: UET2.2
Subject : Expression, Information, and Communication Techniques
SHV:22h30 (Lectures: 1h30)
Credits:1
Coefficient:1

Teaching objectives:

This course aims to develop the student's skills, both personally and professionally, in the field of communication and expression techniques. It also enables the student to learn about the techniques, tools, and methods used to facilitate communication.

Recommended prior knowledge:

Languages (Arabic; English)

Content of the course:

Chapter 1: Researching, analyzing, and organizing information (2 weeks)
Identifying and using documentary sources, tools and resources, Understanding and analyzing documents, Establishing and updating documentation.

Chapter 2: Improving expression skills (2 weeks)
Taking communication situations into account, Producing written messages, Communicating orally, Producing visual and audiovisual messages, Improving group communication skills.

Chapter 3: Developing autonomy, organization, and communication skills in the context of a project approach (2 weeks)
Situating oneself in a project and communication approach, Anticipating action, Implementing a project: Presentation of a practical work report (Homework).

Chapter 4: ICT - Definition and Evolution (2 weeks)
Definition, Activities using ICT, Mastery of ICT skills, Evolution of ICT, Information and communication services.

Chapter 5: Researching, using, and retrieving information (2 weeks)
Search directories (YAHOO, GOOGLE), Search engines, Query and search language, Retrieval and printing of an HTML page, Retrieval of an image, Downloading a file or software, Reading an HTML file locally, Reading a multimedia file saved on the Web.

Chapter 6: ICT Rights (2 weeks)
Computer crime, Media law, Electronic communications law, E-commerce law, Internet governance, ...

Chapter 7: Securing sensitive information, protecting confidential data, and preserving nuisances (3 weeks)
Backing up important data, "Informatique et Libertés" law, Internet dangers, Computer hacking, Machine protection, Protection against viruses, Protection against cyber threats or online threats (Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Preventing data loss, Spam, Hoaxes, Cryptology, Electronic signature...

Assessment method:

Exam final : 100 %.

Bibliographical references:

(L*ivres et polycopiés, sites internet, etc.)*

1. Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod 2013.
2. Denis Baril, Sirey, Techniques de l'expression écrite et orale, 2008.
3. 3- Matthieu Dubost, Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014.
4. Allegrezza Serge et Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan LDW, 2011. ISBN-10: 0230362923 ; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael et JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492 ; ISBN-13: 9781107668492
6. Baron G.L., et Bruillard E. L'informatique et ses usagers dans l'éducation. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. En ligneChantepie P. et Le Diberder A. Révolution numérique et industries culturelles. Repères. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. Comment le numérique transforme les lieux de savoirs. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. Greenfield David. « The Addictive Properties of Internet Usage ». In Internet Addiction, 133?153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. htPW://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818 ; ISBN 13: 9781599045818
12. Paquelin D. L'appropriation des dispositifs numériques de formation. Du prescrit aux usages. Paris, L'Harmattan, 2009. ISBN-10: 2296085563 ; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge LDW, 2002. ISBN-10: 0415192137 ; ISBN-13: 978-0415192132

Semester : 5
Course unit : UEF 3.1.1
Subject : Analytical mechanics
SHV : 67h00 (Lectures: 3h00, DW: 1h30)
Credits: 6
Coefficient : 3

Teaching objectives:

This subject aims to provide students with the necessary tools to analyze a mechanical problem, choose the most appropriate method of solution based on the nature of the problem, its data, and its unknowns. The course is divided into two parts; the first part deals with solid dynamics using classical mechanics, while the second part deals with analytical mechanics using energy principles in solving mechanical problems.

Recommended prior knowledge:

Classical Mechanics, Physics1, Mathematics

Content of the course :

Part A: Solid mechanics supplements

Chapter 1: Dynamics of the solid (3 weeks)
Translation motion, rotation around a fixed axis, planar motion. Motion of a solid at a fixed point in space, Euler's equation, Euler angles, motion of a solid in space. Central force motions.
Chapter 2: Kinetics elements (1 week)
Inertia tensor, kinetic energy.

Part B: Analytical mechanics

Chapter 3: Fundamental notions (2 weeks)
Mechanical connections and their classifications, mechanical systems and their classifications, connection equation, possible and virtual displacements, degrees of freedom, work of connection forces, generalized coordinates and velocities, coordinate transformation equations.
Chapter 4: Principle of virtual work (1 week)
Chapter 5: D'Alembert's principle (1 week)
Chapter 6: First-order Lagrange equation (1 week)
Chapter 7: Second-order Lagrange equation (3 weeks)
Chapter 8: Hamilton's equation (3 weeks)
Hamilton's formalism, Hamilton's equation, Routh's equation.

Assessment method : Continuous assessment : 40% ; Exam : 60%.

Bibliographical references:

a. S. Targ, *Éléments De Mécanique Rationnelle*, éditions Mir, Moscou.
b. J. Starjinski, *Mécanique rationnelle* , édition Mir, Moscou.
c. V. I. Arnold, *Les méthodes mathématiques de la mécanique classique*, Editions Mir, Moscou.
d. H. Cabannes, *Problèmes de mécanique générale*, Dunod.
e. M. Combarnous, D. Desjardin& C. Bacon, *Mécanique des solides et des systèmes : Lectures et exercices corrigés*, Dunod.
f. W. B. Kibble & F. H. Berkshire, *Classical Mechanics*, 5th Edition, Imperial College Press.
g. G. Kotkine& V. Serbo, Recueil *de problèmes de mécanique classique- réponses et solutions*, éditions Mir, Moscou.
h. Jozef HERING, *Lectures de mécanique, Mécanique analytique*, OPU, Alger, 1993.

Semester : 5
Course unit : UEF 3.1.1
Subject : Mechanical Construction 1
SHV: 45h00 (Lectures: 1h30, DW: 1h30)
Credits: 4
Coefficient : 2

Teaching objectives:

Provide students with scientific and technological training in the field of mechanical engineering and this through knowledge of standard machine elements and parts, used in the construction of mechanical structures, mechanisms and machines, their standardization, mechanical power transmission.

Recommended prior knowledge:

Industrial Drawing, Strength of Materials, mechanical manufacturing processes.

Content of the course :

Chapter 1. Introduction (2 weeks)
General information (Mechanical Construction, Design Study, Safety Factor, Standards, Economy, Reliability).

Chapter 2. Threaded assemblies (3 weeks)
Screws, bolts, dowels, resistance calculation (Shearing, caulking, bending, tightening of a hyperstatic system)

Chapter 3. Non-dismountable assemblies (4 weeks)
Riveting (different types of rivets, sizing calculation etc.)
Welding (Different types of welds, Calculation of welds: butt, lap, joint cover, cylindrical, dynamic load etc.)

Chapter 4. Assembly of parts by force fitting (3 weeks)
Introduction, Advantages, Disadvantages, resistance calculation (axial load, torque).
Mounting by heating the hub, Mounting by cooling the shaft, calculation of the adjustment.

