



FACULDADE DE
CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA



PhD Program In Electrical and Computer Engineering

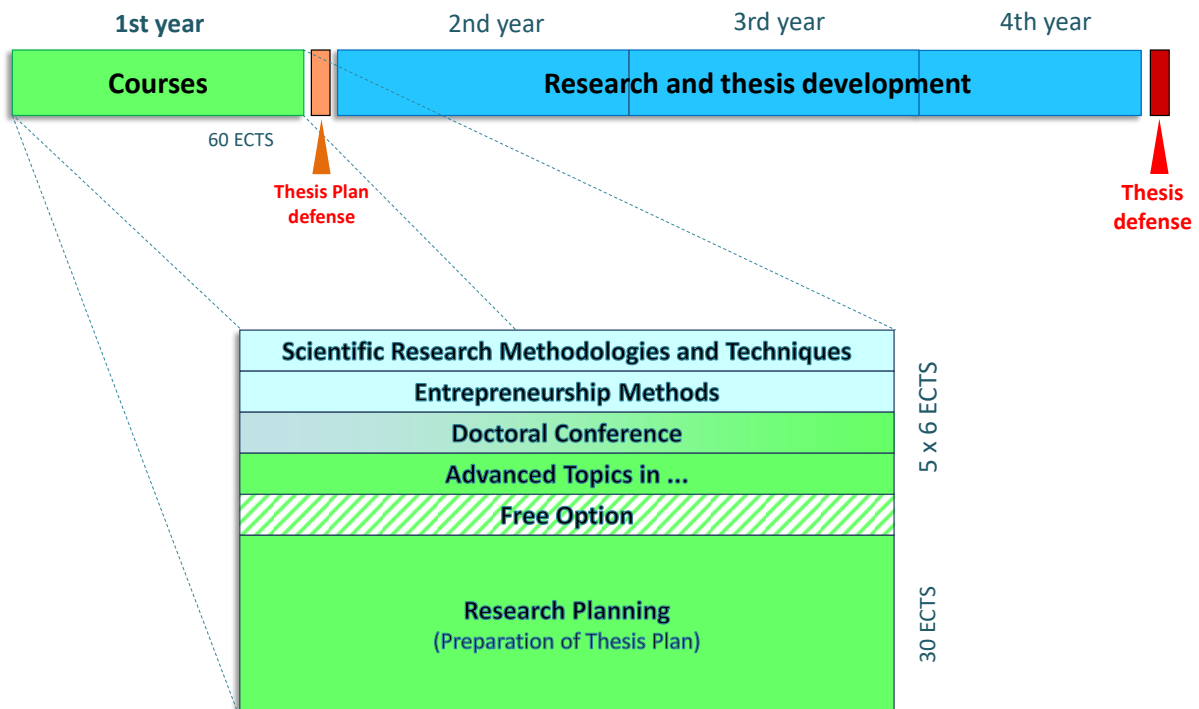
(3rd Cycle – Bologna model)

SYLLABUS

2019/2020

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Year 1: COURSES

COURSE: SCIENTIFIC RESEARCH METHODOLOGIES AND TECHNIQUES 2019/2020

Summary of objectives

This course aims at introducing the base concepts and methods of scientific research. The students will be guided on issues such as preparation of technical papers, preparation of the thesis, intellectual property, ethical principles in science, and research roadmapping and management. Finally, the preparation of a research project proposal is also exercised.

ECTS: 6

Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



Rui
Neves-Silva
Assoc. Professor



Ricardo
Gonçalves
Full Professor



João
Goes
Full Professor

DETAILED PROGRAM

Unit 1: INTRODUCTION

Objectives for a PhD, base concepts, types of research, relationship with supervisor

Unit 2: SCIENTIFIC METHOD

Overview of research methods, steps of the scientific method, engineering research

Unit 3: LITERATURE REVISION

Information sources, information search, special sources, synthesis and critics

Unit 4: PUBLICATION OF RESULTS

Writing scientific papers, publication channels, evaluation procedures, citations

Unit 5: THESIS ORGANIZATION AND VALIDATION

Structure, research question, thesis contribution, validation of results

Unit 6: RESEARCH IN COLLABORATION

Types of projects and partnerships, requirements, collaboration spirit and constraints

Unit 7: PROJECT PROPOSAL PREPARATION

General structure of a proposal, typical example

Unit 8: RESEARCH PROJECT MANAGEMENT

Management structure, management principles, tools, risks, reporting

Unit 9: ASSESSMENT OF RESEARCH RESULTS

Phases of research and outcomes, research performance indicators

Unit 10: RESEARCH ETHICS

Ethical issues and behavior, responsible conduct, scientific practices and violation

Unit 11: INTELLECTUAL PROPERTY RIGHTS

Concepts, types, protection mechanisms, rights identification, rights transfer

Unit 12: ROADMAPPING AND FUTURE PLANNING (1)

Future planning objectives and approaches, concept of roadmapping

Unit 13: ROADMAPPING AND FUTURE PLANNING (2)

Roadmapping methodology

Unit 14: PROJECT PROPOSAL PREPARATION - Examples

Examples in different programs – EC, ESA, national

Slides: <https://sites.google.com/a/uninova.pt/cam/teaching/srmt>

Contact professors for topics 1-13: L. M. Camarinha-Matos <cam@uninova.pt>

Contact professors for topic 14: R. Neves-Silva, R. Gonçalves <rg@uninova.pt>, J. Goes <jg@uninova.pt>

MODUS OPERANDI:

The course will comprise a set of lectures (2 h per unit) followed by work assignments to be performed by the students.

EVALUATION PROCEDURE

Evaluation method:

1. Several homework assignments, including preparation of a technical paper (acting as an author), evaluation of a technical paper (acting as a referee), etc.
2. Preparation of a research project proposal in response to a national or European Call for proposals.

Professors responsible for the evaluation:

L. M. Camarinha-Matos, J. Goes, R. Neves Silva, R. Gonçalves

**COURSE: ENTREPRENEURSHIP METHODS
2019/2020**

Summary of objectives

This unit aims to offer students base skills in entrepreneurship methods and strategies with particular emphasis on innovation management and productization of research results.

ECTS: 6

Responsible professors



José Barata
Assoc. Professor

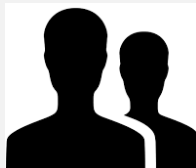


Luis M. Camarinha-Matos
Full Professor

Other professors involved



Pedro Sousa
Assist. Professor



Other
Invited experts

DETAILED PROGRAM

The course includes 15 Units of 2 h each, followed by practical work to be done by the PhD candidates.

Unit 1: INTRODUCTION

Unit 2: BASIC CONCEPTS

Unit 3: BUSINESS PLAN

Unit 4: ENTREPRENEURIAL ACTIVITIES

Unit 5: NEW VENTURE FINANCING

Unit 6: PRODUCTIZATION OF RESEARCH RESULTS

Unit 7: INCUBATORS AND TECHNOLOGICAL PARKS

Unit 8: MANAGEMENT OF CREATIVITY

Unit 9: TECHNOLOGY TRANSFER

Unit 10: INTELLECTUAL PROPERTY (1)

Unit 11: INTELLECTUAL PROPERTY (2)

Unit 12: INNOVATION IN NETWORKS

Unit 13: SOCIAL ENTREPRENEURSHIP

Unit 14: STRATEGY AND LEADERSHIP

Unit 15: ELEVATOR PITCH

MODUS OPERANDI:

The course will comprise a set of lectures (2 h per unit) followed by work assignments to be performed by the students.

Slides: <http://sites.fct.unl.pt/doutoramento-engenharia-electrotecnica-computadores/pages/entrepreneurship-methods>

Contact professors: J. Barata <jab@uninova.pt>, L. M. Camarinha-Matos <cam@uninova.pt>

EVALUATION PROCEDURE

Evaluation method:

1. Select promising research results from a recently finished (or ongoing) research project. Elaborate a plan for impact creation / exploitation of those results.
2. Participate in the competition "Learn to be an entrepreneur".

Professors responsible for the evaluation: J. Barata, L. M. Camarinha-Matos, invited experts

**COURSE: DOCTORAL CONFERENCE
2019/2020**

Summary of objectives

This unit is organized as a set of activities for the preparation and realization of an **Advanced Doctoral Conference on Computing, Electrical and Industrial Systems (DoCEIS)** with a strong involvement of the candidates in all associated phases, and corresponds to an important mechanism to provide both scientific and soft skills.

Candidates will acquire skills on all aspects of preparation and running of scientific events. They will also exercise their presentation and intervention skills and share experiences with other PhD candidates. Through a series of selected keynote lectures the students will also get a better awareness of the current trends and challenges in their area of research. The conference, in all its phases, will also offer an important opportunity for social and professional networking.

ECTS: 6



Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



Luis
Gomes
Assoc. Professor



João
Goes
Full Professor



Pedro
Pereira
Assist. Professor

DETAILED PROGRAM

Unit 1: Conference preparation

- Tutorials on the basics of conference planning and organization
- Scientific program preparation
- Organizational logistics
- Dissemination and support seeking

Modus operandi:

- 3 tutorial sessions introducing summarizing the needs and mechanisms.
- Organization of a list of tasks to be performed by the students, under supervision of the responsible professors (task forces)
- Organization of a series of periodic meetings where task forces report their progress and next steps are discussed.

Unit 2: Conference realization

- The conference will run during 3 or 5 days, tentatively scheduled for May.
- Sessions will include:
 - Tutorials by invited experts on scientific, methodological, or soft skills topics.
 - Presentation and discussion of the base ideas of the thesis plans.
 - Discussion of the scientific and technical challenges in the several Electrical and Computer Engineering specialization areas.
 - Sharing of experiences among PhD students from different geographical regions.
 - Forum on practical aspects (e.g. Publications, job market, careers, etc.).
 - Creation of collaborative (social) networks.

Modus operandi:

- Plenary and parallel track sessions
- PhD students to have an active involvement in the logistics of the event.

Unit 3: Synthesis and assessment

- Brief synthesis of the technical / scientific findings in the conference.
- Assessment of the operational aspects.

Modus operandi:

- Preparation of a report by the PhD candidates after the conference.

Contact professors: L. M. Camarinha-Matos <cam@uninova.pt>, L. Gomes <lugo@fct.unl.pt>, J. Goes <jg@uninova.pt>, P. Pereira <pmp@fct.unl.pt>

OTHER GUIDANCE

The conference is open to PhD students from other universities.

The possibility of publishing the proceedings as a book by an international publisher (e.g. Springer), like in previous years, is strongly encouraged. Similarly, the possibility of organizing special issues of journals (ranked in the Science Citation Index) shall be pursued.

Slides: <http://sites.fct.unl.pt/doutoramento-engenharia-electrotecnica-computadores/pages/doctoral-conference>

EVALUATION PROCEDURE

Evaluation method:

Elements to be considered in the evaluation:

- Performance of the preparatory tasks
- Contribution to the technical content of the conference
- Assessment report

Professors responsible for the evaluation: L. M. Camarinha-Matos, L. Gomes, J. Goes, P. Pereira

**COURSE: RESEARCH PLANNING
2019/2020**

Summary of objectives

This unit is devoted to the preparation of the Thesis Plan including definition of the research question(s) and its motivation, analysis and synthesis of the state of the art, and planning of the research activities.

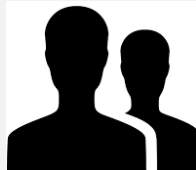
ECTS: 30

Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



All PhD Supervisors



ALL THESIS ACCOMPANYING COMMITTEES

DETAILED PROGRAM

Unit 1: Analysis of the state of the art and elaboration of a synthesis clearly identifying the current challenges. Special emphasis is put on the production of added value by the student.

Unit 2: Elaboration of the work plan for the 2nd phase of the PhD Program, including:

- Definition of objectives (research questions) and their motivation.
- Definition of the approach, methods and tools to be adopted.
- Preliminary identification of the potential contributions and their putting in context, including intermediate results.
- Definition of the activity plan and its scheduling.

Unit 3: Elaboration of the thesis validation strategy and plan.

Unit 4: Elaboration of the plan for dissemination and validation in the scientific community.

