Mathematics

The Spring/Summer semester

Course	Type of class		ECTS
Mathematics	Lecture	Chalkboard practice	6
Numbers of hours per week	2	2	

Lecturer: Dr Anna Strzelewicz, PhD.
Department of Physical Chemistry and Technology of Polymers

Contents

UNIT 1. Complex numbers

Cartesian and polar representations of complex numbers. Euler's theorem. Powers of complex numbers: the de Moivre theorem. Extension of the de Moivre result to negative and rational powers. Roots of complex numbers. The geometric representation of Complex Numbers. Absolute Values. Functions of a complex variable. Analytic Functions. The Elementary Functions of z.

UNIT 2. Ordinary differential Equations (ODEs)

General Introduction: Nature and origin of differential equations. Examples from physics, chemistry and biology. General remarks on solution. Type and order. Well posedness.
First order ODEs: Homogeneous equations of first order. Exact equations. Integrating factors. Linear equations. Method of variation of parameters for solving linear first order ODE. Power series solutions of nonlinear ODEs of first order. Picard's Method. Bernoulli's equations. Clairaut equations.
Second order ODEs: Equations reducible to first order equations. The general solution of the homogeneous equation – Wronskian and linear independency. The linear homogeneous ODEs of second order with constant coefficients. The nonhomogeneous linear ODE with constant coefficients. Method of variation of parameters. The linear ODE with functional coefficients. Laplace and Fourier transform methods.

UNIT 3. Multiple integrals

Double integrals. Areas, moments and centres of mass. Double integrals in polar form. Triple integrals in rectangular coordinates. Masses and moments in three dimensions. Triple integrals in cylindrical and spherical coordinates. Substitutions in multiple integrals.

UNIT 4. Integration of Vector Fields

Vector and scalar fields. Line integrals. Line integrals of vector fields. Vector fields, work, circulation, and flux. Path independence, potential functions, and conservative fields. Green's theorem in the plane. Surface area and surface integrals. Parametrized surfaces. Oriented surfaces. Gradient, Divergence, and Curl. Stokes' theorem and Gauss's Law. Divergence theorem and a unified theory.

UNIT 5. Partial Differential Equations

The usual three operators and classes of equations: *The potential operator,. the diffusion operator and the wave operator*. The usual three types of problems*: Boundary value problems, initial value problems and eigenvalue problems*. The usual three questions**:** *Existence, uniqueness and stability.*
The usual three types of „boundary conditions"**:** *Dirichlet boundary condition. Neumann boundary condition. Robin boundary condition.* The usual three solution methods**:** *Separation of variables. Green's function method. Variational methods*.The Fourier transform. The Laplace transform**.**

UNIT 6. Elements of Probability Theory and Statistics

Combinatorial analysis. Permutations. Combinations. Probability theory. Probability of random events. Random variables and distribution. Mean value or expectation and variance. Chebyshev's inequality. The law of large numbers. Some important distributions. Limit theorems for sums of independent random variables. Statistics. Design of experiments. Regression and correlation.

References

1. Ross L.Finney, Maurice D.Weir, Frank R.Giordano „Thomas' CALCULUS", Addison Wesley 2003
2. Bronshtein, I.N.; Semendyayev, K.A.; Musiol, G.; Muehling, H. Handbook of Mathematics, Springer - Verlag 2004
3. Kazimierz Kuratowski "Introduction to calculus", Pergamon Press, 1962
4. G.Doggett, B.T.Sutcliffe, "Mathematics for Chemistry", Longman 1999.
5. S.L.Salas, E.Hille, "Calculus – one and several variables", 6th ed. John Wiley,NY 1994.
6. Włodzimierz Wrona „Matematyka" tom I i II, PWN 1966
7. Włodzimierz Krysicki, Lech Włodarski, Analiza matematyczna w zadaniach, PWN 2007