Programme Détaillé par Matière

EE477: Probability and Stochastic Processes

Course Information:

Semester: I	**Unit**: UEF11	**Credit Hours:** 6	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

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.

Course Prerequisite(s):

Basic single and multi-variable calculus

Course Outline:

- **Introduction** (probability, conditional probability, independence,…)
- **Random variable** (distribution function, density function, moments, special distributions)
- **Several random variables**
- **Random processes** (continuous/discrete processes, stationarity, ergodicity, process parameters)
- **Correlation functions** (autocorrelation function, cross-correlation functions, correlation matrices)
- **Spectral density** (relation to Fourier transform, properties, relation to autocorrelation functions, cross-spectral density, White noise)
- **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)
- **Linear estimation, and Wiener filtering**

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE479: Advanced Mathematics

Course Information:

Semester: I	**Unit**: UEF11	**Credit Hours:** 6	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

To develop, deepen and extend the concepts and tools acquired in previous linear Algebra course.

Course Prerequisite(s):

A course in calculus and a course in linear Algebra

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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*

EE475: Complex Variable

Course Information:

Semester: I	**Unit**: UEF11	**Credit Hours:** 6	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

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

Course Prerequisite(s):

A basic course in analysis (single variable calculus)

Course Outline:

- **Algebra of complex numbers**
- **Function of a complex variable**
- **Analytic functions**
- **Power series**
- **Residues theorem and its applications**
- **Integrals**
- **Conformal mappings**

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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

EE451: Digital Control Systems

Course Information:

Semester: I	Unit: UEF12	Credit Hours: 6	Coefficient: 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

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.

Course Prerequisite(s):

A course in discrete-time linear systems (linear systems II)

A course in linear (continuous-time) control systems

Course Outline:

- **Introduction**: Sampling processes, Simplified digital control systems..
- **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.
- **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.
- **Frequency response methods:** discrete-time LTI system response to a sinusoidal input, bilinear transformation in the W-plane, the Bode method.
- **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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE453: Digital Controllers Implementations

Course Information:

Semester: I	**Unit**: UEM11	**Credit Hours:** 3	**Coefficient:** 2
Lecture: 1.5hrs/week	**Recitation:** 0 hrs/week	**Lab:** 1.5 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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.

Course Prerequisite(s):

A course in digital systems is required; additionally this course is to be taken along or after the digital control systems course

Course Outline:

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

Assessment Method: Continuous + mini project

Textbook(s) and/or other required material:

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.

EE421: Introduction to Scientific Computing with Matlab

Course Information:

Semester: I	**Unit**: UEM11	**Credit Hours:** 3	**Coefficient:** 2
Lecture:1.5 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 1.5 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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.

Course Prerequisite(s):

A basic course in computer programming

A course in linear control systems

Course Outline:

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

Assessment Method: Continuous + mini project

Textbook(s) and/or other required material:

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.

EE472: Numerical Methods

Course Information:

Semester: II	Unit: UEF21	Credit Hours: 4	Coefficient: 3
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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 when analytical solutions are not possible.

Course Prerequisite(s):

A basic course in calculus; A basic course in computer programming

Course Outline:

- **Introduction:** Mathematical Preliminaries and Error Analysis.
- **Solutions of equations of one variable:** Bisection, Secant, and Newton-Raphson Methods, Error Analysis
- **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.
- **Numerical Integration:** Quadrature Rules, Romberg Integration, Error Analysis.
- **Interpolation and Polynomial Approximation:** Introduction, Lagrange Polynomials, Spline Interpolation, Error Analysis.
- **Numerical Solution of Initial-Value Problems:** Taylor's Methods, Runge-Kutta's Methods, Error Analysis.
- **Approximating Eigen-Values**: Introduction, The Power Method, The Householder's Method, The QR Method, Error Analysis.

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE412: Digital Signal Processing

Course Information:

Semester: II	**Unit**: UEF21	**Credit Hours:** 4	**Coefficient:** 3
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 45.0

Course Objectives:

The fundamental goal of this course is to introduce the student to the analysis, design, and implementation of digital filters to process digital signals.

