



# Technical University of Crete

## School of Electrical & Computer Engineering

### Courses & research topics offered to the incoming Erasmus+ students during the Academic Year 2019-20

#### A. Postgraduate courses

##### A.1 Autumn Semester:

- 1) Special Topics in Information Systems - AIS 605 (Prof. Euripides G.M. Petrakis) / 7 ECTS units:** Information Retrieval (introduction, applications, performance measures, methods). Classical Information Retrieval Models (text retrieval, Boolean, vector, probabilistic models). Clustering (K-means, incremental K-means, bisecting K-means, agglomerative clustering). Hierarchical Clustering: the BIC-Means approach. Searching the Web [link analysis methods (PageRank, HITS), systems and techniques]. Indexing Methods (primary and secondary key access methods, spatial access methods). Semantic Web [introduction, applications, technologies (ontologies, reasoning, query languages), tools (XML, XML schema, RDF, RDFS, OWL, SPARQL, SWRL, Protege, Pellet)]. Semantic Web: ontology development. Cloud (introduction, applications, technologies). Future Internet (infrastructures and services).

##### A.2 Spring Semester:

- 1) Nonlinear Systems - SYS 603 (Assist. Prof. Nikolaos Bekiaris-Liberis) / 7 ECTS units:** Phase portrait. Second-order systems. Existence and uniqueness of solutions. Sensitivity equations. Comparison principle. Lyapunov stability. LaSalle theorem. Linearization. Center manifold theorem. Stability of perturbed systems. Input-to-state stability. Input-output stability. Perturbation theory and averaging. Singular perturbations. Circle and Popov criteria. Nonlinear control design using backstepping.
- 2) Electronic Energy Management Systems - ENE 602 (Assoc. Prof. E. Koutroulis) / 7 ECTS units:** Design of DC-DC and DC-AC power converters. Battery structures for electric energy storage. Electronic systems for maximizing power production (Maximum Power Point Tracking – MPPT). Smart meters. Special sensors, actuators and controllers for energy management and energy saving in Smart Homes/Buildings. Electronic energy management systems for Renewable Energy Sources, Smart Grids, Microgrids and electric vehicles. Electronic systems for wireless power transmission and energy harvesting.

**3) Introduction to the Quantum Technology – PHYS 602 (Assoc. Prof. D. Angelakis) / 7 ECTS units:** Introduction to Quantum Mechanics and the basics of quantum computation and cryptography. Dirac notation, linear quantum operators and observables, Hilbert space. Quantum mechanics postulates: quantum states, time evolution and Schrödinger equation, quantum measurements. Quantum bits and Bloch sphere. Quantum gate for one and two qubits. Entanglement. Quantum circuits and applications: superdense coding and quantum teleportation. Quantum computing and quantum parallelism. Quantum algorithms: Deutch, Deutch-Jozsa. The quantum Fourier transform. Grover's algorithm for search. Basics of quantum cryptography: the Ekert91 and BB84 protocols. Quantum implementation technologies review. The De Vincenzo criteria. The spin-qubit, Rabi oscillation and single qubit gates. Two qubit gates with spin qubits. Summary of the basics of quantum technologies based on linear optics, cold ions, Cavity QED systems, NMR, solid state and superconducting circuits.

**B. Supervision of diploma thesis (for undergraduate students) and MSc/PhD thesis (for postgraduate students) during the Autumn and Spring Semesters, in the following fields:**

- 1) Multiagent Systems (including Multiagent Learning), (Algorithmic) Game Theory, Computational Social Choice, Smart Grid. (Assoc. Prof. G. Chalkiadakis)**
- 2) Power Electronics, Microelectronic Energy Management Systems, Renewable Energy Sources, Sensors & Electronic Measurement Systems. (Assoc. Prof. E. Koutroulis)**
- 3) Electrophysiological signal analysis, Biomedical image processing, Biomolecular Imaging, Genomic data analysis and interactions, Image processing for surveillance applications. (Prof. M. Zervakis)**
- 4) Implementation of Quantum Computation with cavity QED or Superconducting Circuits or Integrated Photonic Chips, Different projects in implementation of Quantum Simulations and Quantum Computing in Quantum Technologies. (Assoc. Prof. D. Angelakis)**