Unit 5: Integration of the research plan into the activities of the host research group.

Unit 6: Integration, if planned, of the activities in a national or international project.

Unit 7: Preparation of a report and public presentation and defense of the Thesis Plan.

THESIS PLAN – REPORT STRUCTURE

A typical table of contents will include:

- Abstract
- 1.Introduction / background
- 2.Research question and general approach
- 3.Literature review
- 4.Research methodology
 - 4.1. Aimed contribution
 - 4.2. Detailed work plan and scheduling
 - 4.3. Validation methodology
 - 4.4. Dissemination plan
 - 4.5. Integration with other research activities
- 5.References

Size: 35 to 60 pages.

EVALUATION PROCEDURE

- Presentation of the Thesis Plan in a seminar (open to the public).
- Discussion between the Thesis Accompanying Committee and the candidate.

**COURSE: ADVANCED TOPICS IN CONTROL AND DECISION
2019/2020**

Summary of objectives

The research activity on the scientific area of control and decision requires basic knowledge in a number of key topics:

- Dynamic behaviour of linear and non-linear systems
- Optimization and optimal control
- System modelling
- Stability and robustness analysis

Advanced Topics in Control and Decision aims to provide the students the ability to use these tools on the development of their research activity.

ECTS: 6

Responsible professor

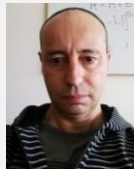


Fernando Coito
Assoc. Professor

Other professors involved



Luis Palma
Assist. Professor



Paulo Gil
Assist. Professor

DETAILED PROGRAM

Unit 1: Linear Systems

- Modelling and mathematical representation
- Time and frequency analysis
- Controllability and Observability of LTIS
- Controller design
- Asymptotic observers and state reconstruction

Recommended bibliographic references:

- Ribeiro, M. I., 2002. Análise de Sistemas Lineares, IST Press.
- Hespanha, J. P., 2009. Linear system Theory, Princeton Univ. Press.

Contact professor for this topic: L. Palma <lbp@fct.unl.pt>

Unit 2: Optimal Control

- Formulation of optimal control problems
- Continuous time optimal control using the variational approach
- Fixed final time
- The linear quadratic regulator
- Terminal constraints, input constraints and path constraints problems
- Minimum time problems
- Discrete-time optimal control and Computational optimal control
- Introduction to dynamic programming

Recommended bibliographic references:

- Athans, M. and Falb, P. L., 2006. Optimal Control: An Introduction to the Theory and Its Applications. Dover Publications.
- Lewis, F. L., Vrabie, D., Syrmos, V., 2012. Optimal Control, Wiley.

Contact professor for this topic: P. Gil <psg@fct.unl.pt>

Unit 3: Adaptive Control:

- Basic deterministic theory of LQ and predictive control
- Deterministic receding horizon control
- State estimation and system identification
- Linear Quadratic and predictive stochastic control
- Adaptive control

Recommended bibliographic references:

- Astrom, K.J. and Wittenmark, B., 2008. Adaptive Control, Dover Publications.
- Billings, S. A., 2013. Nonlinear System Identification: NARMAX, Methods in the Time, Frequency, and Spatio-Temporal Domains. Wiley.
- Ljung, L., 1999. System Identification - Theory For the User, PTR Prentice Hall.
- Mosca, E., 1995. Optimal, Predictive and Adaptive Control, Prentice Hall. <http://www.dsi.unifi.it/~mosca/Main.pdf>

Contact professor for this topic: F. Coito <fjvc@fct.unl.pt>

EVALUATION PROCEDURE

Evaluation method:

During the course the student will prepare a number of written essays, to be evaluated.

Professors responsible for the evaluation: F. Coito, P. Gil, L. Palma

**COURSE: ADVANCED TOPICS IN ELECTRONICS
2019/2020**

Summary of objectives

As CMOS technologies are scaling down into the nanometer range and approaching the fundamental limits, many new physical effects degrade the devices' behaviour. Many new non-idealities have to be addressed and overcome to achieve successful fabrication, with high yield, of analog and mixed-signal chips, such as the case of Systems on Chip (SoC) or Systems in Package (SiP). The nature of these non-idealities includes short-channel and quantum effects, hot carrier injection (HCI), and time-dependent dielectric breakdown (TDDB), which limit the supply voltage. Moreover, mechanical stress and lithographic effects limit the matching accuracy, leakage and mobility effects degrade the device performance, and poor intrinsic gain of transistors restrict, the use of traditional amplifier-based circuits. This means that new solutions and approaches have to be used to obtain the same functionality from the different blocks used in system design.

The main objective of this course on is to provide the attendees all required background in the design of Integrated Circuits (ICs) in advanced deep nanoscale CMOS technologies (e.g. equations, advanced modeling and noise analysis) and in state-of-the-art topologies of the main building blocks used in most of RF and base-band electronic circuits (Low-Noise-Amplifiers, Power-Amplifiers, Oscillators, passive and active Mixers, Operational Transconductance Amplifiers and high-speed Comparators, ADCs and power management circuits).

All important issues such as low-voltage and low power design techniques will be addressed. Practical design examples (front-end design) assisted by advanced CAD tools will be provided.

ECTS: 6

Responsible professor



João Goes
Full Professor

Other professors involved



Nuno Paulino
Assist. Professor



João P. Oliveira
Assist. Professor



Rui Tavares
Assist. Professor



Luis Oliveira
Assist. Professor

DETAILED PROGRAM

Unit 1: CMOS Technology, Transistor Equations and Noise

- CMOS technology
- Transistor's equations and operating regions
- Noise analysis

Recommended bibliographic references:

- Slides
- Chapters from the book: P. Valizadeh, "Field Effect Transistors, A Comprehensive Overview: From Basic Concepts to Novel Technologies", 2016, Wiley
- Chapters from the book: Yannis Tsvividis, ""(Operation and Modeling of) The MOS Transistor", 3rd. Edit., 2010, Oxford Press.
- Chapters from the book: J. P. Oliveira and J. Goes "Parametric Analog Signal Amplification Applied to Nanoscale CMOS Technologies" 2012, Springer

Contact professor for this topic: J. P. Oliveira <jpao@fct.unl.pt>

Unit 2: Transistor Models, optimization and CAD tools

- MOS transistor compact modeling for nanoscale technologies: BSIMv3 (130 nm CMOS) BSIMv4 (65 nm CMOS), BSIMv6 and modified PSP for SOI (e.g., the UTSOI model for 28 nm CMOS)
- Design methodologies and Circuit Optimizers
- Simulation Tools. Layout Tools. Verification Tools
- Practical examples involving Tools

Recommended bibliographic references:

- Slides, Cadence Spectre Manuals.
- Cadence SpectreRF Manuals from Version 6, 2016.
- Chapters from the book: P. Valizadeh, "Field Effect Transistors, A Comprehensive Overview: From Basic Concepts to Novel Technologies", 2016, Wiley
- Chapters from the book: Yannis Tsvividis, "(Operation and Modeling of) The MOS Transistor", 3rd. Edition, 2010, Oxford Press

Contact professor for this topic: R. Tavares <rmt@fct.unl.pt>

Unit 3: Advanced CMOS Amplifier and Comparator Topologies. Low-voltage design techniques

- Amplifier basics and basic building-blocks
- Advanced amplifier topologies
- CMOS Comparators
- Design techniques for low-voltage supply circuits. Bulk driven, DTMOS and weak inversion approaches.

Recommended bibliographic references:

- Slides
- Chapters from the book: P. Harpe, A. Baschiroto and K. A. A. Makinwa (Series Editors), "High-Performance AD and DA Converters, IC Design in Scaled Technologies, and Time-Domain Signal Processing", 2015 Springer
- Chapters from the book: B. Goll and H. Zimmermann, "Comparators in Nanometer CMOS Technology", 2015, Springer
- Chapters from the book: Willy Sansen "Analog Design Essentials", Springer.
- High-performance AD and DA Converters, IC Design in Scaled Technologies, and Time-domain Signal Processing: Advances in Analog Circuit Design 2014

Contact professor for this topic: J. Goes <jg@uninova.pt>

Unit 4: Low-Noise Amplifiers (LNAs) and Power Amplifiers (PAs) for modern radio transceivers architectures

- Introduction to RF CMOS Transceiver architectures and Design for 4G and WSN applications. Challenges towards 5G and wireless IoT.
- Wideband and blocker tolerant LNAs with noise and distortion cancelling techniques.
- N-Path filtering and dynamic impedance transformation
- Low noise amplification and frequency conversion using Parametric based signal processing both in continuous and discrete time domain
- Linearization techniques for PAs in modern nanometer CMOS technology. Outphasing topologies.

Recommended bibliographic references:

- Slides
- Chapters from the book: H. Darabi, "Radio Frequency Integrated Circuits and Systems", 2015, Cambridge University Press
- Chapters from the book: H. Darabi and A. Mirzaei "Integration of Passive RF Front End Components in SoCs", 2013, Cambridge University Press
- Chapters from the book: J. P. Oliveira and J. Goes "Parametric Analog Signal Amplification Applied to Nanoscale CMOS Technologies" 2012, Springer
- Chapters from the book, H. Tuiz and R. Pérez "Linear CMOS RF Power Amplifiers", 2014, Springer
- Chapters from the book: B. Razavi "RF Microelectronics", 2nd. Edition, 2012, Prentice Hall.
- Chapters from the book: R. Caverly "CMOS RFIC Design Principles, 2007, Artech House.

Contact professor for this topic: J. P. Oliveira <jpao@fct.unl.pt>

Unit 5: PLL/Oscillators and Mixers

- Advanced RF CMOS Oscillators and PLL.
- Active and passive mixers using discrete-time and N-Path impedance transformation and parametric amplification.
- A practical example
- Measurement related issues in RF CMOS testing

Recommended bibliographic references:

- Slides
- Chapters from the book: H. Darabi, "Radio Frequency Integrated Circuits and Systems", 2015, Cambridge University Press
- Chapters from the book: H. Darabi and A. Mirzaei "Integration of Passive RF Front End Components in SoCs", 2013, Cambridge University Press
- Chapters from the book: B. Razavi "RF Microelectronics", 2nd. Edition, 2012, Prentice Hall.
- Chapters from the book: L. B. Oliveira, "Analysis and Design of Quadrature Oscillators", 2008, Springer.
- Chapters from the book: J. P. Oliveira and J. Goes "Parametric Analog Signal Amplification Applied to Nanoscale CMOS Technologies" 2012, Springer

Contact professor for this topic: L. B. Oliveira <l.oliveira@fct.unl.pt>

Unit 6: ADC design in nm CMOS technologies

- Pipeline ADCs
- SAR ADCs
- Sigma Delta ADCs.

Recommended bibliographic references:

- Slides
- Chapters from the book: P. Harpe, A. Baschiroto and K. A. A. Makinwa (Series Editors), "High-Performance AD and DA Converters, IC Design in Scaled Technologies, and Time-Domain Signal Processing", 2015 Springer
- Chapters from the book: Herman Casier, Arthur van Roermund, Michiel Steyaert "Analog Circuit Design: Smart Data Converters, Filters on Chip, Multimode Transmitters", Springer 2014
- Chapters from the book: Michael Figueiredo, João Goes, Guiomar Evans, "Reference-free CMOS Pipeline Analog-to-digital Converters", Springer 2013
- Chapters from the book: Richard Schreier, Gabor C. Temes, "Understanding Delta-Sigma Data Converters", Wiley-IEEE Press; 1 edition (November 8, 2004)
- Chapters from the book: Jose M. de la Rosa, Rocio del Rio, "CMOS Sigma-Delta Converters: Practical Design Guide" April 2013, Wiley-IEEE Press

Contact professor for this topic: N. Paulino <nunop@uninova.pt>

Unit 7: Integrated power management and energy harvesting in CMOS technology

- Inductorless integrated CMOS DC-DC converter.
- MPPT and self-start capable circuit design techniques for solar cells, piezo and thermal energy transducers

Recommended bibliographic references:

- Slides
- Chapters from the book: "CMOS Circuits for Piezoelectric Energy Harvesters: Efficient Power Extraction, Interface Modeling and Loss Analysis", 2016, Springer Series in Advanced Microelectronics)
- Chapters from the book: A. Baschiroto, K. Makinwa, P. Harpe "Frequency References, Power Management for SoC, and Smart Wireless Interfaces: Advances in Analog Circuit Design 2013", 2013, Springer

Contact professor for this topic: N. Paulino <nunop@uninova.pt>

EVALUATION PROCEDURE

Evaluation method:

An "American Style" (1.5 hour) exam covering the subjects of all 5 units (comprising about 18 to 20 questions).