Chapter 5. Elements of obstacles (3 weeks)
Keys, splines and springs (calculation of dimensioning and resistance)

Assessment method : Continuous assessment : 40% ; Exam : 60%.

Bibliographical references:

2. Buchet Jean David Morvan. *Les engrenages* Ed. : Delcourt G. Productions 01/2004
3. Georges Henriot. *Les engrenages* Ed. : Dunod
4. Alain Pouget , Thierry Berthomieu , Yves Boutron, Emmanuel Cuenot. *Structures et mécanismes - Activités de construction mécanique* Ed. Hachette Technique
5. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique*, Tome 1, *Projets-études, composants, normalisation*, AFNOR, NATHAN 2001.
6. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 3, Projets-calculs, dimensionnement, normalisation*, AFNOR, NATHAN 1997.
7. YoudeXiong, Y. Qian, Z. Xiong, D. Picard. *Formulaire de mécanique, Pièces de construction*, EYROLLES, 2007.
8. Jean-Louis FANCHON. *Guide de Mécanique*, NATHAN, 2008.

9. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 1, Principes et Ecoconception*, DUNOD, 2009.
10. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 2, Applications*, DUNOD, 2001.
11. Francis ESNAULT, DUNOD. *Construction mécanique, Transmission de puissance, Tome 3, Transmission de puissance par liens flexibles*, 1999.
12. Bawin, V. et Delforge, C., *Construction mécanique* , Edition originale : G. Thome, Liège, 1986.
13. M. Szwarcman. *Eléments de machines*, édition Lavoisier 1983
14. W. L. Cleghorn. M*echanics of machines*, Oxford University Press, 2008.

Semester : 5
Course unit : UEM 3.1.2
Subject : Strength of Materials 2
SHV : 45h00 (Lectures : 1h30, DW: 1h30)
Credits: 4
Coefficient : 2

Teaching objectives:

This subject is a continuation of Material Resistance taught in the fourth semester. It will cover composite stress, energy methods, and hyperstatic systems.

Recommended prior knowledge:

Mechanics of Materials 1, Materials Science, Mathematics.

Content of the course :

Chapter 1: Planar bending of symmetrical beams - review (2 weeks)
- **Review of bending moment and shear force**
- **Normal stresses in simple bending**
- **Shear stresses in simple bending**

Chapter 2: Displacement of symmetrical beams in planar bending (2 weeks)
- **Displacement of constant section beams**
- **Initial parameter method**
- **Method of moments of areas**
- **Superposition method**

Chapter 3: General theorems of elastic systems (applications) (3 weeks)
- **Elastic deformation energy in tension**
- **Elastic deformation energy in torsion**
- **Elastic deformation energy in shear**
- **Elastic deformation energy in bending**
- **General expression of elastic deformation energy**
- **Castigliano's theorem**
- **Generalized fictitious force method**

Chapter 4: Combined stresses (3 weeks)
- **Generalities**
- **Deflected bending (generalities, stresses, deformations)**
- **Combined bending**
- **Bending-torsion**

Chapter 5: Solution of hyperstatic systems (4 weeks)
- **Generalities (systems of bars, nodes, joints, frames, etc...)**
- **Initial parameter method**
- **Method of superposition of force effects**
- **Method of equations of the 3 moments**
- **Method of forces**

Chapter 6: Examples of dimensioning - Applications (1 week)

Assessment method : Continuous assessment : 40% ; Exam : 60 %.

Bibliographical references:

1. A. Giet ; L. Geminard. *Résistance des matériaux*, Editions Dunod 1986, Paris.
2. S. P. Timoshenko. *Résistance des matériaux*, Editions Dunod ; Paris.
3. M. Albiges, ; A Coin .*Résistance des matériaux*, Editions Eyrolles 1986 ; Paris.
4. Jean-Claude Doubrère. *Résistance des matériaux*, Editions Eyrolles 2013
5. YoudeXiong. *Exercices résolus de résistance des matériaux*, Editions Eyrolles, 2014.
6. Claude Chèze. *Résistance des matériaux - Dimensionnement des structures, Sollicitations simples et composées, flambage, énergie interne, systèmes hyperstatiques*, Ellipses, 2012.

Semester : 5
Course unit : UEF 3.1.2
Subject : Elasticity
SHV: 45h00 (Lectures : 1h30, DW: 1h30)
Credits: 4
Coefficient : 2

Teaching objectives:

This course provides an introduction to the fundamental concepts of elasticity, with a focus on stress and strain tensors and Hooke's laws.

Recommended prior knowledge:

- Algebra
- Differential and integral calculus
- Matrix calculus
- Strength of Materials

Content of the course :

Chapter 1: Introduction, Mathematical Review (3 weeks)
Index notation, Vector calculus, Tensor calculus.
Chapter 2: Stress Tensor (4 weeks)
• Cut, facet, and stress vector
• Cauchy formula, stress tensor
• Equilibrium equations
• Principal stresses and principal directions
• Scalar invariants of the stress tensor
• Spherical and deviatoric tensor
Chapter 3: Strain Tensor (3 weeks)
• Displacement vector
• Strain tensor
• Length and angle transformation
• Principal strains
• Scalar invariants of the strain tensor
• Spherical and deviatoric tensor
Chapter 4: Hooke's Law (Stress-Strain Relationships) (4 weeks)
• Formulation in stresses
• Formulation in strains
• Thermoelastic formulation
Chapter 5: Strength Criteria (1 week)
• Maximum normal stress criterion (Rankine criterion)
• Maximum shear stress criterion (Tresca criterion)
• Von Mises criterion

Assessment method : Continuous assessment : 40 % ; Exam : 60 %.

Bibliographical references:

1. Harry Lass , Vector and Tensor Analysis, McGraw-Hill, 1950
2. A. I. Borisenko and I. E. Tarapov, Vector and Tensor Analysis, Dover, 1979
3. Frank Ayres, Matrices Lectures et Problèmes, Schaum,1983
4. Martin H. Sadd. Elasticity : Theory, applications and Numerics, Elsevier 2005.
5. Yves Debard. Elasticité, Université Lemans, 2006.
6. Guenfoud M., Introduction à la mécanique des milieux continus application à la mécanique des solides, Université de 8 mai 1945 Guelma, 2006.
7. Gabriel Lamé. Leçons sur la théorie mathématique de l'élasticité des corps solides, Editions Jacques Gabay, Paris 2006.
8. Denis Dartus. Elasticitélinéaire, Editions Cépaduès, paris 1995.
9. Jean Coirier. Mécanique des milieux continus, Lectures et exercicescorrigés, Dunod, 2013.

