REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

MINISTERE DE L'ENSEIGNEMENT SUPERIEUR
ET DE LA RECHERCHE SCIENTIFIQUE

Cahier des charges

De reconduction d'une Formation à recrutement national

Master

الجمهورية الجزائرية الـــديمقراطيـــة الـــشعبيـــــة

وزارة التعليـــــم العالـــــي والبحـــــث العلمـــــي

دفتر الشروط

لتجديد تكوين ذات تسجيل وطني

ماستر

Fiche d’organisation semestrielle des enseignements

Semestre 1:

Unités d'enseignement	Matières	Crédits	Coefficient	Volume horaire hebdomadaire			VHS (14-16 semaines)	Autre*	Mode d'évaluation	
	Intitulé			Cours	TD	TP			Contrôle Continu	Examen
UE Fondamentale Code : UEF 11 Crédits : 18 Coefficients : 12	Probability and stochastic processes	6	4	3.0	1.5	0.0	67.5		40%	60%
	Advanced mathematics	6	4	3.0	1.5	0.0	67.5		40%	60%
	Complex variable	6	4	3.0	1.5	0.0	67.5		40%	60%
UE Fondamentale Code : UEM 12 Crédits : 6 Coefficients : 4	Digital control systems	6	4	3.0	1.5	00	67.5		40%	60%
UE Méthodologique Code : UEM 11 Crédits : 6 Coefficients : 4	Digital controllers implementations	3	2	1.5	0	1.5	45		100%	0%
	Introduction to scientific computing with MATLAB	3	2	1.5	0	1.5	45		100%	0%
Total semestre 1		**30**	**20**	**15**	**6**	**3**	**360**			

*Autres travaux supplémentaires

Semestre 2:

Unités d'enseignement	Matières	Crédits	Coefficient	Volume horaire hebdomadaire			VHS (14-16 semaines)	Autre*	Mode d'évaluation	
	Intitulé			Cours	TD	TP			Contrôle Continu	Examen
UE Fondamentale Code : UEF 21 Crédits : 8 Coefficients : 6	Numerical Methods	4	3	3.0	0.0	0.0	45		40%	60%
	Digital Signal Processing	4	3	3.0	0.0	0.0	45		40%	60%
UE Fondamentale Code : UEM 22 Crédits : 11 Coefficients : 8	Industrial Automation	5	4	3.0	0.0	00	45		40%	60%
	Multivariable Control Systems	6	4	3.0	0.0	0.0	45		40%	60%
UE Fondamentale Code : UEM 23 Crédits : 6 Coefficients : 4	Data Structures and Algorithms	6	4	3.0	1.5	0.0	67.5		40%	60%
UE Méthodologique Code : UEM 21 Crédits : 5 Coefficients : 4	Numerical Methods laboartory	1	1	0.0	0.0	1.5	18		100%	0%
	Industrial Automation laboartory	2	1.5	0.0	0.0	3.0	36		100%	0%
	Data Structures and Algorithms laboartory	2	1.5	0.0	0.0	3.0	36		100%	0%
Total semestre 2		**30**	**22**	**15**	**1.5**	**7.5**	**337.5**			

Semestre 3:

Unités d'enseignement	Matières	Crédits	Coefficient	Volume horaire hebdomadaire			VHS (14-16 semaines)	Autre*	Mode d'évaluation	
	Intitulé			Cours	TD	TP			Contrôle Continu	Examen
UE Fondamentale Code : UEF 31 Crédits : 19 Coefficients : 12	Optimal control Systems	6	4	3.0	1.5	0.0	67.5		40%	60%
	Nonlinear Systems and control	6	4	3.0	1.5	0.0	67.5		40%	60%
	System Identification	7	4	3.0	0.0	1.5	67.5		40%	60%
UE Fondamentale Code : UEF 32 Crédits : 6 Coefficients : 4	Industrial instrumentation	6	4	3.0	0.0	00	45.0		40%	60%
UE Méthodologique Code : UEM 31 Crédits : 2 Coefficients : 1.5	Industrial instrumentation laboartory	2	1.5	0.0	0.0	3.0	36.0		100%	0%
UE Decouverte Code : UED 31 Crédits : 3 Coefficients : 1.5	Introduction to fault detection and isolation	3	1.5	1.5	0	0.0	22.5		40%	0%
Total semestre 3		**30**	**19**	**13.5**	**3.0**	**4.5**	**306**			

*Autres travaux supplémentaires

4- Semestre 4 :

	VHS	Coeff	Crédits
Project de fin d'Etudes	**560**	**16**	**24**
Communication skills (UET)	40	2	3
Project Management (UET)	40	2	3
Total Semestre 4	640	20	30

En plus du travail personnel, le Projet de Fin d'Etudes peut renfermer un stage en entreprise et/ou la participation à des séminaires. Il est sanctionné par un mémoire et une soutenance.