Professors responsible for the evaluation: J. Goes, N. Paulino, L. B. Oliveira, R. Tavares and J. P. Oliveira.

**COURSE: ADVANCED TOPICS IN ENERGY
2019/2020**

Summary of objectives

To provide advanced knowledge in research and project skills in the area of Electrical Engineering, with particular focus on energy and electrical machines.

ECTS: 6

Responsible professor



João Martins
Assoc. Professor

Other professors involved



Mário
Ventim Neves
Assist. Professor



Stanimir
Valtchev
Assist. Professor



João
Murta Pina
Assist. Professor



Anabela
Pronto
Assist. Professor



Pedro
Pereira
Assist. Professor

DETAILED PROGRAM

Unit 1: Mathematical methods for electromagnetic fields resolution

- Study of numerical methods for problem resolution in Electrical Engineering with particular emphasis on electrical machines and power transmission lines.

Recommended bibliographic references:

- Binns, Lawrenson, Trowbridge: The analytic and Numerical Solution of Electric and Magnetic Fields; Wiley, 1995
- Bastos, Sadowski: Electromagnetic Modeling by Finite Elements Method; Marcel Dekker, Inc, 2003
- Morton, Mayers: Numerical Solution of Partial Differential Equations; Cambridge University Press, 2005
- Åke Björck: Numerical Methods in Matrix Computations; Springer International Publishing Switzerland, 2015
- Amos Gilat ; Numerical Methods for Engineers and Scientists; John Wiley & Sons; 3rd Edition 2014
- Charles W. Steele: Numerical Computation of Electric and Magnetic Fields; Springer; 2012 (reprint of 1987 edition)
- Francisco Rivas-Davalos : Evolutionary Algorithms for Power Distribution System Planning ; LAP Lambert Academic Publishing (14 Jun 2010)

Contact professor for this topic: M. Ventim Neves <ventim@uninova.pt>

Unit 2: Advanced Materials for Energy Applications

- New materials for energy applications:
 - Thermoelectric materials for energy conversion
 - Phase change materials (PMC) for improving energy efficiency
 - New materials and/or new structures for PV cells
 - Super capacitors for energy storage
 - Superconductors for power energy systems

Recommended bibliographic references:

- C. Schuss, K. Leppänen, K. Remes et al., "Detecting Defects in Photovoltaic Cells and Panels and Evaluating the Impact on Output Performances", IEEE Transactions on Instrumentation and Measurement, 65 (5), pp. 1108-1119, 2016.
- Y. Hu, W. Cao, J. Ma et al., "Identifying PV Module Mismatch Faults by a Thermography-Based Temperature Distribution Analysis", IEEE Transactions on Device and Materials Reliability, 14 (4), pp. 951-960, 2014.
- S. Samoilenkov, A. Molodyk, S. Lee et al., "Customised 2G HTS wire for applications", Superconductor Science and Technology, 29 (2), 024001, 2016.
- F. Guarino et al., "PCM Thermal Energy Storage in Buildings: Experimental Study and Applications", Energy Procedia, vol. 70, pp. 219-228, May 2015.
- Supercapacitors: Materials, Systems, and Applications, Ed. François Béguin, Elżbieta Frąckowiak, John Wiley & Sons, 2013.
- A. Luque, S. Hegedus, Handbook of Photovoltaic Science and Engineering, John Wiley & Sons, 2nd Ed., 2011.
- Solar Cells - Materials, Manufacture and Operation, Ed. By Augustin McEvoy, L. Castaner and Tom Markvart, Elsevier, 2nd ed., 2012.
- High Temperature Superconductors (HTS) for Energy Applications, Ed. by Z. Melhem, Oxford Instruments Nanoscience, UK, 2011.

Contact professors for this topic: A. Pronto <amg1@fct.unl.pt>, J. Murta Pina <jmmp@fct.unl.pt>

Unit 3: Integration of High Temperature Superconducting (HTS) Technologies in the Power System:

- Analysis of potential benefits of integrating mature and prospecting HTS technologies in all sub-systems of the power system, namely generation, transmission, distribution, end-use and storage.
- Design and modelling methodologies of HTS devices.
- Energy conversion (motors, generators, transformers).
- Transmission and distribution of electric energy (cables).
- Enabling integration of renewable sources (fault current limiters).
- Energy storage and power quality (flywheels with superconducting bearings and superconducting magnetic energy storage).

Recommended bibliographic references:

- N. Amaro, J. Souc, E. Pardo, J. Murta-Pina et al., "AC losses in Bi-2223 Single-Pancake Coils From 72 to 1152 Hz - Modeling

- and Measurements", IEEE Transactions on Applied Superconductivity, 26 (8), 8202207, 2016.
- N. Mineev, I. Igor, "Measurements and Numerical Simulations of Trapped Field in a Stack of HTS Tapes", IEEE Transactions on Applied Superconductivity, 26 (3), 8200904, 2016.
- N. Vilhena, A. Taillacq, A. Pronto, J. Murta-Pina, A. Alvarez, "Analysis of electromagnetic forces in superconducting fault current limiters under short-circuit condition", IEEE Transactions on Applied Superconductivity, 26 (3), 5601704, 2016.
- Murta-Pina, J., Pereira, P., Ceballos, J., Álvarez, A., Amaro, N., Pronto, A., Silva, J., Arsénio, P., "Validation and application of sand pile modeling of multiseeded HTS bulk superconductors", IEEE Transactions on Applied Superconductivity, 25 (13), 6801605, 2015.
- High Temperature Superconductors (HTS) for Energy Applications, Ed. by Z. Melhem, Oxford Instruments Nanoscience, UK, 2011.
- Swarn Kalsi, Applications of high temperature superconductors to electric power equipment, John Wiley & Sons, 2011.
- Weijia Yuan, Second-Generation High-Temperature Superconducting Coils and Their Applications for Energy Storage, Springer, 2011.
- Ferreira, R., Pina, J., Vilhena, N., Arsénio, P., Pronto, A., Martins, J., "Analysis of the effects of asymmetric faults in three-phase superconducting inductive fault current limiters", Journal of Physics: Conference Series, 507, 3, 032036, May 2014.
- Figueira, P., Pronto, A., Vilhena, N., Pina, J., "Electric and magnetic properties measurement and analysis of a conventional and a superconducting power transformer", Journal of Physics: Conference Series, 507, 3, 032015, May 2014.
- Malozemoff, A.P., "John R. Clem: Contributions to the Phenomenology of Superconductivity", IEEE Transactions on Applied Superconductivity, 25, 3 (1), 2015.

Contact professors for this topic: J. Murta Pina <jmmp@fct.unl.pt>, A. Pronto <amg1@fct.unl.pt>

Unit 4: Diagnosis in Electrical Machines

- Mathematical methods to diagnosis faults in electrical machines (Park vector application)

Recommended bibliographic references:

- P. J. Tavner, J. Penman (1987); Conditioning monitoring of electrical machines, RSP, Letchworth, Hertfordshire, UK.
- J.F. Martins, V.F. Pires and A.J. Pires, Unsupervised Neural-Network-Based Algorithm for an On-Line Diagnosis of Three-Phase Induction Motor Stator Fault, IEEE Transactions on Industrial Electronics 54 (2007).
- A. Bellini, Fiorenzo Filippetti, Carla Tassoni, Gérard-André Capolino, Advances in Diagnostic Techniques for Induction Machines, IEEE Transactions on Industrial Electronics 55 (2008).
- P. Tavner, L. Ran, Jim Penman and Howard Sedding, Condition Monitoring of Rotating Electrical Machines, 2nd Edition, Institution of Engineering and Technology, 2008, ISBN 978-0-86341-739-9, ELECTRONIC ISBN 978-1-61583-314-6
- Vincent Choqueuse, Mohamed Benbouzid, Yassine Amirat, Sylvie Turri; Diagnosis of three-phase electrical machines using multidimensional demodulation techniques, IEEE Transactions on Industrial Electronics 59 (2012).
- M. Marques, J. Martins, V. F. Pires, Rui Dias Jorge, and L. F. Mendes, Fault Detection and Diagnosis in Induction Machines: A Case Study, Doctoral Conference on Computing, Electrical and Industrial Systems - DOCEIS'13, (2013)
- V. Fernão Pires, Manuel Kadivonga, J.F. Martins, A.J. Pires, Motor square current signature analysis for induction motor diagnosis, Measurement, 46 (2), (2013)
- Firouzi, M.; Electr. Eng. Dept., Azad Univ. Res. & Sci., Tehran, Iran ; Gharehpetian, G.B., Improving Fault Ride-Through Capability of Fixed-Speed Wind Turbine by Using Bridge-Type Fault Current Limiter, IEEE Transactions on Energy Conversion, 28 (2), (2013).
- Toliyat, Subhasis Nandi, S. Choi and H. Meshgin-Kelk, Electric machines modeling, condition monitoring and fault diagnosis, CRC press, 2013.
- F Filippetti, A Bellini e G Capolino. "Condition monitoring and diagnosis of rotor faults in induction machines: State of art and future perspectives". Em: Electrical Machines Design Control and Diagnosis (WEMDCD), 2013 IEEE Workshop on. IEEE. 2013, pp. 196–209.
- D. Ftoit, J. Maia, V. Fernão Pires, J.F. Martins, Fault diagnosis in six-phase induction motor using a current trajectory mass center, Measurement, Volume 51, May 2014, Pages 164-173, ISSN 0263-2241
- Bindu, S.; Thomas, V.V., "Diagnoses of internal faults of three phase squirrel cage induction motor — A review," Advances in Energy Conversion Technologies (ICAECT), 2014 International Conference on , vol., no., pp.48,54, 23-25 Jan. 2014
- El Houssin El Bouchikhi, Vincent Choqueuse, Mohamed Benbouzid, Induction machine faults detection using stator current parametric spectral estimation, Mechanical Systems and Signal Processing, Volumes 52–53, February 2015, Pages 447–464

Contact professor for this topic: J. Martins <jf.martins@fct.unl.pt>

Unit 5: Power conversion achieving a maximum efficiency, maximum sustainability and minimum impact on the environment:

- Soft-switching power converters and resonant power converters;
- Power converters for contactless transfer of energy;
- Energy harvesting (at scale from microwatt to kilowatts).