Semester : 5
Course unit : UEM 3.1
Subject : Industrial Drawing
SHV : 45h00 (PW:3h00)
Credits: 4
Coefficient : 2

Teaching objectives:

This course complements the Technical Drawing course of Semester 4, it will enable students to acquire the principles of standardized representation of mechanical parts called industrial drawing. Furthermore, this subject will allow the student to represent and read plans of mechanisms and machines. It also aims to improve the student's graphic imagination in order to master this universal language of communication among technicians, and to prepare them for the proper use of the CAD tool.

Recommended prior knowledge:

Technical Drawing, General Technology, and Conventional Processes in Mechanical Manufacturing.

Content of the course :

Chapter 1: Elementary mechanical functions (3 weeks)

Mechanical connections (elementary connection, connection character, connection mode, connection realization). Centering and orientation function (rotation guidance, translation guidance, functional notation, adjustments, technical specifications (symbolization).

Chapter 2: Reading of drawing (3 weeks)
Sketches, dimensions, kinematic diagrams, assembly drawing, definition drawing, exploded representation.

Chapter 3: Analysis of a drawing (5 weeks)
Assembly of bearings, thrusts, joints, plain bearings, obstacles, gears, lubrication function, sealing, chain of dimensions.

Chapter 4: Application: CAD of a mechanical system (4 weeks)

Realization of different parts
Assembly including the use of the library of elements (bearings, screws, etc.).
Plan drawing (tolerances, functional clearances, adjustments, etc.).

Remarque :

- Les chapitres 1 et 2 constituent la partie technologie mécanique et doit être présentée sous forme de Lectures accompagné d'exemples d'application.

- Le travail personnel de l'étudiant pour cette matière doit se être donné sous forme de mini projet :

    - Réalisation du dessin d'ensemble d'un mécanisme et les différents dessins de définition des pièces le constituant, avec calcul des ajustements et applications de la cotation fonctionnelle.
    - Utilisation de la DAO pour dessiner un ensemble de pièces et réaliser l'assemblage et en fin présenter la mise en plan avec les différents détails (cotation, symboles technologiques … etc.)

Assessment method : Continuous assessment : 100% .

Bibliographical references:

1. Chevalier A. *Guide du dessinateur industriel*, Editions Hachette Technique,
2. Saint-Laurent, GIESECKE, Frederick E. *Dessin technique*, Éditions du renouveau pédagogique Inc., 1982.
3. Jean-Louis Berthéol, François Mendes. *Exercices de dessins de pièces et d'assemblages mécaniques avec le logiciel SolidWorks*, Edition Castilla 2007
4. Lenormand, Foucher. *Mémento de dessin industriel T1: Convention de présentation cotation*, Edition Dunod
5. Heurtematte J. *Aide mémoire de dessin de l'élève dessinateur et du dessinateur industriel,* Delagrave.
6. Norbert M.*Aide-mémoire de l'élève dessinateur*, Casteilla.
7. , J-Louis Franch. *Guide des sciences et technologies industrielle,*. DUNOD
8. Michel Denis. *Le Computer-Aided Design.* Editions Hermes 2008
9. Sites internet du *modeleur volumique SolidWorks* (forum – tutoriaux – exemples)

Semester: 5
Course unit: UEM 3.1
Subject: COMPUTER-AIDED DESIGN AND MANUFACTURING
SHV: 45h00 (PW: 03h00)
Credits: 4
Coefficient: 2

Teaching objectives:

This subject allows the student to become familiar with the use of CAM software on one hand, and to be initiated to CAM and become familiar with computer numerical control machine tools on the other hand.

Recommended prior knowledge:

Technical Drawing, Mechanical Manufacturing, C.A.D.

Content of the course:

CAO section

- Presentation and use of CAO software. **(1 week)**
- Techniques for reconstructing rough surfaces - Bézier curves, poles, NURBS - B-splines: base functions, properties. **(2 weeks)**
- Complex surfaces, curvature concept, connectivity, connection. **(2 weeks)**
- CAO tools for shape design - Design of a parametric 2D system - An example of polyhedral modeling. **(2 weeks)**
- Design of stamped shapes, mold impressions. **(2 weeks)**

FAO section

- Presentation of CN machines (different parts and components). Placing parts on machines. Selection of cutting tools and definition of their geometries. Piece origin setting. **(2 weeks)**
- Turning of a part and analysis of the program generated by the software. **(2 weeks)**
- Milling of a part and analysis of the program generated by the software. **(2 weeks)**

Assessment method: Continuous assessment : 100 %

Bibliographical references:

1. J. W. Oswald & S. F. Krar. *Technology of Machine Tools*, McGraw-Hill, New York, 4e éd. 1989
2. R. Kibbe, J. Neely, R. Meyer et al., *Machine Tool Practices*, Prentice-Hall, New York, 1991
3. J. W. Oswald & S. F. Krar, *Technology of Machine Tools*, McGraw-Hill, New York, 4e éd. 1989

Semester : 5
Course unit : UEM 3.1
Subject :PW Metrology
SHV : 15h00 (PW : 01h00)
Credits: 1
Coefficient : 1

Teaching objectives:

The practical works (PW) in metrology will allow students to become familiar with and manipulate different measurement techniques. They will enable them to learn about direct and indirect reading measuring instruments used in mechanics.

Recommended prior knowledge:

Metrology lectures, Applied Mathematics, Technical Drawing, Mechanical Manufacturing, Computer-Aided Design (CAD).

Content of the course :

PW 1 (in two parts): Calibration of length measuring and control devices (vernier caliper, micrometer, comparator, and depth gauge). Concepts of calibration, errors, and measurement uncertainty.
PW 2: Control of inclinations, angles, and cones.
PW 3: Control of threads and gears.
PW 4: Control of geometric form tolerances: circularity, cylindricity, straightness, flatness, parallelism, eccentricity, etc.
PW 5: Control of roughness and surface condition.
PW 6: Use of special inspection equipment.

Assessment method :

Continuous assessment : 100% .

Bibliographical references:

1. Jean Claude HOCQUET, *métrologie*, EncyclopædiaUniversalis,:htPW://www.universalis.fr/encyclopedie/metrologie/
2. Ammar Grous. *Métrologie appliquée aux sciences et technologies - Volume 1*Hermès - Lavoisier 2009

Semester : 5
Course unit : UED 3.1
Subject : Control and Regulation
SHV : 22h30 (Lectures: 01h30)
Credits: 1
Coefficient : 1

Teaching objectives:

Recognize the main techniques of regulation of mechanical systems and the components used.

Recommended prior knowledge:

Mathematics, Numerical Methods

Content of the course :

Chapter 1: Terminology of control systems (1 week)

Functional diagram of a controlled system. Constituent elements of a functional diagram of a controlled system.

Chapter 2: Laplace transformation (2 weeks)

Definitions and properties.

Chapter 3: Transfer functions (2 weeks)

Algebra of functional diagrams and transfer function of systems.