Programme détaillé par matière

(1 fiche détaillée par matière)

Semestre : 01
UE : UEF 11
Matière : Probability and Stochastic processes

Objectifs de l'enseignement

The objective is to present an introduction to the theory of probability and random processes, and introduce basic concepts and topics useful to the solution of engineering problems.

Connaissances préalables recommandées
Basic single and multi-variable calculus

Contenu de la matière :

1. **Introduction** (probability, conditional probability, independence,…)
2. **Random variable** (distribution function, density function, moments, special distributions)
3. **Several random variables**
4. **Random processes** (continuous/discrete processes, stationarity, ergodicity, process parameters)
5. **Correlation functions** (autocorrelation function, cross-correlation functions, correlation matrices)
6. **Spectral density** (relation to Fourier transform, properties, relation to autocorrelation functions, cross-spectral density, White noise)
7. **Response of linear systems to random inputs** (mean mean square value, autocorrelation of system output, cross-correlation input/output, Frequency-domain analysis, cross-spectral densities)
8. **Linear estimation, and Wiener filtering**

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projets)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. A. Papoulis, "*Probability, Random Variables and Stochastic Processes*", 3rd Ed, McGraw-Hill, 1991.
2. C.W Helstrom, "*Probability and stochastic processes for engineers*", 2nd Ed, Macmillan, 1991.

Semestre : 01
UE : UEF 11
Matière : Complex variable

Objectifs de l'enseignement.

The objective of this course is to introduce the student to basic complex variable function analysis, namely to provide the necessary tools to deal with the analysis of analytic functions.

Connaissances préalables recommandées.

A basic course in analysis (single variable calculus)

Contenu de la matière :

1- Algebra of complex variables
2- Function of a complex variable
3- Analytic functions
4- Power series
5- Residues theorem and its applications.
6- Integrals
7- Conformal mappings

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. Ahlfors, Lars V. *Complex Analysis : An introduction to the Theory of Analytic functions of One complex variable.* 3d Ed. Nex York, McGraw-Hill, 1979.
2. Caratheodory, Constantin. *Theory of functions of a complex variable.* Vol.2 , NY, Chelsea, 1960.

Semestre : 01
UE : UEF 11
Matière : Advanced Mathematics

Objectifs de l'enseignement :
To develop, deepen and extend the concepts and tools acquired in previous linear algebra courses to solve engineering problems.

Connaissances préalables recommandées :
A course in calculus
A course in linear Algebra

Contenu de la matière :

1- **Review of vector spaces and linear mappings**
2- **Orthogonality.**
3- **Positive definiteness**
4- **Computations with matrices** (norm, condition number, eigenpairs, linear equations, least squares problem,…)
5- **Matrix decompositions**
6- **Singular Value decomposition and the Moore-Penrose inverse**
7- **Systems of linear differential equations**

Mode d'évaluation : contrôle continu (interrogations, devoirs)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1- Gilbert Strang, *Linear Algebra and its Applications*
2- Steven Roman, *Advanced Linear Algebra*
3- R.L. Finney, D.R. Ostberg, R.G. Kuller, *Elementary Differential Equations with Linear Algebra*

Semestre : 01
UE : UEF 12
Matière : Digital control Systems

Objectifs de l'enseignement :

Provide the student with basic tools for the analysis and design of discrete-time linear control systems. This course can be seen as the extension of continuous-time (linear) control systems tools to the discrete-time case.