Course Prerequisite(s):

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

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

1. J. G. Proakis, and D. G. Manolakis, "Digital Signal Processing, principles, algorithms, and applications ", Prentice-Hall, 3rd edition 1996.

2. A. V. Oppenheim, and R. W. Schafer, " Discrete-time Signal Processing'', Prentice Hall; 3rd edition, 2009.

EE452: Industrial Automation

Course Information:

Semester: II	**Unit**: UEF22	**Credit Hours:** 5	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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.

Course Prerequisite(s):

A course in Electronics (analog and digital), and a course in process control and instrumentation

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE454: Multivariable Control Systems

Course Information:

Semester: II	Unit: UEF22	Credit Hours: 6	Coefficient: 4
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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

Course Prerequisite(s):

A basic course in linear algebra

A basic course in linear control systems

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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

EE422: Data Structures and Algorithms

Course Information:

Semester: II	Unit: UEF23	Credit Hours: 6	Coefficient: 4
Lecture: 3 hrs/week	Recitation: 1.5 hrs/week	Lab: 0 hrs/week	Semester hrs: 67.5

Course Objectives:

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.

Course Prerequisite(s):

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.

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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

EE452L: Industrial Automation Laboratory

Course Information:

Semester: II	**Unit**: UEM21	**Credit Hours:** 2	**Coefficient:** 1.5
Lecture: 0 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 3 hrs/week	**Semester hrs:** 36.0

Course Objectives:

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.

Course Prerequisite(s):

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

Course Outline:

- **Burglar alarm system**
- **Sequential control (traffic light, washing machine)**
- **Conveyor Control**
- **Elevator control**
- **Car park / parking controller**
- **Security door system with keypad**
- **Step motor control**
- **DC motor control (**open loop PWM control, feedback automatic speed control**)**

Assessment Method: Continuous + Final Test

Textbook(s) and/or other required material:

Laboratory handouts available before each Lab session

EE472L: Numerical Methods Lab

Course Information:

Semester: II	**Unit**: UEM21	**Credit Hours:** 1	**Coefficient:** 1
Lecture: 0 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 1.5 hrs/week	**Semester hrs:** 18.0

Course Objectives:

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

Course Prerequisite(s):

Differential equations and computational methods

Course Outline:

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

Assessment Method: Continuous + Final Test

Textbook(s) and/or other required material:

Laboratory handouts available before each Lab session

EE422L: Data Structures and Algorithms Laboratory

Course Information:

Semester: II	**Unit**: UEM21	**Credit Hours:** 2	**Coefficient:** 1.5
Lecture: 0 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 3 hrs/week	**Semester hrs:** 36.0

Course Objectives:

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.

Course Prerequisite(s):

This course is to be taken along or after the data structures and algorithms course.

Course Outline:

- Comparing the running times of Algorithms.
- Array and Pointer Implementation of General Lists.
- Array and Pointer Implementation of Restricted Lists.
- Array and Pointer Implementation of Binary Trees.
- Implementation of Depth First Search for Digraphs.
- Implementation of Depth First Search for graphs.
- Implementation of Dijkstra's Algorithm.
- Implementation of Floyd Warshall's Algorithm.
- Implementation of Mege Sort, Heap Sort and Bin Sort Algorithm.

Assessment Method: Continuous + Final Test

Textbook(s) and/or other required material:

Laboratory handouts available before each Lab session

EE551: Optimal Control Systems

Course Information:

Semester: III	**Unit**: UEF31	**Credit Hours:** 6	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

Introduce the problem of optimal control of dynamical systems, as well as the common approaches to solve it.