Chapter 4: Study of a first-order controlled system (3 weeks)

Definition and transfer function. System response to different input signals.

Chapter 5: Study of a second-order controlled system (3 weeks)

Definition and transfer function. System response to different input signals. Representation of the system in the complex plane.

Chapter 6: BODE and Nyquist diagrams of controlled systems (2 weeks)

Chapter 7: Study of stability of controlled systems (2 weeks)

Analytical stability criteria according to Routh and Hurrwitz. Geometric criterion according to Nyquist.

Assessment method : Exam : 100%.

Bibliographical references:

1- Henri Bourles. *Systèmes linéaires de la modélisation à la commande*. Editions Lavoisier 2006, Paris.
2- Jean Marie Flans .*La régulation industrielle*; Hermès 1994 ; Paris.
3- Philippe de Larminat. *Automatique commande des systèmes linéaires.* Editions Hermès 1996 ; Paris
4- Patrick *Prouvost. Automatique – Contrôle et régulation*, EditionDunod 2010.

5- Yves GRANJON. *Automatique* . Edition Dunod 2010
6- Olivier Le Gallo. *Automatique des systèmes mécaniques*. Edition Dunod , 2009
7- Gérard Boujat, Patrick Anaya. *Automatique industrielle*, 2007. Edition Dunod
8- JANET Maurice. *Précis de calcul matriciel et de calcul opérationnel*, Edition Euclide 1982
9- Patrick Prouvost. *Automatique – Contrôle et régulation*. Edition Dunod 2010.

Semester : 5
Course unit : UED 3.1
Subject :Maintenance
SHV : 22h30 (Lectures:01h30)
Credits: 1
Coefficient : 1

Teaching objectives:

Through this course, the student will acquire knowledge about the role of maintenance in the company, its organization, as well as its different functions. They will also be able to perform calculations related to reliability.

Recommended prior knowledge:

Content of the course :

Chapter 1: Generalities of Maintenance (2 weeks)
- **Importance of maintenance in the enterprise**
- **Objectives of maintenance in the enterprise**
- **Maintenance policies in the enterprise**

Chapter 2: Different forms of maintenance (4 weeks)
- **Forms of maintenance action**
- **Maintenance operations**
- **Level of maintenance**
- **Related activities of maintenance**

Chapter 3: Organization of Maintenance (4 weeks)
- **Preparation of maintenance work**
- **Planning of maintenance work**
- **Management of human resources**
- **Study and methods office**

Chapter 4: Equipment Monitoring and Logistics (2 weeks)
- **Knowledge and behavior of equipment**
- **Logistic function**

Chapter 5: Maintenance Reliability (3 weeks)
- **Maintenance-reliability**
- **Reliability indicator parameters**
- **Reliability calculation**
- **Analysis of failure modes and their causes AMDEC**

Assessment method : Exam : 100 %.

Bibliographical references:

1- GODELIER E. *La culture d'entreprise* ,Éditeur : La Découverte - 30/08/2006
2-Boitel D., Hazard C. *Guide de la maintenance,* Edition Elisabeth Ponard Avril 1990.
3- Auberville J. M. *Maintenance industrielle – de l'entretien de base à l'optimisation de la sureté* Edition Ellipses – Juin 2004.
4- Zwingelstein G. *La maintenance basée sur la fiabilité* Edition HERMES, 1996.
5- Vernier J. P. *Fonction maintenance* A 8300 Techniques de l'ingénieur.
6- Bleux J. M., Fanchon J. L. *Maintenance : Systèmes automatisés de production*, Edition Nathan Janvier 2000.
7- FD X60- 000 *Maintenance industrielle : Fonction maintenance,* Normalisation française. Mai 2002.
8- Ridoux M. *AMDEC-Moyen*. Techniques de l'Ingénieur, traité L'entreprise industrielle. AG 4 220.

Semester : 5
Course unit : UET 3.1
Subject : Environment and Sustainable Development
SHV: 22h30 (Lectures: 1h30)
Credits: 1
Coefficient : 1

Teaching objectives:

Make students aware of the relationship between energy, environment and sustainable development and control sources of pollution; reduce them in order to guarantee sustainable development.

Recommended prior knowledge:

Fluid mechanics, fundamental thermodynamics, heat transfers, and environmental characteristics.

Content of the course:

Chapter 1. Introduction to the concept of environment (2 weeks)
Definition of the environment, General definition, Legal definition, Brief history, Man and the environment, How man has modified his environment, Scapegoat demography.

Chapter 2. The notion of sustainable development (2 weeks)
Definition, Brief history, The fundamental principles of sustainable development, The ethical principle, The precautionary principle, The principle of prevention, The objectives of sustainable development, the environmental issues of sustainable development.

Chapter 3. Environment and Natural Resources (4 Weeks)
Introduction, Resources, Water, Air, Fossil fuels (oil, natural gas, coal, etc.), Other energies (solar, wind, hydraulic, geothermal, biomass, etc.), Mineral elements , Biodiversity, Soils, Food resources.

Chapter 4. Substances (4 Weeks)
The different types of pollutants, Regulated pollutants, Organic compounds, Heavy metals, Particles, Chlorofluorocarbons, The effects of different substances on the environment, Greenhouse effect and climate change, Destruction of the ozone layer, Acidification , eutrophication and photochemistry, Acid rain. Ozone peaks; Effects on materials; Effects on ecosystems: forest, fresh water supply, health effects. The different types of transmitters, The Corinair nomenclature.

Chapter 5. Environmental Preservation (3 Weeks)
Introduction of new materials, Reserving oil for noble uses, Improving energy efficiency, Recycling, Economic, legal and regulatory mechanisms for preserving the environment, The role of public authorities in solving environmental problems, The conceivable option of private solutions, Current environmental policies, The polluter-pays principle, Ecological taxation: eco-taxes, The market for tradable emission permits.

Assessment method:

Exam: 100 %.

Bibliographical references:

1- De Jouvenel, B., « Le thème de l'environnement, Analyse et prévision », 10, pp. 517533, 1970.
2- Faucheux S., Noël J-F, « Economie des ressources naturelles et de l'environnement » , Armand Collin, Paris.
3- Reed D. (Ed.), « Ajustement structurel, environnement et développement durable », l'Harmattan, Paris, 1995.

4- Vivien F-.D, « Histoire d'un mot, histoire d'une idée : le développement durable à l'épreuve du temps », Ed. scientifiques et médicales Elsevier ASA, pp. 19-60, 2001.
5- Boutaud, Aurélien, Gondran, Natasha, « L'empreinte écologique », Paris : La Découverte, 2009.
6- Lazzeri, Yvette (Dir.), « préface de Gérard Guillaumin, Développement durable, entreprises et territoires: vers un renouveau des pratiques et des outils », Paris, L'Harmattan, 2008.