Connaissances préalables recommandées :
A course in discrete-time linear systems(linear systems II)
A course in linear (continuous-time) control systems
Contenu de la matière :

1- **Introduction**: Sampling processes, Simplified digital control systems..
2- **Z-domain analysis**: review of the Z-transform, z-transform of impulse sampled signals, frequency response of zero-order hold, pulse transfer function of closed loop systems, PID controller, direct, standard, series and parallel programming, mapping between s and z-planes, stability analysis in the z-domain.
3- **Design of discrete-time control systems:** discrete-time equivalents of continuous time filters, backward difference, step and impulse invariance, bilinear transformation, matched pole-zero mapping, transient response and steady-state error analysis, root locus, deadbeat response.
4- **Frequency response methods:** discrete-time LTI system response to a sinusoidal input, bilinear transformation in the W-plane, the Bode method.
5- **State-space methods:** state-space equations, partial fractions expansion methods, solution of discrete state-space equations, discretization of continuous-time systems, PTF matrix, controllability, observability, pole placement through state feedback, and observer feedback, Ackerman formula, servo-systems

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen
Références *(Livres et polycopiés, sites internet, etc).*

1- H. Ogata, *Discrete-Time control systems, 2nd* Ed, Prentice Hall, 1995.
2- G.F. Franklin, J.D. Powell, M. Workman, *Digital control of dynamic systems,* 3rd Ed, Pearson Educations, 2005.

Semestre : 01
UE : UEM 11
Matière : Digital controllers implementations

Objectifs de l'enseignement :

A digital control system with I/O interface is widely applied in industry, Engineering textbook do not address thoroughly their practical implementation due to the limited knowledge introduced by real-time requirement. This laboratory course addresses the practical aspects of the implementation of common digital controllers (PID, state and observer-feedback) on digital computers.

Connaissances préalables recommandées :
A course in digital systems is required; additionally this course is to be taken along or after the digital control systems course
Contenu de la matière :

1- **Introduction**
2- **Embedded systems basics**
3- **Real-time systems basics**
4- **Software prototyping** (simulink, labview…)
5- **I/O interfaces** (ADC, DAC, delays, sensors and actuator interfacing)
6- **PID controller implementations** (derivative noise, integral windup)
7- **State-feedback and observer feedback implementations**

Mode d'évaluation : control continu (laboratoires et mini-projet)

Références *(Livres et polycopiés, sites internet, etc).*

1- J. Ledin, "Embedded Control Systems in C/C++: An Introduction for Software Developers Using MATLAB", CMP books, 2003.
2- T. Wescott*, "Applied Control Theory for Embedded Systems",* Newnes, 2006.

Semestre : 01
UE : UEM 11
Matière : : Introduction to scientific computing with Matlab

Objectifs de l'enseignement
To give students fluency in MATLAB, one of the de-facto standards for scientific computing software. The content in oriented toward control engineering related computations.

Connaissances préalables recommandées :
A basic course in computer programming
A course in linear control systems
Contenu de la matière :

1. **Variables, scripts, and operations: elementary operations, operators, functions,** user-defined functions, scripts...
2. **Matrix computations and linear algebra**: arrays, matrices, linear algebra operations...
3. **Visualization and programming**: basic plotting (2d, 3d, charts..), control structures for programming, debugging...
4. **Solving equations and curve fitting**: manipulating polynomials, computing roots, peace-wise interpolation, least-squares interpolation...
5. **Control systems related toolboxes**: using toolboxes for modeling, analysis, and design of control systems (control systems toolbox, symbolic...)
6. **Simulink:** numerical simulation with Simulink, embedding s-function in Simulink, interfacing...
7. **File I/O, building GUIs**: reading, writing input/output data, Programming GUIs, handle graphics...

Mode d'évaluation : control continu (devoirs et/ou mini-projets) + travail personnel

Références *(Livres et polycopiés, sites internet, etc).*

1. C.B. Moler, *Numerical computing with MATLAB*, 2nd Ed, SIM, 2008
2. D.P. O'Leary, *Scientific Computing with Case Studies*, 1st Ed, SIM, 2008
3. A. Quarteroni, F. Saleri, *Scientific Computing with MATLAB and Octave*, 2nd Ed, Springer, 2006.
4. www.mathworks.com/help/techdoc/

Semestre : 02
UE : UEF 21
Matière : Digital Signal Processing

Intitulé de la Matière : Digital Signal Processing

Objectifs de l'enseignement

The fundamental goal of this course is to introduce the student to the analysis, design, and implementation of digital filters to process digital signals.
Connaissances préalables recommandées *Maximum 2 lignes).*

A course in discrete-time signals and systems or linear systems II.

