A. Postgraduate courses

A.1 Winter Semester:

1) **Optimization (Prof. A. Liavas) / 7 ECTS**

2) **Probability Theory and Introduction to Machine Learning (Prof. G. Karystinos & Prof. M. Paterakis) / 7 ECTS**

3) **Programming and Database Fundamentals (Assoc. Prof. V. Samoladas) / 7 ECTS**
   Database design and use of databases in applications. Design and implementation issues in databases. Design and implementation of relational systems. Design and implementation of object–oriented systems. XML databases. Query optimization in databases. Optimizing the performance of applications with design at the physical level, cost optimization for transactions, recovery. Distributed databases. Data


**A.2 Spring Semester:**


2) **Time Series Modeling and Analysis (Prof. D. T. Hristopulos) / 7 ECTS units:** Stochastic processes (discrete and continuous), stationarity, mean and autocorrelation functions, frequency-domain analysis, ARMA(p,q) Models, SARIMA models for time series with complex trends and periodicities, Nonlinear auto-regressive, conditionally heteroskedastic models (ARCH/GARCH), Parameter estimation (methods of moments, least squares and maximum likelihood), Optimal model selection and residual analysis, Cross validation methodologies, Forecasting methodologies (for stationary time series, time series with trends and periodicities, exponentially weighted smoothing), Analysis of multivariate time series, Estimation of cross-covariance function, Transfer function models, Introduction to nonlinear time series analysis with dynamical systems theory. Examples and Exercises in R.

3) **Stochastic Processes and Time Series Analysis, MATH-412 (Prof. D. T. Hristopulos) / 7 ECTS units:** Fundamental concepts of stochastic processes (in continuous and discrete


5) **Reinforcement Learning and Dynamic Optimization (Prof. T. Spyropoulos) / 7 ECTS units:** The course will cover tools for optimization problems, where a sequence of (inter-dependent) decisions must be made (dynamically), often under uncertainty about the environment to be optimized (requires learning). Problems like this arise in many modern applications, ranging from autonomous driving and robotics, to game playing (chess, poker, go) and wired/wireless network management. The specific topics covered will be the following: Quick revision of first order optimization methods (gradient descent and stochastic gradient descent); Multi-armed Bandits; Online Convex Optimization; Markov Decision Processes; Tabular Reinforcement Learning - RL (Q-Learning, SARSA); Policy gradient methods; Approximate (e.g. Deep) RL solutions such as Deep Q Networks, Actor-Critic methods, the AlphaZero algorithm, and others. The class will include both take home exercises, as well as a programming project.

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)*

3) Methods of causality analysis (theoretical and applications to brain connectivity and climatic variable associations), Gaussian process regression (theoretical and applications to space-time datasets pertaining to energy, environmental variables, etc.), Computational methods for the simulation of non-Gaussian data (e.g., rainfall, wind speed, solar energy) (Prof. D. T. Hristopulos)