Semester : 6
Course unit : UEF 3.2.1
Subject :Mechanical Construction 2
SHV: 67h00 (Lectures: 3h00 , DW:01h30)
Credits: 6
Coefficient : 3

Teaching objectives:

This subject constitutes the continuation of ME1, it is essentially interested in the calculations of dimensioning of the principal transmission elements of movement of the machines (gear, bearings and shafts etc...), as it touches the general technological study of the mechanisms (reducer, gear box, clutch, brake, etc.)

Recommended prior knowledge:

Industrial design, Strength of Materials, mechanical manufacturing processes.
Rational mechanics, Industrial design, Strength of Materials and ME 1

Content of the course :

Chapter 1: Gears (Study of the geometric characteristics of cutting) (3 weeks)
- Cylindrical gear (straight and helical teeth),
- Bevel gear (straight and helical teeth),
- endless screw.

Chapter 2: Introduction to the Dynamic Study of Gears (2 weeks)
- Surface pressure and breaking strength for cylindrical gears (straight and helical teeth)

Chapter 3: Shafts And Axes (3 weeks)
- Calculation of the prior diameter of axes and shafts
- Verification of shafts and axles to fatigue

Chapter 4: Motion transmission (calculation and dimensioning) (3 weeks)
- Bearings and thrust bearings
- Belts and Chains….

Chapter 5: Reducers and Gearboxes (2 weeks)
- Kinematic study of a speed reducer
- Kinematic study of a gearbox
- Notions on Epicyclic Trains

Chapter 6: General concepts on couplings, clutches and brakes (2 weeks)

Assessment method : Continuous assessment : 40 % ; Exam : 60%.

Bibliographical references:

1. Les engrenages (Buchet Jean David Morvan) Ed. :Delcourt G. Productions 01/2004
2. Les engrenages (Georges Henriot) Ed. : Dunod

3. Construction mécanique. Transmission de puissance – volume 3-(F.Esnault) Ed. Dunod
4. Alain Pouget , Thierry Berthomieu , Yves Boutron, Emmanuel Cuenot.*Structures et mécanismes - Activités de construction mécanique*. Ed. Hachette Technique
5. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 1, Projets-études, composants, normalisation* , AFNOR, NATHAN 2001.
6. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 3, Projets-calculs, dimensionnement, normalisation* , AFNOR, NATHAN 1997.
7. YoudeXiong, Y. Qian, Z. Xiong, D. *Formulaire de mécanique, Pièces de construction*,. Picard, EYROLLES, 2007.
8. Jean-Louis FANCHON. *Guide de Mécanique* , NATHAN, 2008.
9. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 1, Principes et Ecoconception*, DUNOD, 2009.
10. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 2, Applications*, , DUNOD, 2001.
11. Francis ESNAULT. *Construction mécanique, Transmission de puissance*, Tome 3, Transmission de puissance par liens flexibles, ,DUNOD, 1999.
12. W. L. Cleghorn. *Mechanics of machines*, , Oxford University Press, 2008.
13. A. CHEVALIER, *Guide du dessinateur industriel*, Edition HACHETTE technique, 1980.
14. Aublinmichel et al.,"systèmes mécaniques : *Théorie et dimensionnement*",Ed. Dunod, 1998
15. Drouin g. Et al.,*"Eléments de machines"*,*Ed.*Ecole polytechnique de montréal, 1986
16. J. E. Shigley, c. R. Mischke, "*Standard handbook of machine design*",Ed. Mc-graw-hill.
17. Richard g. Budynas, j. Keith nisbett, "shigley's mechanical engineering design", ed. Mc-graw-hill.
18. R. C. Juvinall,k. M. Marshek,"*Fundamentals of machines component design*",ed.JohnWiley &Sons.

Semester : 6
Course unit : UEF 3.2.1
Subject :Theory of mechanisms
SHV:45h (Lectures: 1h30 mn , DW: 1h30 mn)
Credits: 4
Coefficient : 2

Teaching objectives:

The content of this course will allow students to undertake an analysis or synthesis study of mechanical systems. At the third-year undergraduate level, three essential parts are to be considered: (i) a mathematical review of the essential mathematical tools necessary for the study of mechanisms (torque, vector product, co-moment, linear systems, etc.). (ii) A good understanding of a mechanical system plan in order to identify equivalence classes, contact graphs, standardized mechanical linkages, minimal schematization, and classification of mechanisms. (iii) Static and kinematic studies of parallel linkages, series linkages, and closed chains. (iv) Introduction to the study of cam motion mechanisms, such as the plotting of the real and theoretical profile of a cam and its space diagram etc.

Recommended prior knowledge:

• Vector analysis, Industrial Drawing, general technology, mechanical manufacturing, and rational mechanics.

• Algebra: Matrix, determinant, linear systems, and matrix operations.

Content of the course :

Chapter 1: Preliminary and Reminders (3 weeks)
• Notion of the torque and its characteristics
• Definitions and assumptions:
Machine. Mechanisms. Kinematic chain. Fixed or frame element. Kinematic link/couple. Planar mechanism. Spherical mechanism. Spatial mechanisms. Examples of mechanisms.
• Usual mechanical linkages:

Chapter 2: Modeling of Mechanisms (2 weeks)
• Graph associated with a mechanical system.
• Kinematic chains and diagrams of a mechanical system.

Chapter 3: Mobility and Hyperstaticity of a Mechanism (4 weeks)
• Definitions: Kinematic and static analysis of parallel linkages
• Kinematic and static analysis of serial linkages
• Kinematic and static analysis of closed chains
• Systematic search for isostatic solutions.

Chapter 4: Kinematic Analysis of Planar Mechanisms (3 weeks)
• Definition of a planar mechanism
• Identification of the parameters of a planar mechanism

• Grashoff's laws for four-bar linkages.
• Analysis of the displacements of a planar mechanism (graphical method, analytical method, case study)

Chapter 5: Introduction to CAD and Synthesis of Mechanisms (2 weeks)
• Design of an isostatic mechanism using a CAD software (SolidWorks)
• Modeling and simulation of a mechanism using CAD software (e.g., SolidWorks, etc.)
• Simulation on the CosmosMotion module

Chapter 6: Notions and Generalities on Cam Mechanisms (1 week)

Assessment method : Continuous assessment : 40% ; Exam : 60%.