Contenu de la matière :

1- **Review (**sequences, Fourier transform of sequences, Z-transform**)**
2- **The Discrete and fast Fourier transforms: (**definition of the DFT, circular shift and convolution, The FFT, windowing signals..**.)**
3- **Digital filters:** (definitions, classification…)
4- **IIR filter design:** (mapping from analog, direct design using optimization…)
5- **FIR filter design:** (the Window method, frequency sampling method, direct design using optimization…)
6- **Digital filter implementation** (IIR filter structures, FIR filter structures, quantization effect…)
7- **Implementation of digital filters and FFT in software and hardware**

Mode d'évaluation : contrôle continu+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. J. G. Proakis, and D. G. Manolakis, "*Digital Signal Processing, principles, algorithms, and applications* " Prentice-Hall, 3rd edition 1996.
2. 2. A. V. Oppenheim, and R. W. Schafer, " *Discrete-time Signal Processing*'' Prentice Hall; 3rd edition, 2009.

Semestre : 02
UE : UEF 21
Matière : Numerical methods

Objectifs de l'enseignement

Many problems in science, technology, economy etc. can be modeled by mathematical formalisms whose exact solutions are either unknown or are computationally expensive. In these cases, a set of techniques, known collectively as Numerical Methods, produce efficiently approximate solutions to exact solutions.

Connaissances préalables recommandées *Maximum 2 lignes).*
A basic course in calculus
A basic course in computer programming

Contenu de la matière :

1- **Introduction**: Mathematical Preliminaries and Error Analysis.
2- **Solutions of equations of one variable**. (Bisection, Secant, and Newton-Raphson Methods,. Error Analysis)
3- **Solution to a system of equations: (Linear Algebraic Methods** (Direct Methods (Gauss Elimination, Matrix Factorization, Special Matrices, **Iterative Methods** (The Jacobi and Gauss-Siedel Methods, the Conjugate Gradient Method Error Analysis.)
4- **Numerical Integration:** (Quadrature Rules, Romberg Integration, Error Analysis.)
5- Interpolation and Polynomial Approximation (Introduction, Lagrange Polynomials, Spline Interpolation, Error Analysis.)
6- **Numerical Solution of Initial-Value Problems** (Taylor's Methods, Runge-Kutta's Methods, Error Analysis.)
7- **Approximating Eigen-Values** (Introduction, The Power Method, The Householder's Method, The QR Method, Error Analysis.)

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. H.M. Antia. *Numerical Method for Scientists and Engineers*. Mc Graw Hill, 1995.
2. W. Dos Passos. *Numerical Methods, Algorithms and Tools*. Taylor and Francis Group, 2010
3. *Numerical Methods*. Faires & Burns. 2002.

Semestre : 02
UE : UEF 23
Matière : Data Structures and Algorithms

Objectifs de l'enseignement.

Data Structures are the many different ways of storing, organizing data so it can be processed efficiently. As such Data Structures and Algorithms are at the heart of Computer Science and Computer Engineering. At the end of the course, the student will become familiar with Data Structures such Lists, Trees, Sets, Graphs and Digraphs. Moreover, Algorithm Time Complexity is an important feature of the course.

Connaissances préalables recommandées.

The student should have taken a first course in programming such as Programming I offered to the freshmen students at EEGI. Calculus I also is required and finally being familiar with some counting techniques will be helpful.

Contenu de la matière :

1- **Introduction to Design and Analysis of Algorithms**: Definition of an algorithm, Types, Abstract Data Types and Data Structures. Running Time of an Algorithm.
2- **The Abstract Data Type List:** Definition of ADT List. Restricted Lists. Array and Pointer Implementation of ADT List
3- **The Abstract Data Type Tree: B**asic Definitions. Binary Trees. Tree Traversals. BST. Time Complexity of Tree Operations.
4- **The Abstract Data Type Directed Graph:** Basic Definitions. Computer Representation of a Digraph. Digraph Algorithms.
5- **The Abstract Data Type Undirected Graph:** Basic Definitions. Computer Representation of a Graph. Digraph Algorithms.

