MATHEMATICAL METHODS FOR ENGINEERING

1.1. Identification

University:	Universidad Politécnica de Valencia											
School:	Escuela Técnica Superior de Ingeniería del Diseño											
Course:	Mathematical Methods for Engineering											
ECTS:	4											
Semester:	*Winter*							*Summer*				X
Category	*Fundamental course*					X		*Specialisation course*				
Module	*MFI*	X	*MFII*	X	*MFIII*	X	*MSI*		*MSII*		*MSIII*	
Teachers:	Carmen Coll											
Language:	*English*		*Italian*				*Swedish*		*Spanish*			X

1.2. Learning-outcomes.

- To extend the understanding of some necessary Mathematics.
- Solve mathematical problems relevant to engineering.
- Show logical thinking in problem solving.

1.3. Competencies

- **General**

  - to have critical understanding of technical and scientific tools.
  - to demonstrate organizational and time-management skills.
  - to work in an international context.

- **Specific**

  - Write up in an accurate, coherent and logical manner your solutions to a range of mathematical problems to perform energy balances to industrial processes.
  - to demonstrate knowledge and understanding of Mathematical methods of Laplace transform theory, elementary Fourier series, eigenvalues and eigenfunctions, complex variable theory and vector calculus.

1.4. Contents

Ordinary differential Theory: First-Order linear equations. Existence and uniqueness of solutions of first-order differential equations. Applications: temperature equalization models, mixing problems. Higher-order linear differential equations. Numerical solutions of differential equations: Euler method, Heun Method, Runge-Kutta Method

Predictor-corrector Methods. Eigenvalues, eigenvectors and eigenfunctions. Systems of linear differential equations. Introduction to nonlinear systems.
Laplace Transform Theory: The (one-sided) Laplace transform and its existence. Use of Laplace transforms in solving simple ODEs with constant coefficients and given boundary conditions. Step functions and their transforms. Laplace transforms of standard functions. Uniqueness of the inverse. Elementary properties - linearity, first and second shifting theorems, change of scale. Transforms of derivatives and integrals and of products with powers of t. Transforms of periodic functions.The limit of F(s) as s->infinity. The initial and final value theorems and their uses. Laplace transforms of some further special functions - the saw-tooth function, the dirac delta function. Theorems relating to inversion. The solution of slightly more complicated ordinary differential equations with given initial or boundary conditions - constant coefficient equations, simultaneous equations, some equations with non-constant coefficients, equations with discontinuous forcing terms.
Linear dynamic systems: Introduction. General form of solutions. Matrix exponential. Transfer function. Stabilization problem. Stabilization by linear feedbacks. Optimal stabilization. Applications.

1.5. Teaching Methodology

Teaching methods include

- Lecture sessions: Standard chalk and talk lectures, using either blackboard or whiteboard.
- Practical sessions: They include questions and problems.

Learning activities include

- Individual study.
- Note-taking at lecture classes.
- Problems solved by “cooperative work”
- Preparation for a written examination

1.6. Evaluation

- written exams
- oral evaluation of the problems solved by “cooperative work”

1.7. Bibliography

- Kreyszig E, *Advanced Engineering Mathematics* Wiley, 1979
- Spiegel M R, Matemáticas superiores para ingenieros y científicos Schaum’s coll., McGraw-Hill