Recommended bibliographic references:

- Kazimierczuk, M., D. Czarkowski, Resonant Power Converters, John Wiley & Sons, Inc., New York, 1995
- Kurs, A., A. Karalis, R. Moffatt, J. Joannopoulos, P. Fisher, M. Soljacic, Wireless Power Transfer via Strongly Coupled Magnetic Resonances, Science 6 July 2007, no. 5834, pp. 83-86
- Valtchev, S., R. Medeiros, Svilen Valtchev, Ben Klaassens, An Instantaneous Regulation for the Wired and Wireless Super-Resonant Converters, International Telecommunication Energy Conference INTELEC, Amsterdam, The Netherlands, DOI 10.1109/INTLEC.2011.6099875, October 2011
- Valtchev, S., K. Brandisky, B. Borges, J. B. Klaassens, Resonant Contactless Energy Transfer with Improved Efficiency, IEEE Transactions on Power Electronics, vol. 24, No. 3, pp. 685–699, DOI 10.1109/TPEL.2008.2003188, 2009
- Valtchev, S., J. B. Klaassens, Efficient Resonant Power Conversion, IEEE Transactions on Industrial Electronics, IE–37, No. 6, pp. 490–495, DOI 10.1109/41.103453, 1990.
- Valtchev S., B. Borges, V. Anunciada, 1kW/ 250kHz Full-Bridge Zero-Voltage-Switched Phase-Shift DC-DC Converter with Improved Efficiency, Proceedings of the 17th International Telecommunication Energy Conference INTELEC, The Hague, The Netherlands, pp. 803–807, DOI 10.1109/INTLEC.1995.
- Valtchev, S., J. B. Klaassens and M. van Wesenbeeck, Super-Resonant Converter with Switched Resonant Inductor with PFM-PWM Control, IEEE Transactions on Power Electronics, vol. 10, No. 6, pp. 760–765, DOI 10.1109/63.471296, 1995.
- van Wesenbeeck, M., J. B. Klaassens, U. von Stockhausen, A. Muñoz de Morales Anciola, S. Valtchev, A Multiple-Switch High-Voltage DC-DC Converter, IEEE Transactions on Industrial Electronics, vol. 44, No. 6, pp. 780–787, DOI 10.1109/41.649939, 1997.
- Mihailov, K., R. Arnaudov, S. Valtchev, Energy Harvesting from the Voltage Drop in TN-S, TN-C-S and Other Consumer Electric Networks, 16th International PEMC Conference and Exposition, Antalya, Turkey, September 2014.
- Valtchev, S., R. Neves-Medeiros, A. Krusteva, G. Gigov, P. Avramov, A wireless energy transceiver based on induction heating equipment, 16th International PEMC Conference and Exposition, Antalya, Turkey, September 2014
- J. V. P. Pereira Dias, Hyungchul Kim, Donguk Jang, Computer Model for Railway Inductive Power Supply Using Valtchev Model, 10.1109/ICEMS.2011.6073510, ICEMS Conference 2011, Beijing
- Romba Jorge, L., S. Valtchev, F. Coito, Resonant Power Conversion through a Saturable Reactor, DOCEIS'14 Conference, Caparica, Portugal, April 2014

- Todorov, G., T. Todorov, I. Ivanov, S. Valtchev, S., Ben Klaassens, Tuning Techniques for Kinetic MEMS Energy Harvesters, International Telecommunication Energy Conference INTELEC, DOI 10.1109/INTLEC.2011.6099874, October 2011, Amsterdam, The Netherlands
- Shashank Priya, Daniel J. Inman (Editors), Energy Harvesting Technologies, Springer Verl., 517 p., 2009.
- Ed. by Mickaël Lallart, Small-Scale Energy Harvesting, 346 p., ISBN 978-953-51-0826-9, 2012
- M. R. Chiarelli, Jan Kunzmann, et al., FutureWings Project, Deliverable D1.1 (piezo), 22 Oct 2013, http://www.futurewings.eu/FILES_linked/Deliverable_D_1_1_1%20Pisa.pdf,
- Valtchev, S., J. Almeida, J. Pamies Teixeira, J.B. Klaassens, Conversion of Wind-Induced Vibrations into Electricity, International Telecommunication Energy Conference INTELEC, October 2014, Vancouver, Canada

Contact professor for this topic: S. Valtchev <ssv@fct.unl.pt>

Unit 6: Energy efficient systems: energy management systems are of major importance in any energy efficiency strategy. The rapid growth of the Internet of Things (IoT) has encouraged the integration of different existing systems, increasing its potential to be offered as new services, namely:

- Building management systems;
- Intelligent appliances to support real-time decisions;
- smart metering/smart “buildings” systems;
- End-users as a proactive part of the energy system;

Recommended bibliographic references:

- Spano, E.; Niccolini, L.; Pascoli, S.D.; Iannacconeluca, G., "Last-Meter Smart Grid Embedded in an Internet-of-Things Platform," Smart Grid, IEEE Transactions on , vol.6, no.1, pp.468,476, Jan. 2015
- Yu Wang; Shiwen Mao; Nelms, R.M., "Distributed Online Algorithm for Optimal Real-Time Energy Distribution in the Smart Grid," Internet of Things Journal, IEEE , vol.1, no.1, pp.70,80, Feb. 2014
- "Contributing to the Internet of Things"; L. M Camarinha-Matos, J. A Goes, L. A Gomes, J. A Martins, Doctoral Conference on Computing, Electrical and Industrial Systems - DoCEIS'13, pp. 3-12, 15-17 April 2013, Caparica, Lisbon - Portugal.
- Kelly, S.D.T.; Suryadevara, N.K.; Mukhopadhyay, S.C., "Towards the Implementation of IoT for Environmental Condition Monitoring in Homes," Sensors Journal, IEEE , vol.13, no.10, pp.3846,3853, Oct. 2013
- Bui, N.; Castellani, A.P.; Casari, P.; Zorzi, M., "The internet of energy: a web-enabled smart grid system," Network, IEEE , vol.26, no.4, pp.39,45, July-August 2012
- Collective Awareness Systems, 1st ed., Luis M. Camarinha-Matos, Luis M. Barreto, Nuno S. Mendonça, Ed. Springer, 2014, Chapter 44, pp.401-408. ISBN: 978-3-642- 54733-1 (Print) 978-3-642-54734-8 (Online)
- Kumar, S.; Pal, S.K., "ICT Integrated Social Media Framework for consumer awareness in society using ICT tools," Computer and Information Science (ICIS), 2014 IEEE/ACIS 13th International Conference on , vol., no., pp.229,233, 4-6 June 2014
- Azevedo, I.L., Morgan, G.M, Palmer, K., and Lave, L. (2013), Reducing U.S. residential energy use and CO2 emissions: how much, how soon, and at what cost? ES&T, 47, 2502–2511.
- Arrobe, D.; Martins, J.; Lima, C., "Locating and monitoring tenants in PV based buildings," Renewable Energy Research and Applications (ICRERA), 2013 International Conference on , vol., no., pp.1112,1116, 20-23 Oct. 2013
- Silva, D.; Vieira, S.; Lima, C.; Martins, J.; "Home Energy Saving Adviser System"; International Conference on Power Engineering, Energy and Electrical Drives (POWERENG 2011), Malaga, Spain, 11-13 May 2011.

Contact professor(s) for this topic: J. Martins <jf.martins@fct.unl.pt>, P. Pereira <pmrp@fct.unl.pt>

The previous units are organized in two scientific areas:

Area 1: Energy Efficiency

Unit 1: Mathematical methods for electromagnetic fields resolution

Unit 2: Advanced Materials for Energy Applications

Unit 5: Power conversion achieving a maximum efficiency, maximum sustainability and minimum impact on the environment

Unit 6: Energy efficient systems

Area 2: Energy and Conversion

Unit 1: Mathematical methods for electromagnetic fields resolution

Unit 2: Advanced Materials for Energy Applications

Unit 3: Integration of High Temperature Superconducting (HTS) Technologies in the Power System

Unit 4: Diagnosis in Electrical Machines

EVALUATION PROCEDURE

Evaluation method:

- 1 – There will be an initial overview seminar (2 h).
- 2 – The student must select one of the two scientific areas.
- 3 – The student shall perform a work covering at least 2 units of the selected area. The assessment will be made by the corresponding professors (of the selected units).
- 4 – The evaluation may take the following forms:
 - 4.1 – Development of a prototype (and corresponding report)
 - 4.2 – Realization of field work (e.g. in an external research group)
 - 4.3 – Preparation of a monography on a specific topic.
- 5 – Prepare a Powerpoint presentation (40 min).

Professors responsible for the evaluation:

J. Martins, M. Ventim Neves, S. Valtchev, J. Murta Pina, A. Pronto, P. Pereira

OTHER GUIDANCE

Students are asked to contact personally the professor(s) of each unit.

**COURSE: ADVANCED TOPICS IN SIGNAL PROCESSING
2019/2020**

Summary of objectives

- 1 - In facing a concrete situation, the student must, by mere observation, to know how to extract some qualitative characteristics from the signal at hand, namely, those referent to periodic/non-periodic, deterministic/random and frequential occupation, in order to decide which analysis and modeling tools are suitable to use.
- 2 - To use, with skill, a) the suitable analyze methods, namely, those of spectral analysis; b) creation of linear models, chiefly, autoregressive.
- 3 - To know how to use and design linear systems which allow separate signals into simpler components to become easier their study and processing.

ECTS: 6

Responsible professor



Manuel Ortigueira
Assoc. Professor (retired)

Other professors involved



Fernando Coito
Assoc. Professor

DETAILED PROGRAM

Unit 1: Revision of basic concepts

- Discrete-time signals and systems.
- Difference equations
- The Fourier Analysis - DFT and FFT
- The Z Transform

Recommended bibliographic references:

- Ifeachor, E., C., Jervis, B., W., "Digital Signal Processing: A Practical Approach", 2nd edition, Prentice-Hall, 2002.
- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Lyons, R.G. "Understanding Digital Signal Processing" 3rd Edition, Prentice-Hall, 2010
- Essentials of Digital Signal Processing, by B.P. Lathi and Roger A. Green, Cambridge University Press, 2014

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 2: Introduction to Stochastic Processes

- Definition
- Main characteristics.
- Parameter estimation: mean, variance, and correlation.

Recommended bibliographic references:

- Ifeachor, E., C., Jervis, B., W., "Digital Signal Processing: A Practical Approach", 2nd edition, Prentice-Hall, 2002.
- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Lyons, R.G. "Understanding Digital Signal Processing" 3rd Edition, Prentice-Hall, 2010

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 3: Spectral Analysis

- Blackmann-Tukey and Bartlett-Welch methods.
- High resolution methods: Capon, Min-Norm and MUSIC
- Multiwindow methods.

Recommended bibliographic references:

- Ifeachor, E., C., Jervis, B., W., "Digital Signal Processing: A Practical Approach", 2nd edition, Prentice-Hall, 2002.
- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Lyons, R.G. "Understanding Digital Signal Processing" 3rd Edition, Prentice-Hall, 2010

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 4: Linear Prediction

- Estimation methods: correlation, covariance and Burg.
- Ladder/lattice structures.
- Applications: speech coding and spectral analysis.

Recommended bibliographic references:

- Ifeachor, E., C., Jervis, B., W., "Digital Signal Processing: A Practical Approach", 2nd edition, Prentice-Hall, 2002.

- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Lyons, R.G. "Understanding Digital Signal Processing" 3rd Edition, Prentice-Hall, 2010
- Oppenheim, A.V. and Schafer, R.W. "Discrete-Time Signal Processing", Prentice-Hall, 3rd Ed. 2010.

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 4: The ARMA model.

- Description and properties
- Estimation methods.
- Applications.

Recommended bibliographic references:

- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Brockwell, P. J.; Davis, R. A. "Time Series: Theory and Methods", 2nd edition, New York: Springer (2009).

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 5: The Time-Frequency Distributions and Wavelet Transform.

- The short-time Fourier transform and the spectrogram
- The Wigner distribution – The Cohen class
- The Wavelet transform
- Applications.

Recommended bibliographic references:

- B. Boashash, Time-Frequency Signal Analysis and Processing: A Comprehensive Reference, 1st ed. Elsevier Inc., 2003.
- F. Hlawatsch and F. Auger, Time-Frequency Analysis. Wiley, 2013.

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

Unit 6: Advanced topic (to choose according to the particular interests of students):

- Adaptive Algorithms. Applications: noise and echo canceling; adaptive equalization.
- Filters: structures and characteristics. Special Filters. Realization.
- Multirate Conversion.
- Adaptive array signal processing.

Recommended bibliographic references:

- Iffachor, E., C., Jarvis, B., W., "Digital Signal Processing: A Practical Approach", 2nd edition, Prentice-Hall, 2002.
- Proakis, J. G. e Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms, and Applications", 4th edition, Prentice-Hall, 2006.
- Lyons, R.G. "Understanding Digital Signal Processing" 3rd Edition, Prentice-Hall, 2010

Contact professors for this topic: M. Ortigueira <mdo@fct.unl.pt>, F. Coito <fjvc@fct.unl.pt>

EVALUATION PROCEDURE

Evaluation method:

- The assessment will consist of the realization of a project.
- This project can be in group, but will have an individual evaluation.

Professors responsible for the evaluation: M. Ortigueira, F. Coito and another Professor from the DEE with interests on the Signal Processing area.

OTHER GUIDANCE

There will be several texts and software available at the page of the discipline.