Mode d'évaluation : Contrôle continu(devoirs et/ou miniprojets) +Examen final
Références *(Livres et polycopiés, sites internet, etc).*

1. Aho, Hopcroft and Ullman. *Data Structures and Algorithms.* Addison-Wesley, 1983
2. Brassard, Bratley. *Fundamentals of Algorithms.* Prentice Hall, 1993
3. Cormen, Liserson, Rivest, Stein. *Introduction to Algorithms*. MIT Press, 2001
4. Horowitz, Sahni, Rajasekaran. *Computer Algorithms.* Computer Science Press,.1998

Semestre : 02
UE : UEF 22
Matière Industrial Automation

Objectifs de l'enseignement.
The course provides fundamentals and advanced understanding of PLC hardware and programming techniques, the interaction between hardware and software in a real-time system, the necessary process to organize and complete a programmable controller project. Large system control such as SCADA and DCS are introduced as well. Upon completing the course, the students will have detailed knowledge of PLC hardware, various PLC programming languages, Industrial busses and Protocols.

Connaissances préalables recommandées.
A course in Electronics (analog and digital), and a course in process control and instrumentation.

Contenu de la matière :

1- **Introduction:** (definitions, types of Industrial Automation,...)
2- **PLC Programming**: (program structure, Structured programming, User & data type…Program blocks, Program execution and scan, Programming styles: LADDER, STL and FBD, structured text)
3- **PLC Instruction Set:** (Basic logic elements, Standard logic instructions, Advanced logic instructions, math and data manipulation instructions)
4- **PLC Input /Outputs** (sensors and actuators and interfacing with PLC**)**
5- **Industrial busses and industrial protocols**
6- **Introduction to industrial plant automation systems** (DCS and SCADA)
7- **Industrial robots and vision integration inn automation systems:**

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1- W. Bolton. "*Programmable Logic Controllers".* Newnes, 5th Ed, 2009.
2- M. Rabiee. "*Programmable Logic Controllers: Hardware and Programming".* Goodheart-Willcox 3rd Ed,2012
3- F. Petruzella, "*Programmable Logic Controllers"*, McGraw-Hill , 3rd Ed, 2004.
4- P. Zhang," *Advanced Industrial Control Technology*", William Andrew, 2010.

Semestre : 02
UE : UEF 22
Matière : Multivariable control systems

Objectifs de l'enseignement :
To presents the main analysis and design tools for the control of linear multivariable control systems described by state-space equations or rational matrices.

Connaissances préalables recommandées :
A basic course in linear algebra
A basic course in linear control systems

Contenu de la matière :

1- **Review of SISO systems canonical forms**: Diagonal/Jordan form, Controller form, observer form, Similarity transformations.
2- **MIMO systems representations**: State-space, I/O, Basic properties…
3- **MIMO systems canonical forms:** General form, Block form, similarity transformations…
4- **State feedback design of MIMO systems:** General form, Block form, Robustness…
5- **Observer design of MIMO systems:** General form, Block form, Robustness…
6- **Elements of matrix polynomial theory:** latent roots, latent vectors, right/left solvents…..
7- **Poles/zeroes of MIMO systems and compensator design**
8- **Minimal realization of MIMO systems**
9- **Model reduction of MIMO systems**

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. S. Skogestad, *Multivariable Feedback Control: Analysis and Design,* 2nd Ed, Wiley-Interscience, 2005.
2. C.T. Chen, *Linear System Theory and Design*, 3rd Ed, Oxford Press, 1998.
3. P. Albertos and A. Sala, *Multivariable Control Systems: An Engineering Approach,* 1st Ed, Springer, 2003.

Semestre : 02
UE : UEM 21
Matière : Industrial automation laboratory

Objectifs de l'enseignement:
This is a companion laboratory course for the industrial automation course: the objective is to put the theoretical concepts into practical Implementations and discuss their potential limitations.

Connaissances préalables recommandées :

This course is to be taken along or after the industrial automation course

Contenu de la matière :

1. **Burglar alarm system**
2. **Sequential control (traffic light, washing machine)**
3. **Conveyor Control**
4. **Elevator control**
5. **Car park / parking controller**
6. **Security door system with keypad**
7. **Step motor control**
8. **Dc motor control (**open loop PWM control, feedback automatic speed control**)**

Mode d'évaluation : Continu + lab. Test

Références *(Livres et polycopiés, sites internet, etc).*
Laboratory handouts available before each Lab session

Semestre : 02
UE : UEM 21
Matière : Data Structures and Algorithms Laboratory

Objectifs de l'enseignement :

This is a companion course to the Data Structures and Algorithms course. Using a Programming Language such as C++ or Java, the student will learn how to implement the variety of different Data Structures and the Operations on these Data both elegantly and efficiently.

