ANNEX 2 – COURSE DESCRIPTION

<table>
<tr><td>Course Title</td><td colspan="5">Neural Networks and Genetic Algorithms</td></tr>
<tr><td>Course Code</td><td colspan="5">ACSC402</td></tr>
<tr><td>Course Type</td><td colspan="5">Elective</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">4^{th}, 7^{th} – 8^{th}</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Harris Papadopoulos</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td>0</td></tr>
<tr><td>Course Purpose</td><td colspan="5">Neural networks and genetic algorithms are two of the most widely used approaches for solving difficult real-world problems in a huge variety of fields such as medicine, finance, business, communications, science and sports. The aim of this course is to provide an introduction to the fundamental principles and techniques of these two important branches of artificial intelligence, with an emphasis on the design and application of neural network and genetic algorithm systems to practical problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">1. Define and explain the theoretical foundations of Neural Networks and Genetic Algorithms.
2. Evaluate the strengths and weaknesses of Neural Networks and Genetic Algorithms and recognize the situations where each technique can be applied successfully.
3. Point out, explain and propose ways of dealing with the issues involved in the application of Neural Network and Genetic Algorithm techniques.
4. Compare and evaluate different types of Neural Networks and Genetic Algorithms and identify the most appropriate one for a given problem.
5. Design, implement and apply a suitable Neural Network or Genetic Algorithm for solving a particular problem and evaluate and report the results appropriately.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">None</td><td colspan="2">Corequisites</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">• Introduction to Neural Networks: Biological motivation; Classification and regression problems; Characteristics of Neural Networks; General structure of neurons.
• Perceptrons: Computations of a perceptron; Representational interpretation and limitation; perceptron learning algorithm; Gradient descent; Delta learning algorithm.
• Multilayer Neural Networks: Characteristics; The log-sigmoid, tan-sigmoid and softmax activation functions; The backpropagation training algorithm; Representational power; Issues: local minima and overfitting; Momentum term.</td></tr>
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	• **Genetic Algorithms:** Biological motivation; Search spaces; General structure of a genetic algorithm; Chromosome representation; Fitness function; Selection methods; Genetic operators; Convergence and diversity. • **Applications of Genetic Algorithms:** Combinatorial optimization with GAs; Solving pattern recognition problems with GAs; Hypothesis chromosome representation; Evolving neural network weights.
Teaching Methodology	The course is delivered through three hours of lectures per week, which include presentation of new material and demonstration of concepts and algorithms. Lectures also include in-class exercises to enhance the material learning process and to assess the student level of understanding and provide feedback accordingly. Furthermore a lot of work is in done through homework and private study by carrying out the computations of the different techniques for specific inputs and by experimenting in Matlab with the application of these techniques to benchmark datasets. This provides students with practical experience on the ideas and issues discussed in class. All lecture notes and other material is available to students through the course homepage.
Bibliography	**(a) <u>Textbooks:</u>** • Simon Haykin, ***Neural Networks: A Comprehensive Foundation***, 2nd edition, Prentice Hall, 1998. • Melanie Mitchell, ***An Introduction to Genetic Algorithms***, MIT Press, 1998. **(b) <u>References:</u>** • Christopher M. Bishop, ***Neural Networks for Pattern Recognition***, Oxford University Press, 1996. • David E. Goldberg, ***Genetic Algorithms in Search, Optimization, and Machine Learning***, Addison-Wesley, 1989. • Tom M. Mitchell, ***Machine Learning***, McGraw Hill, 1997.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as class participation and in class exercises, assignments and tests. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Participation Activities (4% of total marks for module) • Three assignments (20% of total marks for module)

	• One closed-book test (16% of total marks for module) • One closed-book, 2-hour exam (60% of total marks for module) Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in complex real-life problems. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**