COURSE: **ADVANCED TOPICS IN COLLABORATIVE NETWORKS** 2019/2020

Summary of objectives

This unit intends to give an updated overview of the current state of the art and research challenges in Collaborative Networks. First a general understanding of the scope of this new scientific discipline and its manifestations is aimed at. Then, a general understanding of the state of the art, current implementation practices, and research challenges shall be acquired.

ECTS: 6

Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



Ana Inês
Oliveira
Assist. Professor



João
Rosas
Assist. Professor

DETAILED PROGRAM

Unit 1: COLLABORATIVE NETWORKS - INTRODUCTION

- Overview
- Examples
- Classes

Recommended bibliographic references:

- Slides VE2, VE3
- Chapter 2.3 of Book 2.
- Camarinha-Matos, L. M. (2008). Advances in collaborative networked organizations. Proceedings of BASYS'08, 23-25 Jun 08, Porto, Portugal, Innovation in Manufacturing Networks (A. Azevedo, Ed.), Springer, pp. 3-16.
- Camarinha-Matos, L. M., Collaborative Networks: A Mechanism for Enterprise Agility and Resilience. In: Enterprise Interoperability VI (K. Maertins et al. Eds.), Proceedings of the I-ESA 7, Springer, 2014, pp. 3-11.
- Christopher Durugbo, Collaborative networks: a systematic review and multi-level framework, International Journal of Production Research, 2015
- F. P. Appio, A. Martini, S. Massa & S. Testa (2016). Collaborative network of firms: antecedents and state-of-the-art properties. International Journal of Production Research. DOI: 10.1080/00207543.2016.1262083

Unit 2: ICT INFRASTRUCTURES FOR COLLABORATION

- Infrastructure and services
- Approaches – layered, service-oriented, agent-based, grid computing
- Security and privacy, cryptography, VPN, e-Notary
- Access rights, biometric solutions, agent passport

Recommended bibliographic references:

- Slides VE4, VE5
- Chapters 5.1, 5.2 of Book 1.
- L. M. Camarinha-Matos, A. Juan-Verdejo, S. Alexakis, H. Bär, B. Surajbali, Cloud-based Collaboration Spaces for Enterprise Networks, Proceedings of ICCCT'15 - IEEE International conference on Computing and Communications Technologies, 185 - 190, 26-27 Feb 2015, Chennai, India. DOI: 10.1109/ICCCT2.2015.7292743

Unit 3: VO BREEDING ENVIRONMENTS

- Concept and typology
- Reference framework
- VBE management
- Value systems, benefits, trust

Recommended bibliographic references:

- Slides VE6
- Chapters 2.1, 2.2, 2.3, 2.4 of Book 1
- H. Afsarmanesh, L. M. Camarinha-Matos, S. S. Msanjila, Models, Methodologies, and Tools Supporting Establishment and Management of Second-Generation VBEs, IEEE Transactions on Systems, Man and Cybernetics – C, , Vol. 41, Issue 5, Sept 2011, pp 692-710.

Unit 4: VIRTUAL ORGANIZATIONS

- VO creation process and approaches
- VO creation framework
- Negotiation support
- VO management, DBP modeling and management
- Performance management, inheritance

Recommended bibliographic references:

- Slides VE7, VE8
- Chapters 2.5, 2.6, 3.1, 3.2, 3.3 of Book 1
- A. I. Oliveira, L. M. Camarinha-Matos, Negotiation Support for Co-Design of Business Services, 2014, in: Collaborative Systems for Smart Networked Environments, IFIP Series 434/2014.
- L. M. Camarinha-Matos, H. Afsarmanesh, A. I. Oliveira and F. Ferrada (2014), Cloud-based Collaborative Business Services Provision in Enterprise Information Systems, Lecture Notes on Business Information Processing, Volume 190, pp 366-384, Springer.

Unit 5: INTERACTION WITH CUSTOMERS

- Direct – EDI, STEP, etc.
- Meeting point - Portals
- E-Market
- Co-innovation

Recommended bibliographic references:

- Slides VE9
- Albrecht, C.C.; Dean, D.L.; Hansen, J. V. (2005). Marketplace and technology standards for B2B e-commerce: progress, challenges, and the state of the art. Information & Management, Volume 42, Issue 6, Pages 865-875.
- Romero, D., Molina, A.: Collaborative networked organisations and customer communities: value co-creation and co-innovation in the networking era. Production Planning & Control, 22(5-6), pp 447-472 (2011).

Unit 6: e-COMMERCE

- Concept and differences regarding CN
- Main issues and approaches
- Payment process, risks
- Auctions, e-procurement
- M-commerce

Recommended bibliographic references:

- Slides VE10
- Tarasewich, P.; Nickerson, R.C.; Warkentin, M. (2002). Issues in mobile e-commerce. Communications of the Association for Information Systems (Volume 8, 2002) 41-64.
- Harrison McKnight, D.; Choudhury, V.; Kacmar, C. (2003). Developing and Validating Trust Measures for e-Commerce: An Integrative Typology. Information Systems Research, Vol. 13, No. 3, September 2002.

Unit 7: VIRTUAL COMMUNITIES AND SOCIAL NETWORKS

- Overview
- Examples
- Classes

Recommended bibliographic references:

- Slides VE11
- Chapters 4.1, 4.2, 4.3 of Book 1.

Unit 8: REFERENCE MODELS

- Modeling framework
- ARCON reference model

Recommended bibliographic references:

- Slides VE12
- Book 2
- L.M. Camarinha-Matos, H. Afsarmanesh, On reference models for collaborative networked organizations, International Journal Production Research, Vol 46, N° 9, May 2008, pp 2453 – 2469.

GENERAL BIBLIOGRAPHY

- Slides VE2-VE12 (2017) – Powerpoint presentations used in the Virtual Enterprises course
- Books:
 1. Camarinha-Matos, L. M.; Afsarmanesh, H.; Ollus, M. (Editors) (2008). Methods and tools for Collaborative Networked Organizations, ISBN 978-0-387-79423-5, Springer: New York.
 2. Camarinha-Matos, L. M.; Afsarmanesh, H. (2008). Collaborative Networks: Reference Modeling, Springer: New York, ISBN 978-0-387-79425-9.

Contact professor: L. M. Camarinha-Matos <cam@uninova.pt>

EVALUATION PROCEDURE

Evaluation method:

Elaboration of a brief monography discussing the applicability of this scientific domain to the area of work of the PhD candidate and identifying what would be the main R&D challenges for development of Collaborative Networks in that context.

Professors responsible for the evaluation:

Luis M. Camarinha-Matos, J. Rosas, A. I. Oliveira

COURSE: ADVANCED TOPICS IN ROBOTICS AND INTEGRATED MANUFACTURING 2019/2020

Summary of objectives

This unit intends to give an updated overview of the current state of the art and research challenges in integrated and intelligent manufacturing systems. Recent progress and challenges on advanced robotics and interaction between humans and machines are also covered.

ECTS: 6

Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



José
Barata
Assoc. Professor



João
Rosas
Assist. Professor



Filipa
Ferrada
Assist. Professor
(invited)

DETAILED PROGRAM

Unit 1: Agile and Reconfigurable Manufacturing Systems

- Motivation and determining factors
- Architectures
- Simulation of (distributed) manufacturing systems
- Cloud-based manufacturing
- Current challenges

Recommended bibliographic references:

- Babiceanu, R.F., & Chen, F.F. (2006). Development and Applications of Holonic Manufacturing Systems: A Survey. *Journal of Intelligent Manufacturing* 17(1), 111-131.
- Barata, J. (2005). Coalition Based Approach For ShopFloor Agility. Edições Orion, Amadora.
- ElMaraghy, H.A. (2006). Flexible and Reconfigurable Manufacturing Systems Paradigms. *International Journal of Flexible Manufacturing Systems* 17(4), 261-276.
- Bi, Z.M., Lang, S.Y.T., Shen, W., & Wang, L. (2008). Reconfigurable manufacturing systems: the state of the art. *International Journal of Production research* 46(4), 967-992.
- Zhang, D. Z. (2011). Towards Theory Building in Agile Manufacturing Strategies — Case studies of an agility taxonomy. *International Journal of Production Economics*, 131(1), 303-312. doi: <http://dx.doi.org/10.1016/j.ijpe.2010.08.010>
- Lepuschitz, W., Zoitl, A., Vallee, M., & Merdan, M. (2011). Toward Self-Reconfiguration of Manufacturing Systems Using Automation Agents. *IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews*, 41(1), 52-69. doi: <http://dx.doi.org/10.1109/TSMCC.2010.2059012>
- Farid, A. (2014). Measures of reconfigurability and its key characteristics in intelligent manufacturing systems. *Journal of Intelligent Manufacturing*, 1-17. doi: 10.1007/s10845-014-0983-7
- Zoitl, A., & Vyatkin, V. (2009). Different perspectives [Face to face; "IEC 61499 architecture for distributed automation: The "glass half full" view]. *Ieee Industrial Electronics Magazine*, 3(4), 7-23. doi: <http://dx.doi.org/10.1109/MIE.2009.934789>
- Cândido, G., Colombo, A. W., Barata, J. and Jammes, F. (2011). Service-Oriented Infrastructure to Support the Deployment of Evolvable Production Systems. *IEEE Transactions on Industrial Informatics*, Vol 7, Number 4, pp 759-767. DOI: 10.1109/TII.2011.2166779.
- Negahban, A., & Smith, J. S. (2014). Simulation for manufacturing system design and operation: Literature review and analysis. *Journal of Manufacturing Systems*, 33(2), 241-261.
- Laguna, M., & Marklund, J. (2013). *Business process modeling, simulation and design*. CRC Press.
- Xu, X. (2012). From cloud computing to cloud manufacturing. *Robotics and computer-integrated manufacturing*, 28(1), 75-86.
- Jahangirian, M., Eldabi, T., Naseer, A., Stergioulas, L. K., & Young, T. (2010). Simulation in manufacturing and business: A review. *European Journal of Operational Research*, 203(1), 1-13.
- Nylund, H., & Andersson, P. H. (2010). Simulation of service-oriented and distributed manufacturing systems. *Robotics and Computer-Integrated Manufacturing*, 26(6), 622-628.
- Altiock, T., & Melamed, B. (2010). *Simulation modeling and analysis with Arena*. Academic press.

Contact professor for this topic: J. Barata <jab@uninova.pt>, J. Rosas <jrosas@uninova.pt>

Unit 2: Agent Based Manufacturing

- Revision of MAS concepts
- SoA of MAS applied to Manufacturing

Recommended bibliographic references:

- Barata, J. (2005). Coalition Based Approach For ShopFloor Agility. Edições Orion, Amadora - Lisboa.
- Monostori, L., Váncza, J., & Kumara, S.R.T. (2006). Agent-Based Systems for Manufacturing. *CIRP Annals* 55(2).
- Olsen, S., Wang, J., Ramirez-Serrano, A., & Brennan, R.W. (2005). Contingencies-based reconfiguration of distributed factory automation. *Robotics and Computer Integrated Manufacturing* 21, 379-390.
- Jammes, F., & Smit, H. (2005). Service-oriented paradigms in industrial automation. *IEEE Transactions on Industrial Informatics* 1(1), 62-70.
- Vrba, P., Tichy, P., Marik, V., Hall, K. H., Staron, R. J., Maturana, F. P., & Kadera, P. (2011). Rockwell Automation's Holonic and Multiagent Control Systems Compendium. *IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews*, 41(1), 14-30. doi: <http://dx.doi.org/10.1109/TSMCC.2010.2055852>

- Leitão, P. (2009). Agent-based distributed manufacturing control: A state-of-the-art survey. *Engineering Applications of Artificial Intelligence*, 22(7), 979–991. doi: <http://dx.doi.org/10.1016/j.engappai.2008.09.005>
- Barata, J., Camarinha-Matos, L., & Candido, G. (2008). A Multiagent-based Control System Applied to an Educational Shop Floor. *Robotics and Computer-Integrated Manufacturing*, 24(5), 597-605. doi: <http://dx.doi.org/10.1016/j.rcim.2007.09.008>
- Onori, M., Lohse, N., Barata, J., & Hanisch, C. (2012). The IDEAS project: plug & produce at shop-floor level. *Assembly Automation*, 32(2), 124-134. doi: <http://dx.doi.org/10.1108/01445151211212280>

Contact professor for this topic: J. Barata <jab@uninova.pt>, L. M. Camarinha-Matos <cam@uninova.pt>

Unit 3: Intelligent Supervision and Self-healing systems

- Execution supervision and system supervision
- Machine learning
- Self-healing systems

Recommended bibliographic references:

- Amin, M. (2001). Toward self-healing energy infrastructure systems. *Computer Applications in Power*, IEEE, Volume: 14, Issue: 1, pp 20-28.
- Ribeiro, L., Barata, J. (2011). Re-thinking diagnosis for future automation systems: An analysis of current diagnostic practices and their applicability in emerging IT based production paradigms. *Computers in Industry*, Vol 62, Number 7, pp 639-659. DOI:10.1016/j.compind.2011.03.001.
- Camarinha-Matos, L.M. (2014). Intelligent Supervision – course notes, UNL.

