

Math 240

Calculus, Part III

Linear algebra:	matrices and matrix algebra, systems of linear equations, eigenvalues and eigenvectors, orthogonal matrices and diagonalization.
Vector calculus:	vector fields, derivatives, line and surface integrals, Green's, Stokes' and divergence theorems.
Ordinary differential equations:	ordinary differential equations and systems of ordinary differential equations; Laplace transform methods; power series solutions, Bessel's and Legendre's equations; applications.

Use of symbolic manipulation and graphics software.

Text: Zill, Dennis and Cullen, Michael: *Advanced Engineering Mathematics, Second Edition* (Sudbury, MA: Jones & Bartlett Publishers, ©1999)

Syllabus:

<u>Chapter</u> <u>Section & Topic</u>	Core Problems	Maple Problems
Vectors, Matrices and Vector Calculus		
7 Vectors 297		
7.6 Vector Spaces 331	1, 5, 6, 9, 11, 16, 19, 23, 26, 29	
8 Matrices 341		
8.1 Matrix Algebra 342	9, 10, 13, 15, 17, 21, 27, 29, 33, 37, 45	
8.2 Systems of Linear Algebraic Equations 351	3, 5, 11, 21, 27, 21, 43	
8.3 Rank of a Matrix 363	3, 11, 15	20
8.4 Determinants 368	11, 13, 17, 19, 25, 27, 29	
8.5 Properties of Determinants 374	11, 13, 17, 21, 27, 31, 39, 40	
8.6 Inverse of a Matrix 381	5, 13, 21, 25, 27, 31, 35, 45, 49, 55, 58	
8.7 Cramer's Rule 391	1, 5, 9, 11, 13	
8.8 The Eigenvalue Problem 395	1, 5, 11, 13, 17, 23	19, 27
8.9 Powers of Matrices 400 (Optional)	1, 5, 7, 11, 15	
8.10 Orthogonal Matrices 404	3, 9, 15, 21	
8.12 Diagonalization 418	3, 11, 15, 27, 33, 35, 39	19, 30
8.15 Method of Least Squares 436	1, 3	6, 7
9 Vector Calculus 447		
9.1 Vector Functions 448	1, 5, 13, 15, 19, 25, 29, 35, 37, 43	3, 7, 23
9.2 Motion on a Curve 454	5, 9, 11, 17	
9.3 Curvature and Components of Acceleration 459	1, 3, 13, 23	
9.7 Divergence and Curl 480	11, 15, 21, 27, 35, 39	1, 5
9.8 Line Integrals 486	3, 5, 13, 17, 23, 27, 35	
9.9 Line Integrals Independent of the Path 495	3, 9, 13, 17, 23, 27	
9.12 Green's Theorem 516	3, 11, 17, 23, 25, 27	
9.13 Surface Integrals 521	5, 13, 15, 25, 33, 37	
9.14 Stokes' Theorem 529	3, 9, 13, 15	
9.16 Divergence Theorem 546	1, 9, 13, 19	
9.17 Change of Variables in Multiple Integrals 552	1, 5, 9, 15, 25	

<u>Chapter</u> <u>Section & Topic</u>	Core Problems	Maple Problems
Ordinary Differential Equations*		
2 First-Order Differential Equations 35		
2.5 Solutions by Substitutions 64	5, 13, 17, 25, 29	
2.6 A Numerical Solution 68	1, 3, 5, 9, 13	
2.7 Linear Models 73	3, 11, 17, 23, 32	33
3 Higher-Order Differential Equations 101		
3.6 Cauchy-Euler Equation 136	7, 13, 21, 28, 37	
3.8 Linear Models: Initial-Value Problems 147	5, 9, 21, 25, 29, 33	43
3.9 Linear Models: Boundary-Value problems 163	11, 21, 25, 31	1, 33
4 The Laplace Transform 189		
4.1 Definition of the Laplace Transform 190	3, 7, 15, 23, 33, 39, 43	
4.2 The Inverse Transform; Transforms of Derivatives 195	7, 15, 21, 27, 35, 36, 43	
4.3 Translation Theorems 204	5, 9, 15, 19, 23, 29, 33, 41, 45, 57, 60, 61, 67, 75	
4.4 Additional Operational Properties 215	5, 13, 19, 25, 31, 43	20, 51
4.5 Dirac Delta Function 224	3, 9, 13	
4.6 Solving Systems of Linear Equations 227	3, 7, 11, 15	
5 Series Solutions of Linear Equations 235		
5.1 Solutions about Ordinary Points 236	3, 9, 13, 17, 27, 29	5, 7, 33
5.2 Solutions about Singular Points 246	3, 9, 13, 17, 23, 27	
5.3 Two Special Equations 256	3, 11, 21, 35, 38	36
10 Systems of Linear Differential Equations 567		
10.1 Preliminary Theory 568	5, 9, 13, 19, 23	
10.2 Homogeneous Linear Systems 575	3, 13, 21, 29, 35, 45	15, 17
10.3 Solution by Diagonalization 588	5, 9	
10.4 Nonhomogeneous Linear Systems 590	7, 19, 23, 27	30

*A brief review of elementary methods of solution will be given (see chapter/section listings below).

OLD EXAM QUESTIONS also form a part of the core.

The core problems indicate the kind of basic problems you will need to be able to solve by hand. They also provide a guide to the basic level of difficulty to be expected on the final exam.

Note: All sections of Math 240 have a COMMON FINAL EXAM

The following chapters and sections contain material covered in previous courses. Students are encouraged to review this material as needed.

Vectors, Matrices and Vector Calculus

7 Vectors 297

- 7.1 Vectors in 2-Space 298
- 7.2 Vectors in 3-Space 304
- 7.3 The Dot Product 309
- 7.4 The Cross Product 317
- 7.5 Lines and Planes in 3-Space 323

9 Vector Calculus 447

- 9.4 Functions of Several Variables 464
- 9.5 The Directional Derivative 470
- 9.6 Planes and Normal Lines 477
- 9.10 Review of Double Integrals 502
- 9.11 Double Integrals in Polar Coordinates 511
- 9.15 Review of Triple Integrals 534

Ordinary Differential Equations

1 Introduction to Differential Equations 5

- 1.1 Definitions and Terminology 6
- 1.2 Initial-Value Problems 15
- 1.3 Differential Equations as Mathematical Models 21

2 First-Order Differential Equations 35

- 2.1 Solution Curves Without the Solution 36
- 2.2 Separable Variables 44
- 2.3 Linear Equations 51
- 2.4 Exact Equations 59

3 Higher-Order Differential Equations 101

- 3.1 Preliminary Theory: Linear Equations 102
- 3.2 Reduction of Order 114
- 3.3 Homogeneous Linear Equations with Constant Coefficients 117
- 3.4 Undetermined Coefficients 123
- 3.5 Variation of Parameters 132