

COURSE ID SHEET



Course No.	5126	NTUA			
Semester:	3	Core	X	Elective	Specialization

Title:	MATHEMATICS IV (Differential Equations)
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Aim:	The students will be able: • to solve O.D.E.s (or I.V.P.s) of the first order (linear, homogeneous, Bernoulli, using integral factor), • to solve O.D.E.s (or I.V.P.s) of the second order (with real constant coefficients), • to calculate a partial solution of a homogeneous O.D.E. when one partial solution is known, • to calculate a special solution of an inhomogeneous O.D.E. when the general solution of the corresponding homogeneous solution is known, • to solve Euler's equation (or a corresponding I.V.P.s), • to use the Laplace transform, • to handle the Heaviside function, • to solve O.D.E.s using the Laplace transform, • to solve a system (homogeneous or not) of first order of O.D.E.s with real constant coefficients using the method of the eigenvalues and the eigenvectors, • to draw a phase plane of a first order system of O.D.E.s (2 equations and 2 unknown functions) with real constant coefficients and to recognize if the point (0,0) is stable or unstable, if it is saddle or node or spiral or center, • to recognize if a point is ordinary or singular (regular or not), • to find the minimum range that a solution of a second order O.D.E.s using series solutions converges, • to solve second order O.D.E.s using series solutions near an ordinary (or a regular singular) point, • to expand an odd or an even function using Fourier series, • to use separation of variables in order to solve a P.D.E., • to solve I.V.P.s for the heat conduction equation using separation of variables with homogeneous and nonhomogeneous boundary conditions.
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Content:	Introduction to Differential Equations (definitions, the notion of the solution, Initial and boundary value problems, Well-posed problems), Separable equations, Linear equations of 1st order, Homogeneous equations, Exact equations and integrating factors, Linear equations of n-order, General theory, Linear independence and Wronskian, Method of reduction of order, Homogeneous equations with constant coefficients, Method of variation of parameters, Method of undetermined coefficients, Euler equation, Series solutions of second order linear equations, Series solutions near an ordinary point, Legendre equation, Series solutions near a regular singular point, The Laplace transform, Definition and properties, The step function, Solution of linear equations with discontinuous forcing function, Convolution and Laplace transform, Solution of integral equations of special type, Systems of 1st order linear equations,
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Solution of homogeneous and nonhomogeneous systems with constant coefficients, Real, complex, repeated eigenvalues, The phase plane for linear systems, Autonomous systems and stability, Fourier series, the convergence theorem, Sine and cosine series, Sturm-Liouville boundary value problems, Derivation of diffusion equation via Fick's law, Solution of initial-boundary value problems for the heat conduction equation using separation of variables with homogeneous and nonhomogeneous boundary conditions.

Hours per semester:

LECTURE	52	EXERCISES	-	LABORATORY	-	HOME-WORK	98	TOTAL HOURS: 150
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Student performance /evaluation:

The evaluation of the students will be done:

- Through a written examination (100%), or
- Through a written examination (90%) and homework exercises (10%).