Bibliographical references:

1. Marc Rossetto et Pierre Agati. Liaison, Mécanismes et Assemblage. 2ièmeédition,. Collection science Sup. Dunod 2001.
2. Michel Aublin, René Boncompain.Systèmes Mécaniques. Théorie et dimensionnement,. Collection science Sup. Dunod 2005.
3. Marc Rossetto et Pierre Agati.Liaisons et Mécanismes. Dunod 1994
4. PartickBeynet.Sciences industrielle pour l'ingénieur. Ellipse édition Marketing S.A., 2012.
5. ViguenArakelian.Structure et cinématiques des mécanismes, Hermes 1997
6. Artobolovsky I. I. Théorie des mécanismes et des machineEdition Sciences Moscou 1988
7. R. le Borzec et J. Lotterie. Principe de la théorie des Mécanismes, édition DUNOD 1977
8. BOUDET- C. BORTOLUSSI. Présentation des mécanismes Techniques de l'ingénieur- B 600/8600,1 – R. 1980
9. Jean-Louis Fanchon. Guide des sciences et technologies industrielles. Edition DUNOD 2014.
10. HUNT K.H. Kinematicgeometryofmechanisms. EdtClordon Press oxford 1978
11. A. Caignot et al. Sciences industrielles de l'ingénieur MPSI.PCSI.PTSI, édition Vuibert,
12. A. Caignot et al.Sciences industrielles de l'ingénieur MP/MP*. PSI/PSI*.PT/PT*, édition Vuibert,
13. Jean-Dominique Mosser et al. Sciences industrielles de l'ingénieur Tout-En-Un, édition DUNOD,
14. Mécanique, Deuxieme partie (43e leçon. – Cames et 44e leçon. - Excentriques. Bielles à coulisse. Pédales et balanciers) RENE BASQUIN Edition Delagrave 1990
15. Formulaire de mécanique: Transmission de puissance Eyrrols 2006 Youde Xiong
16. تكنولوجيا الرسم الهندسي (الفصل 8: تصميم الكامات) ، فيرث و قاندر ويليجين الناشر ماكراوهيل

Semester : 6
Course unit : UEF 3.2.2
Subject :Heat transfer
SHV: 45h00 (Lectures:01h30, DW: 01h30)
Credits: 4
Coefficient : 2

Teaching objectives:

Evaluate the conducted, convected or radiated flows in different situations. Be able to model a thermal problem and solve it in stationary cases and simple geometries. Be able to make the right choice of materials for any thermal application.

Recommended prior knowledge:

Thermodynamics et Mathematics de L1 et L2.

Content of the course :

Chapter 1: Conduction of Heat

- Introduction to heat transfer and its relation to thermodynamics
- Basic laws of heat transfer
- Fourier's Law
- Thermal conductivity and typical values for common materials, as well as the factors that affect it
- Energy equation, simplifying assumptions, and various forms
- Spatial and initial boundary conditions, including the four linear conditions and when they can be applied
- Solutions to the heat equation in Cartesian, cylindrical, and spherical coordinates for both linear and steady-state conditions
- Stationary conduction with heat sources
- Electrical analogy and the use of series and parallel resistances for composite walls and concentric cylinders
- Fins: Different types of fins, practical importance of fins, equation for longitudinal rectangular fins, calculation of heat lost, efficiency, and thickness optimization

Chapter 2: Heat Transfer by Convection

- Mechanisms of heat transfer by convection and parameters that affect convective heat transfer
- Types of convection, including forced, natural, and mixed, with examples
- Differentiating between laminar and turbulent convection in both forced and natural modes
- Methods for solving convection problems, including dimensional analysis and experiments, integral methods for approximating boundary layer equations, and solving the equations representing convection and analogies with similar phenomena such as mass transfer
- Dimensional analysis combined with experiments, including the Pi theorem and the use of common dimensionless numbers in forced and natural convection such as Reynolds, Prandtl, Grashoff, Rayleigh, Peclet, and Nusselt, as well as explaining their meaning and the use of common correlations with practical examples

Chapter 3: Heat Transfer by Radiation

- Introduction, including the concept of solid angles
- Mechanisms of radiative transfer by surface and volume
- Definitions and general laws (luminance, illuminance, intensity, emittance, etc.)
- Bouguer's Law, Kirchhoff's Law, and Draper's Law
- Blackbody radiation and Planck's Law, including the emitted flux in a spectral band and the Stefan-Boltzmann Law
- Global radiative properties of gray surfaces and their relationships
- Radiative exchange between two infinitely extended parallel planes separated by a transparent medium, including the concept of a screen
- Radiative exchange between two black concave surfaces, including the concept of view factors, reciprocity relationships, the summation rule, superposition rule, symmetry rule, and view factors between infinitely long surfaces, as well as the crossed-string method
- Heat lost by a concave surface
- Radiative exchange between n arbitrary surfaces forming an enclosure, including the enclosure rule for view factors and the use of the radiosity method to evaluate exchanged fluxes
- Electrical analogy in radiative heat transfer

Assessment method : Continuous assessment : 40% ; Exam : 60%.

Bibliographical references:

1. Jean-Luc Battaglia, Andrzej Kusiak, Jean-Rodolphe Puiggali, *Introduction aux transferts thermiques, Lectures et solutions*, Dunod éditeur, Paris 2010.
2. J. F. Sacadura coordonnateur, *Transfert thermiques : Initiation et approfondissement*, Lavoisier 2015.
3. A-M. Bianchi , Y. Fautrelle , J. Etay, *Transferts thermiques*, Presses Polytechniques et Universitaires Romandes 2004
4. Kreith, F.; Boehm, R.F.; et. al., *Heat and Mass Transfer, Mechanical Engineering* Handbook Ed. Frank Kreith, CRC Press LLC, 1999.
5. Bejan and A. Kraus, *Heat Handbook Handbook*, J. Wiley and sons 2003.
6. Y. A. Cengel, Heat transfer, *a practical approach*, Mc Graw Hill, 2002
7. Y. A. Cengel, *Heat and Mass Transfer*, Mc Graw Hill
8. H. D. Baehr and K. Stephan, *Heat and Mass transfer*, 2nd revised edition, Springer Verlag editor, 2006.
9. F. P. Incropera and D. P. Dewitt, *Fundamentals of Heat and Mass transfer,* 6th edition, Wiley editor.
10. J. P. Holman, *Heat Transfer*, 6th edition, Mc Graw Hill editor, 1986.
11. J. H. lienhard IV and J. H. Lienhard V, *Heat Transfer Textbook*, 3rd edition, Phlogiston Press, 2004
12. Chris Long and NaserSayma, *Heat Transfer,*Ventus Publishing APS, 2009
13. Hans Dieter Baehr, Karl Stephan, *Heat and Mass Transfer*, Springer editor, 2006

Semester : 6
Course unit : UEF 3.2.2
Subject :Structural dynamics
SHV: 45h00 (Lectures : 01h30, DW : 01h30)
Credits: 4
Coefficient : 2

Teaching objectives:

Mastery of methods for studying the displacements and stresses induced in a given structure subjected to arbitrary dynamic loading.