Course Prerequisite(s):

A course in linear algebra

A course in ordinary differential equation

A course in linear control systems

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE553: Nonlinear Systems and Control

Course Information:

Semester: III	Unit: UEF31	Credit Hours: 6	Coefficient: 4
Lecture: 3 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 67.5

Course Objectives:

Give the student the necessary tools to analyze nonlinear dynamical systems, and presents the most relevant techniques for controlling these systems

Course Prerequisite(s):

A basic course in linear algebra

A basic course in linear control systems

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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

EE555: System Identification

Course Information:

Semester: III	**Unit**: UEF31	**Credit Hours:** 7	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 1.5 hrs/week	**Semester hrs:** 67.5

Course Objectives:

To introduce the student to the field of system identification, and explore the different parametric and non-parametric techniques available for linear systems identification

Course Prerequisite(s):

A course in linear Algebra

A course in probability and stochastic processes

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE557: Industrial Instrumentation

Course Information:

Semester: III	**Unit**: UEF32	**Credit Hours:** 6	**Coefficient:** 4
Lecture: 3 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 45.0

Course Objectives:

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.

Course Prerequisite(s):

A basic course in instrumentation and process control (analog)

Course Outline:

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

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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.

EE557L: Industrial Instrumentation Laboratory

Course Information:

Semester: III	**Unit**: UEM31	**Credit Hours:** 2	**Coefficient:** 1.5
Lecture: 0 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 3 hrs/week	**Semester hrs:** 36

Course Objectives:

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.

Course Prerequisite(s):

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

Course Outline:

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

Assessment Method: Continuous + Final Test

Textbook(s) and/or other required material:

Laboratory handouts available before each Lab session

EE531: Introduction to Fault Detection and Isolation

Course Information:

Semester: III	**Unit**: UED31	**Credit Hours:** 3	**Coefficient:** 1.5
Lecture:1.5 hrs/week	**Recitation:** 0 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 22.5

Course Objectives:

Provides an introduction to the problem of fault detection and isolation as well as some basic solution techniques

Course Prerequisite(s):

A course in probability

Course Outline:

- **Fundamentals:** Supervision of processes-tasks and terminology, reliability, availability, and maintainability, safety, dependability and system integrity.
- **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
- **Fault isolation techniques:** isolation procedures and problems. Fault isolation with classification methods. Fault isolation with inference methods.

Assessment Method: Continuous + Final Exam

Textbook(s) and/or other required material:

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"

EL502: Communication Skills

Course Information:

Semester: IV	Unit:	Credit Hours: 5	Coefficient: 3
Lecture: 2 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 52.5

Course Objectives:

To provide samples of academic writing and appropriate practice materiel for such student and also for those students who need to write papers and reports in English

Course Prerequisite(s):

English

Course Outline:

a) <u>Part One</u>

- Transition from sentence production to the development of continuous prose
- Devices for linking ideas and sentences: logical, grammatical and lexical connectors
- Concepts of reference
- Paragraph Development: Producing pieces of coherent discourse
- Different types of paragraphs (analysis, description, comparison/contrast, analogy, definition ...)

b) <u>Part Two</u>

- Definition: Explaining what something is
- Instructions and Process: Explaining how to do something
- Description of a Mechanism: Explaining how something works
- Analysis through Classification and Partition: Putting things in order
- Analysis through Effect and Cause: Answering Why
- The Summary: Abstracting and Getting to the heart of the matter
- Using the Library: Getting acquainted with ressource materials
- Visuals: Seeing is convincing
- Report Writing: Telling it like it is
- Oral Communication: Saying it clearly
- Business Letters: Sending a Message through the mail

Assessment Method: Continuous + Examen final

Textbook(s) and/or other required material:

1. R. R. Jordan, “Academic writing course , ” Harper Collins publishers , 1990.

2. T. A. Sherman and S. S. Johnson “Modern Technical Writing ”, 5th ed, prentice hall

EE584: Project Management

Course Information:

Semester: IV	**Unit**:	**Credit Hours:** 5	**Coefficient:** 3
Lecture: 2 hrs/week	**Recitation:** 1.5 hrs/week	**Lab:** 0 hrs/week	**Semester hrs:** 52.5

Course Objectives:

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

Course Prerequisite(s):

Economics Basics

Course Outline:

- **Initiating the project**
- **Project planning activities:**
- **Executing the project:**
- **Closing down the project:**
- **Applications and case study**

Assessment Method: Continuous + Examen final

Textbook(s) and/or other required material:

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.