Contact professor for this topic: L. M. Camarinha-Matos <cam@uninova.pt>, J. Rosas <jrosas@uninova.pt>

Unit 4: Collaborative networks of machines and sensors

- Principles of collaborative networks
- Examples of collaborating machines
- Sensor networks for distributed manufacturing

Recommended bibliographic references:

- Akyildiz, I. F.; Su, W.; Sankarasubramaniam, Y.; Cayirci, E. (2002). A Survey on Sensor Networks. *IEEE Communications Magazine* • August 2002, pp 102-114.
- Kitano, H.; Asada, M.; Kuniyoshi, Y.; Noda, I.; Osawa, E. (1997). RoboCup: The Robot World Cup Initiative. *Proceedings of the first international conference on Autonomous agents*, Marina del Rey, California, USA, Pages: 340 – 347.
- Camarinha-Matos, L. M. (2008). Advances in collaborative networked organizations. *Proceedings of BASYS'08*, 23-25 Jun 08, Porto, Portugal, *Innovation in Manufacturing Networks* (A. Azevedo, Ed.), Springer, pp. 3-16.
- Dekkers, R. (2009). A Co-evolutionary Perspective on Distributed Manufacturing. In "Distributed Manufacturing - Paradigm, Concepts, Solutions and Examples" (H. Kühnle, Editor), Springer.
- Leitão, P. (2009). Agent-based distributed manufacturing control: A state-of-the-art survey. *Engineering Applications of Artificial Intelligence*, 22(7), 979–991. doi: <http://dx.doi.org/10.1016/j.engappai.2008.09.005>
- Xu, L., He, W., & Li, S. (2014). *Internet of Things in industries: A survey*.
- Iyengar, S. S., & Brooks, R. R. (Eds.). (2012). *Distributed Sensor Networks: Sensor Networking and Applications*. CRC press.
- Mottola, L., & Picco, G. P. (2011). *Programming wireless sensor networks: Fundamental concepts and state of the art*. *ACM Computing Surveys (CSUR)*, 43(3), 19.
- Chakrabarty, K., & Iyengar, S. S. (2005). Scalable infrastructure for distributed sensor networks (pp. I-XIV). Heidelberg: Springer.

Contact professor for this topic: L. M. Camarinha-Matos <cam@uninova.pt>, J. Barata <jab@uninova.pt>, F. Ferrada <faf@uninova.pt>

Unit 5: Self-Organization and Emergence to Support Evolvable Production Systems

- Bio-inspired mechanisms
- Self-organization and Emergence
- Current solutions and challenges

Recommended bibliographic references:

- Pfeifer, R., Lungarella, M., & Iida, F. (2007). Self-Organization, Embodiment, and Biologically Inspired Robotics. *Science* 318, 1088-1093.
- Kari, L., & Rozenberg, G. (2008). The Many Facets of Natural Computing. *Communications of the ACM* 51(10), 72-83.
- Tharumarajah, A. (2003). A Self-organising View of Manufacturing Enterprises. *Computers in Industry* 51(2), 185-196.
- Deguet, J., L. Magnin, et al. (2007). "Emergence and Software development Based on a Survey of Emergence Definitions." *Studies in Computational Intelligence* 56: 13-21.
- De Wolf, T. (2007). *Analysing and Engineering Self-Organising Emergent Applications*. Computer Science Department, Kath. Univ. Leuven. PhD Thesis.
- Dias Ferreira, J., Ribeiro, L., Onori, M., & Barata, J. (2013, 10-13 Nov. 2013). Bio-inspired self-organised mechatronic-agent interactions to support product emergence. Paper presented at the IECON 2013 - 39th Annual Conference of the IEEE Industrial Electronics Society, Vienna - Austria.
- Serugendo, G., Gleize, M., & Karageorgos, A. (2005). Self-organization in multi-agent systems. *Knowledge Engineering Review*, 20(2), 165-189. doi: 10.1017/s0269888905000494
- Pfeifer, R., Lungarella, M., & Iida, F. (2007). Self-Organization, Embodiment, and Biologically Inspired Robotics. *Science*, 318, 1088-1093.
- Frei, R., Di Marzo Serugendo, G., & Barata, J. (2008). Designing Self-Organization for Evolvable Assembly Systems. Paper presented at the SASO '08 - Second IEEE International Conference on Self-Adaptive and Self-Organizing Systems, Venice – Italy
- Ribeiro, L., Barata, J., & Colombo, A. (2008). MAS and SOA: A Case Study Exploring Principles and Technologies to Support Self-Properties in Assembly Systems. Paper presented at the SASOW 2008 - Second IEEE International Conference on Self-Adaptive and Self-Organizing Systems Workshops, Venice - Italy.
- Ribeiro, L., Barata, J., Onori, M., Hanisch, C., Hoos, J., & Rosa, R. (2011). Self-organization in Automation - The IDEAS Pre-Demonstrator. *Iecon 2011: 37th Annual Conference on IEEE Industrial Electronics Society*

Contact professor for this topic: J. Barata <jab@uninova.pt>, L. M. Camarinha-Matos <cam@uninova.pt>

Unit 6: Autonomous intelligent robots

- Modeling approaches
- Service robots
- Embodiment

Recommended bibliographic references:

- Brooks, R. (2008). I, Rodney Brooks, Am a Robot. *IEEE Spectrum* 45(6): 68-71
- GM., Edelman. 2007. Learning in and from brain-based devices. *Science*.318(5853):1103-5.
- Franceschini, N., Ruffier, F. & Serres, J. (2007). A Bio-Inspired Flying Robot Sheds Light on Insect Piloting Abilities. *Current Biology* 17(4): 329-335

- Pfeifer, R. & Bongard, J. C. (2007), How the body shapes the way we think: a new view of intelligence, MIT Press, Cambridge, MA.
- Kari, L., & Rozenberg, G. (2008). The Many Facets of Natural Computing. Communications of the ACM 51(10), 72-83.
- Ziemke, T. (2008). On the role of emotion in biological and robotic autonomy. BioSystems, 91, 401-408.
- Roy, N.; Baltus, G.; Fox, D.; Gemperle, F.; Goetz, J.; Hirsch, T.; Margaritis, D.; Montemerlo, M.; Pineau, J.; Schulte, J.; Thrun, S. (2000). Towards Personal Service Robots for the Elderly. Workshop on Interactive Robots and Entertainment (WIRE). Pittsburgh, PA.
- Pfeifer, R., Lungarella, M., & Iida, F. (2007). Self-Organization, Embodiment, and Biologically Inspired Robotics. Science, 318, 1088-1093.
- Santana, P., Mendonca, R., Correia, L., & Barata, J. (2013). Neural-Swarm Visual Saliency for Path Following. Applied Soft Computing, 13(6), 3021-3032. doi: <http://dx.doi.org/10.1016/j.asoc.2012.07.011>
- Santana, P., Correia, L., Mendonca, R., Alves, N., & Barata, J. (2013). Tracking natural trails with swarm-based visual saliency. Journal of Field Robotics, 30(1), 64-86. doi: 10.1002/rob.21423

Contact professor for this topic: J. Barata <jab@uninova.pt>, J. Rosas <jrosas@uninova.pt>

Unit 7: Human-machine interaction

- Ergonomic aspects
- Balanced automation systems
- User interface and usability
- Virtual reality and extended reality
- Affective computing

Recommended bibliographic references:

- Innovative and Creative Developments in Multimodal Interaction Systems. Eds. Y. Rybarczyk, T. Cardoso, J. Rosas, and L. Camarinha-Matos. Heidelberg: Springer, 2014.
- Mikhail A. Lebedev, Miguel A.L. Nicolelis. 2006. Brain-machine interfaces: past, present and future. Trends in Neurosciences . 29(9).
- Picard, R. W. (2003). Affective computing: challenges. International Journal of Human-Computer Studies, Volume 59, Issues 1-2, July 2003, Pages 55-64.
- Pantic, M.; Pentland, A.; Nijholt, A.; Huang, T.S. (2007). Human Computing and Machine Understanding of Human Behavior: A Survey. Lecture Notes in Computer Science, Volume 4451/2007, pp 47-71.
- Y., Rybarczyk, Hoppenot P., Colle E., and Mestre D. "Sensori-motor appropriation of an artefact: a neuroscientific approach." Human Machine Interaction - Getting Closer. Ed. Maurtua Inaki. Rijeka: InTech, 2012. 187-212.
- Tachi, S. (2010). Telexistence. World Scientific Publishing, London, UK.

Contact professor for this topic: : L. M. Camarinha-Matos <cam@uninova.pt>, F. Ferrada faf@uninova.pt

EVALUATION PROCEDURE

Evaluation method:

Based on the Syllabus established for this year:

- 1) Select 4 units
- 2) For each Unit make a study, starting with the suggested literature and also finding other relevant sources, and establish a synthetic conceptual framework of the area – concepts, relationships, relevance, challenges, etc.
 - a. When searching for additional references, first define a set of criteria for identifying relevant references.
 - b. Filter references according to such criteria.
- 3) Prepare 1 page synthesis per unit (thus 4 pages).
- 4) Prepare a presentation (40 min).

Professors responsible for the evaluation: L. M. Camarinha-Matos, J. Barata, J. Rosas, F. Ferrada

**COURSE: ADVANCED TOPICS IN INDUSTRY INFORMATION SYSTEMS
2019/2020**

Summary of objectives

This unit aims at providing an overview of the current state of the art and trends in information systems frameworks, architectures and technologies applied to industry. Modeling, management and access, exploitation and integration of information are addressed. A special attention is devoted to soft modeling and reasoning approaches.

ECTS: 6

Responsible professor



Luis M.
Camarinha-Matos
Full Professor

Other professors involved



José
Barata
Assoc. Professor



Ricardo
Gonçalves
Full Professor



Pedro
Sousa
Assist. Professor



Rita
Ribeiro
Assoc. Professor
(invited)



Filipa
Ferrada
Assist. Professor
(invited)

DETAILED PROGRAM

Unit 1: Trends in Information Systems

- Distributed and Federated Information Systems
- Multimedia Information Systems; Intelligent contents
- Big data
- Cloud-based information systems

Recommended bibliographic references:

- Afsarmanesh, H.; Guevara, V.; Hertzberger, L.O. (2004). Federated management of information for TeleCARE. Proceedings of TELECare 2004 - Int. Workshop on Tele-Care and Collaborative Virtual Communities in Elderly Care. INSTICC Press.
- Afsarmanesh, H., Ermilova, E., Msanjila, S., Camarinha-Matos, L.M., Modeling and Management of Information Systems Supporting Functional Dimension of Collaborative Networks, in Transaction on Large-Scale Data- and Knowledge- Centered Systems I, LNCS 5740, pp 1-37, 2009.
- Kosch, H. & Döller, M. (2005). Multimedia Database Systems: Where are we now? IASTED DBA. Innsbruck, Austria.
- Heesch, D. & Rüger, S. (2004). NNk Networks for Content-Based Image Retrieval. CIVR. Dublin, Ireland.
- Wang, Y.; Liu, Z.; Huang, J.-C. (2000). Multimedia content analysis: Using both audio and visual clues. IEEE Signal Processing Magazine, Volume: 17, Issue: 6.
- Camarinha-Matos, L. M., Afsarmanesh, H., Oliveira, A. I., Ferrada, F., Cloud-based Collaborative Business Services Provision, in Enterprise Information Systems, Lecture Notes on Business Information Processing, Vol. 190, pp 366-384, Springer.
- Qi Zhang, Lu Cheng, Raouf Boutaba, Cloud computing: state-of-the-art and research challenges, Journal of Internet Services and Applications, May 2010, Volume 1, Issue 1, pp 7-18
- Agrawal, D., Das, S., El Abbadi, A., Big data and cloud computing: current state and future opportunities, Proceeding EDBT/ICDT '11 Proceedings of the 14th International Conference on Extending Database Technology, pp 530-533.
- Min Chen, Shiwen Mao, Yunhao Liu, Big Data: A survey. Mobile Networks and Applications, April 2014, Volume 19, Issue 2, pp 171-209.
- S. Sagioglu and D. Sinanc, "Big data: A review," Collaboration Technologies and Systems (CTS), 2013 International Conference on, San Diego, CA, 2013, pp. 42-47. doi: 10.1109/CTS.2013.6567202
- H. Chen, R. H. Chiang, V. C. Story, Business Intelligence and Analytics: From Big Data to Big Impact. MIS Quarterly, Vol. 36 No. 4, pp. 1165-1188/December 2012.