Recommended prior knowledge :

Strength of Materials 1, Solving Differential Equations

Content of the course :

Chapter 1: Introduction to Structural Dynamics (2 weeks)

- **Objective of structural dynamics**
- **Characteristics of a dynamic problem**
- **Types of loads**
- **Simple harmonic motion**
- **Vector representation of harmonic motion**

Chapter 2: Forced Vibrations of Single Degree of Freedom Systems (3 weeks)

- **Structure (harmonic excitation, periodic excitation, arbitrary dynamic excitation)**
- **Response of a conservative structure**
- **Response of a damped structure**

Chapter 3: Two-Degree-of-Freedom Vibrations (3 weeks)

- **Free vibrations (notion of natural modes)**
- **Time response of an excited system**

Chapter 4: N-Degree-of-Freedom Systems (4 weeks)

- **Properties of matrices**
- **Calculation of frequencies and modes**
- **Response to excitation**

Chapter 5: Vibration Measurement (2 weeks)

- **Basic principle**
- **Seismography**
- **Accelerometry**
- **Calibration**

Assessment method : Continuous assessment : 40 % ; Exam : 60%.

Bibliographical references:

1- R. Glough, J. Penzien, *Dynamique des structures* Pluralis (1980)
2- M. Lalanne, P. Berthier, J.D.Hagopian, *Mécanique des vibrations linéaires* Masson (1980)
3- S.G.Kelly, *Mechanical Vibrations. Theory and applications*. Cengage learning (2012)
4- Thomas Gmür*Dynamique des Structures - Analyse Modale Numérique*, Presses Polytechniques et Universitaires Romandes,1997
5- Patrick Paultre. *Dynamique des structures*, , Hermès - Lavoisier, 2005,
6- Samikian A. *Analyse et calcul des structures* , Québec, 1984,
7- Studer M.A. et Frey F. *Introduction à l'analyse des structures,* Lausanne, 1997,
8- Clough R. et Penzien J. A. *Dynamics of Structures*, deuxième édition, C. Berkeley, 2004,

Semester : 6
Course unit : UEM 3.2
Subject :End-of-Cycle Project
SHV: 45h00 (PW: 3h00)
Credits: 4
Coefficient : 2

Teaching objectives :

To globally and complementarily assimilate the knowledge from various lectures. To concretely apply the concepts taught during the training. To encourage a sense of autonomy and initiative in the student. To teach them to work collaboratively by fostering intellectual curiosity.

Recommended prior knowledge :

The whole program of the Bachelor's degree.

Content of the course :

The theme of the End-of-Cycle Project must be chosen jointly between the supervising teacher and a student (or a group of students: a pair or even a trio). The subject matter must necessarily be consistent with the objectives of the program and the actual abilities of the student (Bachelor's degree level). It is also preferable for the theme to take into account the social and economic environment of the institution. When the nature of the project requires it, it can be subdivided into several parts.

Note:

During the weeks when students are familiarizing themselves with the purpose and feasibility of their project (bibliographic research, search for necessary software or materials to conduct the project, revision and consolidation of teaching directly related to the subject matter, etc.), the Subject's supervisor must use this face-to-face time to remind students of the essential content of the two Lectures "Writing Methodology" and "Presentation Methodology" covered during the first two semesters of the common core.

At the end of this study, the student must submit a written report in which he or she must explain, in the most explicit manner possible:

- The detailed presentation of the study theme, emphasizing its relevance in its socio-economic environment.
- The means employed: methodological tools, bibliographical references, contacts with professionals, etc.
- The analysis of the results obtained and their comparison with the initial objectives.
- The critique of any observed deviations and the presentation of additional details if necessary.
- The identification of difficulties encountered, highlighting the limits of the work done and the follow-up actions to be taken.

Finally, the student or group of students present their work (in the form of a brief oral presentation or a poster) to their supervising teacher and an examining teacher who may ask questions and thus evaluate the work accomplished on both technical and presentation levels.

Assessment method : Continuous assessment : 100%

Bibliographical references:

Semester : 6
Course unit : UEM 3.2
Subject :Internal Combustion Engine
SHV: 45h00 (Lectures: 01h30 , DW : 01h30)
Credits: 4
Coefficient : 2

Teaching objectives:

Know the operation of the different types of internal combustion engines both thermodynamically and mechanically.

Recommended prior knowledge:

Physics, Thermodynamics

Content of the course :

Chapter 1. Background (3 weeks)
Principle of operation and classification of heat engines.
Internal combustion engine fuels
Chapter 2. Thermodynamics of engine cycles (4 weeks)
The Beau De Rochas Cycle
The diesel cycle
The Sabathé cycle
Real Cycles and Yields
Energy balance
Fuel supply for gasoline engines
Ignition system for gasoline engines
Combustion

Chapter 3. Real cycle of a diesel-type internal combustion engine (3 weeks)
Admission; Compression; Combustion; Relaxation; Exhaust; The parameters indicated; Effective parameters; Construction of the diagram indicated theoretical.
Chapter 4. Dynamics of reciprocating engines (3 weeks)
Crank connecting rod system: Kinematic study – Dynamic study
Distribution system: Kinematic study – Dynamic study
Balancing

Chapter 5. Performance and Characteristics of Reciprocating Engines (2 weeks)
Performance parameters, Standards, Characteristics: Full load - partial loads – universal

Note: It is essential to plan a few practical work sessions on internal combustion engines depending on the availability of the establishment's resources.

Assessment method: Continuous assessment : 40 % ; Exam : 60%.

Bibliographical references:

1. J. B. Heywood, *Internal Combustion Fundamentals*, McGraw Hill Higher Education 1989

2. P. Arquès, *Conception et construction des moteurs alternatifs*, Ellipse 2000
3. J-C. Guibet, Carburants et moteurs, 1997
4. P. Arquès, *Moteurs alternatifs à combustion interne* (Technologie), Masson édition 1987.
5. -FAMIN U.Y., GORBAN A.I., DOBROVOLSKY V.V, LUKIN A.I. et al. *Moteurs marins à combustion interne*. Leningrad:Sudostrojenij, 1989, 344p.
6. Menardon M. *Le moteur à explosion*, Paris, Deboeck ,98
7. Jolivet D. Le *moteur diésel*, Paris Ellipses ,86
8. Benabbassi A. *Les moteurs à combustion interne*, Introduction à la théorie, Alger, OPU. 2002.

Semester : 6
Course unit : UEM 3.2
Subject :PW Heat transfer
SHV: 15h00 (PW: 01h00)
Credits: 1
Coefficient : 1

Teaching objectives:

Consolidate knowledge in heat conduction and convection.

Recommended prior knowledge:

Content of the course :

Plan a few experiments related to heat transfer according to the available resources.

Assessment method : Continuous assessment : 100 % .

Bibliographical references:

Semester : 6
Course unit : UED 3.2
Subject :Hydraulic and Pneumatic Systems
SHV: 22h30 (Lectures: 01h30)
Credits: 1
Coefficient : 1

Teaching objectives:

The objective of the program is to provide students with a set of essential and necessary knowledge for the physical understanding of hydraulic and pneumatic systems.

Recommended prior knowledge :

Knowledge in fluid mechanics and thermodynamics.