Connaissances préalables recommandées :
This course is to be taken along or after the data structures and algorithms course.

Contenu de la matière :

1. Comparing the running times of Algorithms.
2. Array and Pointer Implementation of General Lists.
3. Array and Pointer Implementation of Restricted Lists.
4. Array and Pointer Implementation of Binary Trees.
5. Implementation of Depth First Search for Digraphs.
6. Implementation of Depth First Search for graphs.
7. Implementation of Dijkstra's Algorithm.
8. Implementation of Floyd Warshall's Algorithm.
9. Implementation of Mege Sort, Heap Sort and Bin Sort Algorithm.

Mode d'évaluation : control continu(devoirs et/ou miniprojets) + examen final

Références *(Livres et polycopiés, sites internet, etc).*
Laboratory handouts available before each Lab session

Semestre : 02
UE : UEM 21
Matière : Numerical methods laboratory

Objectifs de l'enseignement :

This is a companion laboratory course for the Numerical methods course; the objective is to put the various methods and algorithms into computer program.

Connaissances préalables recommandées :

This course is to be taken along or after the numerical methods course

Contenu de la matière :

1- **Solving for the Roots of a function.**
2- **Solution of a system of linear equations** (Gauss elimination method, iterative methods..)
3- **Numerical integration** (trapezoidal, Coates, Newton's, Romberg….)
4- **Lagrange polynomial interpolation.**
5- **Spline interpolation**
6- **Numerical solutions of differential equations (**Taylor's methods, Runge-Kutta's methods…)

Mode d'évaluation : Continu + lab. Test

Références *(Livres et polycopiés, sites internet, etc).*
Laboratory handouts available before each Lab session

Semestre : 03
UE : UEF 31
Matière : Optimal control Systems

Objectifs de l'enseignement :
Introduce the problem of optimal control of dynamical systems, as well as the common approaches to solve it.

Connaissances préalables recommandées :
A course in linear algebra
A course in ordinary differential equation
A course in linear control systems
Contenu de la matière :

1- **Introduction**: Problem formulation, performance measures, types of optimal control problems.
2- **Dynamic programming**: optimality principle, recurrence relation of dynamic programming, solution characteristics, discrete-time linear regulator, Hamilton-Jacobi-Bellman equations, continuous time regulator….
3- **Pontryagin's minimum principle:** calculus of variations, necessary conditions for optimal control, linear regulator, pontryagin's minimum principle, …
4- **Applications:** minimum time problems, minimum control effort problem, singular intervals,…
5- **Iterative techniques for optimal control and trajectories:** two point boundary value problems, steepest-decent, gradient projection, quasi-linearization,…

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen
Références *(Livres et polycopiés, sites internet, etc).*

1. D-E. Kirk, *Optimal Control Theory: An Introduction,* Dover Publications, 2004.
2. D-P. Bertsekas*, Dynamic Programming and Optimal Control (2 Vol Set),* 4th Ed, Athena Scientific, 2007.
3. A-E, Bryson and Y-C, Ho, *Applied Optimal Control: Optimization, Estimation and Control,* rev Ed, Taylor & Francis, 1975.
4. H-P, Geering, *Optimal Control with Engineering Applications*, 1st Ed, Springer, 2007

Semestre : 03
UE : UEF 31
Matière : Nonlinear systems and Control

Objectifs de l'enseignement
Give the student the necessary tools to analyze nonlinear dynamical systems, and presents the most relevant techniques for controlling these systems

Connaissances préalables recommandées :
A basic course in linear algebra
A basic course in linear control systems

Contenu de la matière :

1- **Introduction**: Autonomy, Equilibrium points, nonlinear behavior…..
2- **Second order systems and phase plane analysis**: phase portrait, graphical techniques, existence of limit cycles…
3- **Describing function analysis:** optimal-quasi linearization, describing functions of common nonlinearities, describing function analysis of nonlinear systems.
4- **Introduction to Lyaponov theory:** stability concepts, Lyaponov's indirect method, Lyaponov's direct method, application to control design.
5- **Absolute stability:** concepts, Popov's criterion, Circle criterion
6- **Introduction to nonlinear control techniques:** feedback linearization, sliding-mode control, adaptive control.
7- **Application of nonlinear control techniques to robot manipulators:** coupled and decoupled approach.

