Topics of Mathematics in the PhD Admission Procedure

Suggested reading: given parts of E. Kreyszig: Advanced Engineering Mathematics (10th edn., Wiley, 2010.). Thomas's Calculus can also be used in reviewing basics of Mathematics.

Topic	pages
Operations with natural, rational, real and complex numbers	608-618
Properties of infinite sequences and series	671-674
Limit of infinite series, tests for convergence	674-679
Linear and quadratic interpolation, interpolation polynomials	808-811
Curve fitting with the Least Squares Method	872-875
Basic rules of differentiation, derivatives of elementary functions	(inner cover)
Geometrical interpretation of first and higher-order derivatives, approximation with difference quotients	838-839
Integrations: special techniques of the formulation of integral functions	(inner cover)
Numerical approximation of definite integrals of univariate and multivariate functions	827-832, 836-838
Power series, interval of convergence, differentiation and integration of univariate and multivariate functions	680-683, 687-688
Taylor series and Taylor polynomial of elementary functions	690-695
Fourier series of periodic functions in one variable, technique of series expansion	474-479, 483-484
Properties of orthogonal series	498-500, 504-505
Multivariate scalar functions: partial and directional derivatives	392-394, 396-397
Potential and gradient	395-396, 400-401
Ordinary Differential Equations	2-4
Classification, criterion of existence and uniqueness of a solution	27-29, 38-42
Initial Value Problems, Boundary Value Problems, Eigenvalue Problems	6, 499
Analytic and numeric solution to first-order differential equations	9-12, 20-22, 79-82
Problems described by linear differential equations	3, 62-68
Partial Differential Equations: classification, examples	540-541, 555
Conditions on the existence of the unique solution of problems with place and time dependent variables	545-549
Initial and Boundary Value Problems	604-605
Solution methods: Difference Method	923-925
Vectors in the plane and in the space	354-355
Vector operations, components of a vector written in an orthogonal/skew vector basis	356-360
Vector functions in one variable	378-380
Differential geometry of planar and spatial curves	381-387
Trihedron, arc length, curvature and torsion of a space curve	389-390
Representation of surfaces in Cartesian and polar coordinate systems	439-440
Level curve, gradient, surface normal	398-399
Area of a surface	441-442
Vector-vector functions: derivation, Jacobian matrix and the Jacobian	741
Vector-vector functions: integral over a line/surface	413-416, 443-446
Divergence and rotation	402-408
Theorems for integral transformation	433, 453, 464
Technical applications	436, 460
Matrix arithmetics, rank and determinant of a matrix, expansion of a determinant	282-283, 292-293, 295-297
Existence criterion of the inverse of a matrix	301-304
Eigenvalues, eigenvectors	322-328, 334-337
Homogeneous and inhomogeneous system of linear equations, role of the rank in the existence and uniqueness of the solution	288-291
Numerical solution to systems of linear equations with a quadratic matrix of coefficients	846-847, 852-853, 864-867
Probability: definitions based on Combinatorics and set theory	1018-1021
Conditional probability, independence of events	1022-1023
Discrete and continuous random variables, properties of probability and distribution functions	1029-1033
Important distributions	1039, 1041, 1045-1046
Mean and variance of a distribution	1035-1038