Content of the course :

Chapter 1: Introduction and Review (2 weeks)

Hydraulic fluids, different types of hydraulic fluids, mineral oil, synthetic oil, and aqueous products, characteristics of hydraulic fluids. Viscosity, influence of temperature and pressure on viscosity. Flow regime, Reynolds number, pressure drops. Filtration. Air quality: air humidity, air contamination by solid particles, different types of air filters.

Chapter 2: Pumps and Compressors (4 weeks)

Volumetric pumps and compressors, classification, axial piston pumps, radial piston pumps, vane pumps, gear pumps, screw pumps. Hydraulic and pneumatic motors, generalities, motor classification, axial piston motors, radial piston motors, gear motors, vane motors, cam and roller motors.

Chapter 3: Cylinders (2 weeks)

Cylinders, classification, single-acting spring-return cylinder, single-acting cylinder, double-acting single-rod cylinder, double-acting differential cylinder, double-acting double-rod cylinder, telescopic cylinder, rotary cylinder, cylinder stiffness, expression of stiffness, calculation example, end-of-stroke damping, rod buckling.

Chapter 4: Hydraulic Pipelines (3 weeks)

Pipelines, rigid pipelines, materials, dimensions, flexible pipelines. Pressure regulation, direct-acting pressure limiter, indirect-acting pressure limiter, pressure reducer. Flow control, flow limiter, flow regulator, valves. Distributors, accumulators, applications. Study of hydraulic and pneumatic systems.

Chapter 5: Practical Examples (3 weeks)

- **Control of a pneumatic motor**
- **Control of a hydraulic motor with two directions of rotation**

- **Adjustment of the speed of a cylinder**
- **Implementation of a hydraulic circuit**

Chapter 6: Simulation Software (1 week)

Simulation software for hydraulic and pneumatic installations (Automation-Studio-Hydraulique etc...)

Assessment method : Exam100%

Bibliographical references :

1. J. Faisandier :*Mécanismes hydrauliques et électro-hydrauliques.* Ed. Dunod 2006
2. Fawcett. *Applied hydraulics and pneumatics in industry*. Trade and Technical Press LDW , 2009.
3. Gille,DecaulnePelegrin. *Théorie et technique des asservissements* ,Dunod
4. J. Faisandier*Mécanismes hydrauliques et pneumatiques*, Collection: Technique et Ingénierie, Dunod/L'Usine Nouvelle. 2013 - 9ème édition
5. *José Roldanveloria. Aide-mémoire* d'*hydraulique industrielle. Dunod 2004*
6. www.thierry-lequeu.fr/data/99ART147.HTM

Semester : 6
Course unit : UED 3.2
Subject : Non-Metallic Materials
SHV: 22h30 (Lectures: 01h30)
Credits: 1
Coefficient : 1

Teaching objectives:

To introduce students to the science of non-metallic materials by allowing them to acquire knowledge specific to these materials. We will focus in particular on polymer materials, ceramics and composite materials.

Recommended prior knowledge:

Knowledge of the basic sciences acquired in the common core

Content of the course :

Chapter 1: General information on plastics (02 weeks)
Structures and properties, Implementation, Standardization.

Chapter 2: Presentation of polymer materials (03 weeks)

- Nature and structure of polymeric materials
- The macromolecular chain, Thermoplastic and thermosetting polymers
- Elastomers, amorphous polymers and semi-crystalline polymers,
- Properties of polymer materials, Mechanical properties, Physical properties, Thermomechanical tests, Long-term behavior (aging), Combustion.
- Shaping of polymers.
- Polymerization by addition or condensation

Chapter 3: Glass and Ceramics (03 weeks)

- Structures of mineral glasses.
- Types of ceramics and areas of use.
- Manufacture and microstructure of ceramics.
- Manufacture and shaping of glasses.
- Mechanical, electrical, thermal and optical properties.
- Degradation of ceramics.

Chapter 4: Composite materials (04 weeks)

- Association of materials and anisotropy.
- Constituents, properties of constituents.
- Elaboration, shaping and properties of the different families of composites: polymer matrix, metal matrix, ceramic matrix, foams.
- Assembly and machining problem.
- Mechanical tests.
- Specificities of the mechanical behavior of composite materials.

Calculation: homogenization, law of mixtures, law of behavior, breaking criterion.

Assessment method: Exam : 100%.

Bibliographical references:

1. Wilfried Kurz, Jean P. Mercier. *Introduction à la science des matériaux2ième édition*.. 1991
2. Marc Carrega et Coll*Matériaux polymères*. Dunod, 2000
3. Traités des matériaux 14. *Matériaux polymères : propriétés mécaniques et physiques.* Presses polytechnique et universitaire Romandes. 2001
4. Claude Bathias et Coll. *Matériaux composites 2ième édition* . L'usine nouvelle Dunod, 2009

Semester: 6
Course unit : UET 3.2
Subject : Entrepreneurship and Business Management
SHV : 22h30 (Lectures : 1h30)
Credits: 1
Coefficient : 1

Teaching objectives:

- Prepare for professional integration at the end of studies;
- Develop entrepreneurial skills among students;
- Raise awareness among students and familiarize them with the opportunities, challenges, procedures, characteristics, attitudes, and skills required for entrepreneurship;
- Prepare students so that they can one day create their own company or at least better understand their work in an SME.

Recommended prior knowledge:

No particular knowledge, except for proficiency in the language of instruction.

Aims of the course :

To develop skills in analysis, synthesis, teamwork, effective oral and written communication, autonomy, planning and meeting deadlines, responsiveness, and proactivity. To sensitize students to entrepreneurship by providing an overview of useful management knowledge for starting a business.

Content of the course:

Chapter 1 – Operational preparation for employment: (2 weeks)

Writing a cover letter and creating a CV, Job interview skills, Research on career paths in the field, Conducting interviews with professionals in the field, Simulating job interviews.

Chapter 2 – Entrepreneurship and entrepreneurial mindset: (2 weeks)

Entrepreneurship, Businesses around you, Entrepreneurial motivation, Setting goals, Taking risks.

Chapter 3 – The profile of an entrepreneur and the Entrepreneurial profession: (3 weeks)

Qualities of an entrepreneur, Negotiation skills, Active listening, The role of SMEs and PWEs in Algeria, Key success factors when starting a PWE/PME.

Chapter 4 – Finding a good business idea: (2 weeks)

Creativity and innovation, Recognizing and evaluating business opportunities.

Chapter 5 – Launching and running a business: (3 weeks)

Choosing an appropriate market, Choosing the location of the business, Legal forms of the enterprise, Searching for help and funding to start a business, Recruiting staff, Choosing suppliers.

Chapter 6 – Development of the business plan: (3 weeks)

The Business Model and the Business Plan, Realizing the business plan with the Business Model Canvas.

Assessment method : 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.