Mode d'évaluation : contrôle continu (devoirs et/ou miniprojets) +examen final

Références *(Livres et polycopiés, sites internet, etc).*

1. M. Vidyasagar, *Nonlinear Systems Analysis*, 2nd *Ed*, SIAM, 2002.
2. H.K. Khalil, *Nonlinear Systems, 3rd Ed, Prentice Hall, 2001.*
3. S. Sastry, *Nonlinear Systems: Analysis, Stability and Control*, 1st Ed, Springer 1999.
4. J-J. Slotine, W. Li, *Applied Nonlinear Control,* 1st Ed, Prentice Hall, 1991.

Semestre : 03
UE : UEF 31
Matière : System identification

Objectifs de l'enseignement :
To introduce the student to the field of system identification, and explore the different parametric and non-parametric techniques available for linear systems identification.

Connaissances préalables recommandées :
A course in linear Algebra
A course in probability and statistics

Contenu de la matière :

1- **The system identification problem**: Formulation, classification, methodology.
2- **Continuous/Discrete time modeling**: State-space, input/output**.**
3- **Review of stochastic processes:**
4- **Least-squares estimation:** Least-squares theory, statistical properties of least-squares estimators, recursive estimation, Real-time algorithms…
5- **Maximum likelihood method**
6- **Instrumental variable methods**
7- **Nonparametric identification**
8- **Input design**
9- **Model validation**

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1. L. Ljung, *System identification: theory for the user*, 2nd Ed, Prentice Hall, 1999.
2. J.P. Norton*, An Introduction to Identification,* 1st Ed, Dover Publications, 2009.
3. J.N. Juang, *Applied System Identification*, 1st Ed, Prentice Hall, 1993.

Semestre : 03
UE : UEF 32
Matière : Industrial instrumentation

Objectifs de l'enseignement :

This course provides the fundamentals of industrial instrumentation. Topics range from basic measurements, analog and digital information processing, analog and digital transmission, to virtual instrumentation and smart sensors.

Connaissances préalables recommandées :

A basic course in instrumentation and process control (analog).

Contenu de la matière :

1- **Introduction.**
2- **Measurement and instrumentation principles** (instruments characteristics, Measurements characteristics and conditions…)
3- **Measurements sensors** (optical, level , flow, PH sensors, advanced sensors ...)
4- **Signal processing and Measurement systems design:** (analog and digital filtering, Measurement systems characteristics, analysis and design..)
5- **Introduction to data acquisition and virtual instruments:** (Principle and characteristics of data acquisition, data acquisition and virtual instruments…)
6- **Analog and digital information transmission:** (analog voltage and current transmission, V/F and F/V transmission, digital transmissions….)
7- **Industrial communication protocols :**(RS480, Profibus, fieldbus….)
8- **Introduction to smart sensors:**

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1- L. M. Thompson. "Industrial Data Communications", ISA, 4th , 2007
2- B. Mihura, "*LabVIEW for Data Acquisition*",Publisher: Prentice Hall , 2001
3- W. Boyes, "*Instrumentation Reference Book*", Butterworth-Heinemann, 4th Ed, 2009.

Semestre : 03
UE : UEM 31
Matière : Industrial instrumentation laboratory

Objectifs de l'enseignement :
This is a companion laboratory course for the industrial instrumentation course; the objective is to put the theoretical concepts into practical Implementations and discuss their potential limitations.

Connaissances préalables recommandées :

This course is to be taken along or after the industrial instrumentation course

Contenu de la matière :

1- **Using Sensors for physical variables measurement**
2- **Signal processing:** (level and span adjustment, filtering, sample/hold….)
3- **Analog and digital signal transmission:** (current trans. V/F & F/V trans. Digital trans.)
4- **Introduction to data acquisition system:** (signal process, Labview data acquisition).
5- **Virtual instrumentation:** (virtual to visual measurement)
6- **Introduction to smart sensors and data transmission.**

Mode d'évaluation : Continu + lab. Test

Références *(Livres et polycopiés, sites internet, etc).*
Laboratory handouts available before each Lab session

Semestre : 03
UE : UED 31
Matière : Introduction to fault detection and isolation

Objectifs de l'enseignement :
Provides an introduction to the problem of fault detection and isolation as well as some basic solution techniques.