Contact professor for this topic: L. M. Camarinha-Matos <cam@uninova.pt>, Filipa Ferrada <faf@uninova.pt>

Un it 2: Computational Intelligence and Qualitative Reasoning

- Computational intelligence methods
- Data Fusion
- Fuzzy inference Systems

Recommended bibliographic references:

- A. P. Engelbrecht Computational Intelligence: An introduction, Wiley, 2007
- Leszek Rutkowski Computational Intelligence Methods and Techniques, Springer, 2008
- Ross, T. (2004). Fuzzy Logic with Engineering Applications, John Wiley & Sons.
- R. A. Ribeiro, A. Falcão, A.Mora, J. M. Fonseca. FIF: A Fuzzy information fusion algorithm based on multi-criteria decision making, Knowledge-Based Systems Journal 58: (2014) 23–32 DOI: <http://dx.doi.org/10.1016/j.knosys.2013.08.032>
- K. D. Forbus, Qualitative Reasoning - <http://www.grg.northwestern.edu/papers/files/crc7.pdf>
- Springer Handbook of Computational Intelligence (2015) Editors: Janusz Kacprzyk, Witold Pedrycz. Springer. <http://link.springer.com/book/10.1007/978-3-662-43505-2>

Contact professor for this topic: R. Ribeiro <rar@uninova.pt>, L. M. Camarinha-Matos <cam@uninova.pt>

Unit 3: Knowledge Discovery and Data Mining

- Principles of machine learning
- Other data mining algorithms
- Data pre-processing and standards

Recommended bibliographic references:

- K. Cios, W. Pedrycz, R. Swiniarski, L. Kurgan, Data Mining: A Knowledge Discovery Approach, Springer, 2007.
- Hastie, T., R. Tibshirami, et al. (2001). The Elements of Statistical Learning. Data Mining, Inference and Prediction, Springer.
- Berson, A. and S. J. Smith (1997). Data warehousing, data mining & OLAP, McGraw-Hill.
- Chen, Z. (2001). Data Mining and Uncertain Reasoning - An Integrated Approach, John Wiley & Sons.
- Cios, K. J., W. Pedrycz, et al. (1998). Data Mining Methods for Knowledge Discovery, Kluwer.
- Mitchell, Tom. Machine Learning, McGraw Hill, 1997.
- Fayyad, U. M., Piatetsky-Shapiro, G., Smyth, P., Uthurusamy, R. Advances in Knowledge Discovery and Data Mining, AAAI Press/ The MIT press, 1996
- M. Zanin, D. Papo, P. A. Sousa, E. Menasalvas, A. Nicchi, E. Kubik, S. Boccaletti. Combining complex networks and data mining: why and how. *Physics Reports*, Volume 635, 27 May 2016, Pages 1–44

Contact professor for this topic: P. Sousa <pas@uninova.pt>

Unit 4: Systems Integration

- Integration needs, levels, and challenges
- Reference architectures and frameworks
- Approaches and technologies
- Middleware infrastructures

Recommended bibliographic references:

- Chen, D., Doumeingts, G., & Vernadat, F. (2008). Architectures for enterprise integration and interoperability: Past, present and future. *Computers in Industry* 59(7), 647-659.
- Panetto, H., & Molina, A. (2008). Enterprise integration and interoperability in manufacturing systems: Trends and issues. *Computers in Industry* 59(7), 641-646
- Camarinha-Matos, L.M.; Afsarmanesh, H. (2003). Designing the information technology subsystem, invited chapter, in Handbook on Enterprise Architecture, P. Bernus, L. Nemes, G. Schmidt (Eds.), Springer, 2003, pp. 617-680.
- Cândido, G., Colombo, A. W., Barata, J., & Jammes, F. (2011). Service-Oriented Infrastructure to Support the Deployment of Evolvable Production Systems. *IEEE Transactions on Industrial Informatics*, 7(4), 759-767. doi: 10.1109/tii.2011.2166779
- Ribeiro, L., Barata, J. and Colombo, Armando. (2009). Supporting Agile Supply Chains Using a Service-Oriented Shop Floor. *Engineering Applications of Artificial Intelligence*, Vol 22, Number 6, pp 950-960. DOI:10.1016/j.engappai.2008.10.
- Cândido, G., Barata, J. and Colombo, Armando. (2009). SOA in Reconfigurable Supply Chains: A Research Roadmap. *Engineering Applications of Artificial Intelligence*, Vol 22, Number 6, pp 939-949. DOI:10.1016/j.engappai.2008.10.

Contact professor for this topic: J. Barata <jab@uninova.pt>, L. M. Camarinha-Matos <cam@uninova.pt>

Unit 5: Enterprise Interoperability

- Data morphisms, model morphisms and transformations
- Semantic harmonization and adaptability
- New methods and tools for interoperability of complex systems

Recommended bibliographic references:

- Sanislav and Miclea, Cyber-physical systems—concept, challenges and research areas, *J. Control Eng. Appl. Inf.* 14 (2012) 28–33 (<http://ceai.srair.ro/index.php/ceai/article/view/1292i>)
- DiMario, System of Systems Collaborative Formation, World Scientific Publishing Co. Pte. Ltd, 2010 (ISBN: 13 978-981-4313-88-9)
- Kai Mertins and Frédéric Bénaben (Eds.), Enterprise Interoperability VI: Interoperability for Agility, Resilience and Plasticity of Collaborations, Book, John Wiley & Sons, Ltd, 2016
- Jazib Frahim and Venkata Josyula, Intercloud: Solving Interoperability and Communication in a Cloud of Clouds (Networking Technology), (ISBN-10: 158714445X), 2016
- Ilya Prigogine, Order out of chaos, Shambhala, 1984 (ISBN-13: 978-0394542041)
- Peter Erdi, Complexity Explained, Springer, 2008 (ISBN: 978-3-540-35777-3)
- Carlos Agostinho, Yves Ducq, Gregory Zacharewicz, João Sarraipa, Fenareti Lampathaki, Raul Poler, Ricardo Jardim-Goncalves, Towards a sustainable interoperability in networked enterprise information systems: Trends of knowledge and model-driven technology, *Computers in Industry*, Volume 79, 2016, Pages 64-76, ISSN 0166-3615, <http://dx.doi.org/10.1016/j.compind.2015.07.001>. (<http://www.sciencedirect.com/science/article/pii/S0166361515300191>)
- Hervé Panetto, Milan Zdravkovic, Ricardo Jardim-Goncalves, David Romero, J. Cecil, István Mezgár, New perspectives for the future interoperable enterprise systems, *Computers in Industry*, Volume 79, 2016, Pages 47-63, ISSN 0166-3615, <http://dx.doi.org/10.1016/j.compind.2015.08.001>. (<http://www.sciencedirect.com/science/article/pii/S0166361515300312>)
- Ricardo Jardim-Goncalves, Antonio Grilo, Keith Popplewell, Novel strategies for global manufacturing systems interoperability, *Journal of Intelligent Manufacturing* (2016) 27: 1, ISSN: 0956-5515, doi:10.1007/s10845-014-0948-x. (<http://link.springer.com/article/10.1007/s10845-014-0948-x>)

Contact professor for this topic: R. Gonçalves <rg@uninova.pt>

EVALUATION PROCEDURE

Evaluation method:

Based on the Syllabus established for this year:

- 1) Select 4 units
- 2) For each Unit make a study, starting with the suggested literature and also finding other relevant sources, and establish a synthetic conceptual framework of the area – concepts, relationships, relevance, challenges, etc.
 - a. When searching for additional references, first define a set of criteria for identifying relevant references.
 - b. Filter references according to such criteria.
- 3) Prepare 1 page synthesis per unit (thus 4 pages).
- 4) Prepare a Powerpoint presentation (40 min).

Professors responsible for the evaluation: L. M. Camarinha-Matos, R. Ribeiro, J. Barata, R. Gonçalves, P. Sousa, F. Ferrada.

COURSE: **ADVANCED TOPICS IN TELECOMMUNICATIONS** **2019/2020**

Summary of objectives

The objective of this course is to provide complementary formation with respect to the PhD thesis. Therefore, a specific syllabus will be defined for the profile of each student.

The different syllabus could be in the following areas:

- Transmission techniques
- Channel coding
- Estimation and synchronization
- Performance analysis of MAC protocols using Markovian modeling and queuing theory
- Cross-layer design of PHY/MAC communication schemes for decentralized networks
- Network Science.

An example of a syllabus exclusively for the channel coding area is provided below.

ECTS: 6

Responsible professor



Paulo Pinto
Full Professor

Other professors involved



Rui Dinis
Assoc. Professor



Luis Bernardo
Assist. Professor



Rodolfo Oliveira
Assist. Professor

DETAILED PROGRAM – Example for CHANNEL CODING

Unit 1: Basic coding schemes

- Channel capacity
- Basic concepts of channel coding
- Coding over GF(2)
- Block codes
- Convolutional codes
- ARQ, FEC and hybrid strategies
- Performance of coding schemes

Recommended bibliographic references:

- D. Declercq, M. Fossorier, E. Biglieri, *Channel Coding: Theory, Algorithms, and Applications: Academic Press Library in Mobile and Wireless Communications*, Jul. 2014
- D. Costello, D. Forney, "Channel Coding: The Road to Channel Capacity", *IEEE Proceedings*, June 2007

Contact professor for this topic: R. Dinis < rdinis@fct.unl.pt>

Unit 2: Advanced coding schemes

- Polynomial codes
- Cyclic codes
- Coded modulation
- Array codes
- Turbo codes
- BICM (Bit-Interleaved Coded Modulation)
- LDPC (Low-Density Parity Check)

Recommended bibliographic references

- G. Cancellieri, *Polynomial Theory of Error Correcting Codes (Signals and Communication Technology)*, Springer, Nov. 2014
- D. Declercq, M. Fossorier, E. Biglieri, *Channel Coding: Theory, Algorithms, and Applications: Academic Press Library in Mobile and Wireless Communications*, Jul. 2014
- T. Moon, *Error Correction Coding: Mathematical Methods and Algorithms*, Wiley, 2005

Contact professor for this topic: R. Dinis < rdinis@fct.unl.pt>

Unit 3: Modern techniques

- Viterbi algorithm
- Decoding polynomial codes
- Iterative decoders

Recommended bibliographic references:

- D. Declercq, M. Fossorier, E. Biglieri, *Channel Coding: Theory, Algorithms, and Applications: Academic Press Library in Mobile and Wireless Communications*, Jul. 2014

Contact professor for this topic: R. Dinis < rdinis@fct.unl.pt>

EVALUATION PROCEDURE

Evaluation method:

Writing of an essay.

