University: **Alexandria**
Faculty: **Science**
Program: **Computer Science**

Form no. (12)
Course Specification

1- Course Data

Course Code:	**Course Title:**	**Academic Year/Level:**
CS 404	***Mathematical Methods for Robotics and Vision***	Fourth level (Second semester)
Specialization: Computer Science	**No. of Instructional Units:** **Lecture** 2 **Lab** 3	

2- Course Aim	• This course is designed to encourage in students a sense of interest for Robotics concept and its application in different contexts • Provide a solid foundation in the major areas of Robotics • Provide education and training of high quality in Robotics and vision
3- Intended Learning Outcome	
a- Knowledge and Understanding	a1. Describe the main concepts, definitions of intelligence systems a2. Review theories and concepts used in artificial Robotics a3. Identify an understanding of the contribution and impacts of Vision and Robotics in scientific, social, economic, environmental, political and cultural terms. a4. Robotics systems and Vision a5. Neural systems and search algorithms, genetic algorithm and genetic programming a6. Decision tree classification system

b- Intellectual Skills	b1. Manipulate and apply appropriate theories, principles and concepts relevant to artificial Robotics b2. Critically assess and evaluate the literature within the field of artificial Robotics b3 Deduce and interpret information from a variety of sources relevant Robotics
c- Professional Skills	**c1.** Plan, design and execute practical activities using techniques and procedures Appropriate to Robotics **c2.** Execute a piece of independent research using Robotics**,** computer media and techniques;.
d- General Skills	**d1.** Develop appropriate effective written and oral communication skills relevant to the specific course of Robotics **d2.** Demonstrate the ability to work effectively as part of a group **d3.** Solve problems relevant to Robotics using ideas and techniques some of which are at the forefront of the discipline. **d4.** Solve problems relevant to **applications in real life** in computer science using old and new languages some of which are at the forefront of the discipline;
4- Course Content	• Sources and measure of numerical errors, • Accuracy and stability of numerical calculations, • Linear systems, Existence and uniqueness of a solution, • Gaussian elimination and LU factorization, Pivoting, • Matrix norms and condition number, Cholesky factorization, • Over constrained systems, Normal equations, QR factorization, • Gram-schmidt orthonormalization, Householder transform, • Eigenvalue problems, Characteristic polynomial, • Similarity transforms, Jordan forms, Power method, • Singular value decomposition, Nonlinear equations, • Fixed point iteration, Newton, Secant and bisection methods, • Convergence rate, Systems of nonlinear equations, • Unconstrained optimization, Golden section search, Newton iteration, Steepest descent method, Conjugate gradients method, • Preconditioning, Constrained optimization, Lagrange multipliers, Function interpolation, Polynomial interpolants, • Lagrange and newton interpolation, Splines, Numerical quadrature, • Newton-cotes and gaussian quadrature, • Initial value ODE problems, Stability and accuracy, • Forward and backward euler, trapezoidal rule, Runge-kutta, • TVD and multi-step methods, Newmark integrators, • Staggered position/velocity grids, Boundary value PDE problems, Discretization and solution of the laplace equation, • The heat equation, CFL condition and stability.

5- Teaching and Learning Methods	Lecturers – Home works - Oral discussion - Quizzes
6- Teaching and Learning Methods for Students with Special Needs	NONE
7- Student Assessment:	
a- Procedures used:	Lecturers – tutorials- homework – oral discussion - Quizzes

b- Schedule:	Mid-Term exam… …. Week 10 Final exam ……. Week 17
c- Weighing of Assessment:	Term work (exam + home works) 20% Lab exam 10% Oral exam 10% Final exam 60%
8- List of References:	Artificial Intelligence: A modern approach, by Stuart J. Russell, Peter Norvig
a- Course Notes	Course notes provided by the Faculty member of Computer Science Division, Math department, to be handled at the beginning of the semester.
b- Required Books (Textbooks)	Artificial Intelligence: A modern approach, by Stuart J. Russell, Peter Norvig
c- Recommended Books	Artificial Intelligence: A modern approach, by Stuart J. Russell, Peter Norvig
d- Periodicals, Web Sites, …, etc.	

Course Instructor: Dr. Yasser Fouad
Head of Department: Prof. Dr. Mahmoud El-Alem.
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