Connaissances préalables recommandées :
A course in probability
Contenu de la matière :

1- **Fundamentals:** Supervision of processes-tasks and terminology, reliability, availability, and maintainability**,** safety, dependability and system integrity.
2- **Fault detection techniques:** Process, faults and signals models. Fault detection with: limit checking, signals models, process-identification methods, Parity equations, State estimation. Fault detection of closed loops. Fault detection with principal Component analysis (PCA). Comparison and combination of fault detection methods
3- **Fault isolation techniques:** isolation procedures and problems. Fault isolation with classification methods. Fault isolation with inference methods.

Mode d'évaluation : contrôle continu (interrogations, devoirs et/ou mini-projet)+examen

Références *(Livres et polycopiés, sites internet, etc).*

1- M. Blanke, M Kinnaert, "Diagnosis and Fault-tolerant control", 2nd Ed, Springer, 2006.
2- J, Stroustrap, K, Zhou, " Robustness Issues in Fault Diagnosis and Fault-Tolerant Control"

Semestre : 04
UE : UED 41
Matière : Communications skills

Objectifs de l'enseignement :

This is a 'service English' communication course intended to prepare the students to communicate and function in English (Lab reports, Industrial experience reports and end of study cycle project reports). The course outline presented in this document is divided into two parts: a first part (first five units) which is considered as a link between the students' previous work in the first two semesters; and a second part consisting of eleven units which will present the students with discourse behaviours and discourse means to communicate and function in English. Other items are treated throughout the programme: mechanics of writing (punctuation, numbering of chapters and sub-chapters, labelling of visuals, quotations...)

a) **Part One**

1. **Transition from sentence production to the development of continuous prose**

2. **Devices for linking ideas and sentences:** logical, grammatical and lexical connectors

3. **Concepts of reference**

4. **Paragraph Development**: Producing pieces of coherent discourse

5. **Different types of paragraphs** (analysis, description, comparison/contrast, analogy,definition ...)

b) **Part Two**

1. Definition: Explaining what something is

2. Instructions and Process: Explaining how to do something

3. Description of a Mechanism: Explaining how something works

4. Analysis through Classification and Partition: Putting things in order

5. Analysis through Effect and Cause: Answering Why
6. The Summary: Abstracting and Getting to the heart of the matter
7. Using the Library: Getting acquainted with ressource materials
8. Visuals: Seeing is convincing
9. Report Writing: Telling it like it is

10. Oral Communication: Saying it clearly

11. Business Letters: Sending a Message through the mail

Semestre : 04
UE : UED 41
Matière : Project management

Objectifs de l'enseignement :

The objectives of this course to introduce the student to the discipline, techniques, and approaches to engineering projects management.

Connaissances préalables recommandées :

Contenu de la matière :

1- **Initiating the project**
2- **Project planning activities:** (Describing project scope, alternatives and visibility. Dividing the project into manageable tasks (WBS). Estimating and creating a Resource plan, developing a preliminary project schedule. Developing a project communication plan. Determining projects standards and procedures. Identifying and assessing project risk. developing a statement of work, setting a baseline project plan)
3- **Executing the project:** (Executing baseline project plan. Monitoring project progress against baseline. Monitoring changes to baseline plan. Maintaining a project's workbook. Communication the project status)
4- **Closing down the project: (**Closing down the project. Conducting post-project Review. Closing customer contact)
5- **Applications and case study: (**Representing & scheduling project plans. Software tools: PRIMAVERA..**)**

Mode d'évaluation : contrôle continu (devoirs et/ou mini-projets)

Références *(Livres et polycopiés, sites internet, etc).*

1- J-P. Lewis, "Fundamentals of project management", AMACOM, 2nd Ed, 2002
2- H. Kerzner, *"Project management: A system approach to planning, scheduling, and controlling*", Wiley, 8th Ed, 2003.