Professors responsible for the evaluation: P. Fonseca Pinto, L. Bernardo, R. Dinis

**COURSE: ADVANCED TOPICS IN COMPUTATIONAL AND PERCEPTIONAL SYSTEMS
2019/2020**

Summary of objectives

Acquisition of advanced knowledge on topics related to the development of computational and perceptual systems, including modeling of complex evolutionary systems with learning capability, perceptual sub-systems (e.g. image processing with Artificial Intelligence techniques), and computational models and supporting technologies for embedded and cyber-physical systems.

ECTS: 6

Responsible professor



Luis Gomes
Assoc. Professor

Other professors involved



José Manuel
Fonseca
Assoc. Professor



Ricardo
Gonçalves
Full Professor



Pedro
Sousa
Assist. Professor



João Paulo
Pimentão
Assist. Professor



Anikó
Costa
Assist. Professor



André
Mora
Assist. Professor

DETAILED PROGRAM

Unit 1: Structure and dynamics of complex systems

- Behavior of adaptive systems
- Modeling adaptation in evolutionary systems
- Complex systems monitoring and interoperability checking
- Analysis of transitory, feedback and prognosis
- New methods and tools for complex systems interoperability

Recommended bibliographic references:

- Poler, R., Doumeingts, G., Katzy, B., Chalmeta, R, Enterprise Interoperability V: Shaping Enterprise Interoperability in the Future Internet, 2012, Springer.
- Mertins, K., Bénaben, F., Poler, R., Bourrières, J.-P., Enterprise Interoperability VI, Interoperability for Agility, Resilience and Plasticity of Collaborations, 2014, Springer.
- Charalabidis, Y., Lampathaki, F., Jardim-Goncalves, R., Revolutionizing Enterprise Interoperability through Scientific Foundations (Advances in Business Strategy and Competitive, 2014, IGI Global.
- Mainzer, K., Thinking in Complexity: The Computational Dynamics of Matter, Mind, and Mankind, Springer-Verlag; 2007.
- Gharajedaghi, J., Systems Thinking, Second Edition: Managing Chaos and Complexity: A Platform for Designing Business Architecture, 2005; Butterworth-Heinemann.
- Hilborn, R., Chaos and Nonlinear Dynamics: An Introduction for Scientists and Engineers: 2001; Oxford University Press.
- von Bertalanffy, L., General Systems Theory: Foundations, Development, Applications, 1969; GEORGE BRAZILLER.

Contact professor for this topic: R. Gonçalves <rg@uninova.pt>

Unit 2: Modeling formalisms for embedded systems and cyber-physical systems

- Model-driven approaches
- Models of computation
- Behavioral models for developing embedded systems and CPS
- Platform-independent versus platform-specific modeling
- Behavioral formalisms within selected application areas
- Embedded systems and CPS for IoT applications

Recommended bibliographic references:

- Colombo, A., Bangemann, Th., Karnouskos, S., Delsing, J., Stluka, P., Harrison, R., Jammes, F., Lastra, J.L. (Eds.); Industrial Cloud-Based Cyber-Physical Systems - The IMC-AESOP Approach, Springer, 2014.
- Luis Gomes, and João M. Fernandes (Eds.); Behavioral Modeling for Embedded Systems and Technologies: Applications for Design and Implementation; IGI Global; 2010.
- Richard Zurawski (Ed.); Embedded systems handbook, Second Edition 2-Volume Set; CRC Press; 2009.
- Claudius Ptolemaeus (Editor); System Design, Modeling, and Simulation using Ptolemy II. Ptolemy.org, 2014
- Kurt Jensen, Lars Michael Kristensen, Lisa Wells; Coloured Petri Nets and CPN Tools for modelling and validation of concurrent systems. In: International Journal on Software Tools for Technology Transfer (STTT). 2007
- Filipe Moutinho, Luis Gomes; Distributed Embedded Controller Development with Petri Nets - Application to Globally-Asynchronous Locally-Synchronous Systems. SpringerBriefs in Electrical and Computer Engineering, Springer; 2016

Contact professor for this topic: L. Gomes <lugo@fct.unl.pt>, A. Costa <akc@fct.unl.pt>

Unit 3: Knowledge Discovery and Data Mining

- Business Intelligence/Intelligent Systems/Data Warehousing/Data Mining
- Big Data: What Does it Really Mean?
- Data Mining problems and techniques
- Inputs and output data, Data pre-processing, Data Quality, Results quality
- Learning Methods (Classification/Regression, Segmentation, Association)

- Discussion Problems (Ethics and privacy in data mining, Standardization of Techniques in data mining, Dealing with multiple data sources: time and space problems)

Recommended bibliographic references:

- Jared Dean, Big Data, "Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners" (Wiley and SAS Business Series) May 27, 2014.
- Foster Provost, Tom Fawcett, "Data Science for Business: What you need to know about data mining and data-analytic thinking" – August 19, 2013.
- Cathy O'Neil , Rachel Schutt , "Doing Data Science: Straight Talk from the Frontline"– November 3, 2013.
- Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems, Jim Gray, Series Editor, Morgan Kaufmann Publishers, August 2000.
- Daniel T. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", 2004, Wiley-InterScience.
- Zhengxin Chen, Data Mining and Uncertain Reasoning, October 2001, John Wiley & Son.
- Ian H. Witten and Eibe Frank. Data Mining: Practical Machine Learning Tools and Techniques (Second Edition). Morgan Kaufmann, San Mateo, CA, June 2005.
- Tom Mitchell, Machine Learning, McGraw Hill, 1997.

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Unit 4: Image Processing

- Image Enhancement in the Spatial Domain
- Image Enhancement in the Frequency Domain
- Image Restoration and Registration Techniques
- Color Image Processing
- Wavelets and Multiresolution Image Processing
- Image Compression
- Intelligent methods for symbolic image interpretation
- GPU Image Processing

Recommended bibliographic references:

- Chris Solomon, Toby Breckon: Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab. John Wiley & Sons, Ltd. (2011).
- Erik Reinhard, Erum Arif Khan, Ahmet Oguz Akyuz, Garrett Johnson: Color Imaging: Fundamentals and Applications. A K Peters/CRC Press (2008).
- Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing (3rd. Ed.). Prentice Hall (2008).
- Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing Using MATLAB. Prentice Hall (2004).
- J. Parker: Algorithms for Image Processing and Computer Vision. John Wiley and Sons (1996).

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Unit 5: Globally asynchronous locally synchronous (GALS) systems

- Communication in GALS systems.
- Models of computation.
- Decomposition of models and distributed execution
- Distributed and networked embedded systems.

Recommended bibliographic references:

- Luciano Lavagno, Grant Martin, Louis Scheffer (Eds.); Electronic Design Automation for Integrated Circuits Handbook - 2 Volume Set (Industrial Information Technology). CRC Press; 2006.
- Richard Zurawski (Ed.); Embedded systems handbook, Second Edition 2-Volume Set; CRC Press; 2009.
- Filipe Moutinho and Luis Gomes; Asynchronous-Channels Within Petri Net-Based GALS Distributed Embedded Systems Modeling; IEEE Transactions on Industrial Informatics, Vol. 10, N^o. 4, November 2014.
- Filipe Moutinho, Luis Gomes; Distributed Embedded Controller Development with Petri Nets - Application to Globally-Asynchronous Locally-Synchronous Systems; SpringerBriefs in Electrical and Computer Engineering, Springer; 2015; DOI 10.1007/978-3-319-20822-0

Contact professor for this topic: L. Gomes <lugo@fct.unl.pt>, A. Costa <akc@fct.unl.pt>

Unit 6: Other approaches in perception

- Survey of trends in sensorial systems.
- Perception architectures.
- Machine learning techniques applied to sensorial systems.
- New sensorial technologies and materials.
- Reconfigurability issues in wireless sensor nodes
- Health applications.

Recommended bibliographic references:

- Fei Hu, Qi Hao. Intelligent Sensor Networks: The Integration of Sensor Networks, Signal Processing and Machine Learning. CRC Press (2012).
- Enrico Coiera. Guide to Health Informatics. Arnold Publishers; 2003.
- Richard Zurawski (Ed.); Embedded systems handbook, Second Edition 2-Volume Set; CRC Press; 2009
- Tom Mitchell, Machine Learning, McGraw Hill, 1997. Creed Huddleston, Intelligent Sensor Design Using the Microchip Dspic. Newnes.
- Feng Zhao, Leonidas Guibas. Wireless Sensor Networks: An Information Processing Approach. 2004. The Morgan Kaufmann Series in Networking.

Contact professor for this topic: J. M. Fonseca <jmf@uninova.pt>, L. Gomes <lugo@fct.unl.pt>, A. Mora <akc@fct.unl.pt>

EVALUATION PROCEDURE

Evaluation method:

Each student selects (at least) two units and the evaluation is based on written assignments (one per unit) and their oral defense.

Example: Prepare a synthesis of current research challenges in the various topics.

Professors responsible for the evaluation: L. Gomes, J. M. Fonseca, R. Gonçalves, P. Sousa, J. P. Pimentão, A. Costa, A. Mora

**COURSE: FREE OPTION
2019/2020**

Summary of objectives

This unit is aimed at extending the specific scientific background of the candidate and can be selected from any other course (or set of courses totaling 6 ECTS) from the PhD programs offered by FCT/UNL or any other university, subject to approval by the Scientific Committee of the PhD Program.

Examples may include other Advanced Topics offered by PDEEC.

ECTS: 6

CALENDAR OF COURSES

Inaugural session: 10 Feb 2020.

Courses are organized in two modalities according to the nature of the course and the number of enrolled students:

- ADVANCED TOPICS – organized in a tutorial mode (individual studies and direct interaction between students and professors) – start: Jan 2020
- SCIENTIFIC RESEARCH METHODOLOGIES AND TECHNIQUES – Lectures will take place in 11 Feb 2020.
- ENTREPRENEURSHIP METHODS – Lectures will take place in Mar 2020.
- DOCTORAL CONFERENCE – Initial lectures in June 2020; conference preparation along the year.
- FREE OPTION course: Either 1st or 2nd semester, depending on the chosen course.
- RESEARCH PLANNING – organized as individual studies in interaction with the PhD Supervisor – start: Mar 2020.

Formal lectures will be conducted in English.

Years 2 to 4: THESIS DEVELOPMENT

After the courses component, the students will develop the research work proposed in their Thesis Plan, including the thesis writing, for a period of up to 3 years (minimum 2 years).

This work will be conducted by the PhD candidate under guidance of his/her supervisor.

During the first year, a supervisor is appointed for each student by the Scientific Commission of the Program, in accordance with the candidate. The supervisor must be a professor or researcher with a PhD and experienced in conducting research work in the area of the aimed thesis. When the supervisor is external, a co-supervisor will also be appointed.

The topic of the thesis shall be proposed by the supervisor, as early as possible, during the first year of the Program. The topic must be registered according to the legislation, namely the artº 32º of the Law nº 74/2006.

The thesis can be written in English or Portuguese, with an abstract in both languages. Preference is given to English.

After a favorable recommendation from the Thesis Accompanying Committee, the thesis is submitted as a preliminary version. The thesis evaluation committee, nominated by the Rector under proposal of the Scientific Council of the FCT-UNL, might suggest changes / improvements, after which the candidate shall submit the final version to be discussed in a public examination. See Guidelines for Thesis submission in website.

Program Web site:

<http://sites.fct.unl.pt/pdeec>

FCT FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

PhD in Electrical and Computer Engineering

Objectives

Announcements

Calendar

Course syllabus

Course units

Support documents

New candidates

The PhD in Electrical and Computer Engineering aims at preparing researchers with the capacity to perform autonomous research activities and the ability to lead innovation processes in the scientific area of Electrical and Computer Engineering, in both academic and enterprise environments.

This third cycle complements the engineering education of the candidates through advanced studies and research and development in emergent knowledge areas. After finishing this cycle, the candidates will be able to lead, with scientific rigor and supported by updated methodological and technological knowledge, processes of analysis, design, modeling, production and operation of advanced and innovative systems in the domain of Electrical and Computer Engineering.

Specialization areas:

- Computational and Perceptual Systems
- Control and Decision
- Electronics
- Energy
- Enterprise Collaborative Networks
- Industry Information Systems
- Robotics and Integrated Manufacturing
- Signal Processing
- Telecommunications

Latest Announcements

Applications

This syllabus is revised annually.