Course Objectives of MATH 311-507 taught by Dr. Daripa

A student, upon successful completion of this course, should be able to do the following.

- Chapter 1: Matrices and Systems of Equations ("S. Leon")
  – Know the definition of a matrix, elementary row operations, equivalent systems, strict tridiagonal form, pivot, and augmented matrix. Apply this knowledge to reduce a system of an nxn linear system to a strict tridiagonal form when possible and solve the system. Know when the method fails.
  – Know the definitions of lead and free variables, row echelon form of a matrix; Gauss elimination method of solving a system, reduced row echelon form, Gauss-Jordan elimination method, Underdetermined and Overdetermined systems.
  – Know matrix arithmetic operations.
  – Know algebraic rules for matrices, identity matrix, invertible matrix and the definition of an inverse of a matrix, singular matrix.
  – Know the definition of an elementary matrix, types of elementary matrices, row-equivalent matrices, diagonal and triangular matrices, – Find the inverse of a matrix using elementary row operations, LU factorization.

- Chapter 2: Determinants ("S. Leon")
  – Know the definitions of minor and cofactor of an element of a matrix, Find determinant of a square matrix using cofactor expansion. Simple formula for finding the determinant of a triangular matrix.
  – Know the various properties of determinants such as how the determinant of a matrix changes under various row operations. Find the determinant of a non-singular matrix by first converting it to a triangular matrix using elementary row operations.
  – Know the definition of adjoint of a matrix and the formula for the inverse of a nonsingular matrix; Cramer's rule for solving a non-singular nxn linear system of equations.

- Chapter 3: Vector Spaces ("S. Leon")
  – Know the vector space axioms, Determine whether a vector space axiom holds or not for a set, Know the meaning of closure under addition and multiplication, Determine whether a given set is a vector space or not under given rules of addition and scalar multiplication.
  – Know the definition of a subspace, determine whether a given subset of a vector space is a subspace of the vector space or not, null space of a vector space, span and spanning set.
  – Determine whether a given set of vectors in a vector space are linearly independent or not. State various vector spaces.
  – Know the meanings of basis and dimension of a vector space, be able to determine the basis and dimension of a given vector space,
  – Find the coordinates of a vector with respect to different bases, be able to find the transition matrix corresponding to a given change of bases.
  – Know the definitions of row and column spaces of a matrix, and rank of a matrix; determine the basis of these spaces and rank of a matrix, rank-nullity theorem.

- Chapter 4: Linear Transformation ("S. Leon")
  – Know the definitions of a linear transformation, its kernel and range. Image of a subspace of a

vector space, find whether a given transformation is linear or not, find kernel and range of a linear transformation.

– Find matrix representation of a linear transformation with respect to a given basis, learn application of this matrix representation.

- Chapter 5: Orthogonality ("S. Leon")

  – Learn the definition of scalar product in Euclidean space and apply it to find angle between vectors, Cauchy-Schwarz inequality and orthogonality in Euclidean space, be able to apply these ideas to solve distance and equivalent problems.

  – Know and understand the definitions of orthogonal subspaces and orthogonal complement of a subspace, fundamental subspaces and fundamental subspace theorem, additional subspace related theorems.

  – Define inner product spaces and give examples of some inner product spaces, know the basic properties of inner product spaces, Pythagorean law, scalar projection, Cauchy-Schwarz Inequality, normed linear space, triangle inequality.

  – Define orthogonal and orthonormal sets, know several theorems including Parseval's formula about orthonormal sets and their significance, solve least squares problems using projections.

  – Know Gram-Schmidt orthogonalization process for generating an orthonormal basis from any arbitrary basis for a vector space.

- Chapter 6: Eigenvalues ("S. Leon")

  – Find eigenvalues and eigenfunctions of square matrices, theorems about product and sum of matrices, eigenvalues of similar matrices.

  – Solve a linear system of coupled equations using the method of eigenvector expansion.

  – Diagonalize a nonsingular matrix.

- Chapter 7: Vectors ("Susan J. Colley")

  – Find the dot product, cross product, and equations of planes, solve distance problems.

- Chapters 8 and 9 partially covered (Susan. J. Colley)

  – Know parameterization of curves and its application to finding arclength etc.,

  – Know vector fields

  – Know definitions and use of Gradient, Divergence, Curl, and the Del Operator

  – Know how to perform change of coordinates and apply this knowledge to simplify evaluation of multiple integrals.

- Chapter 10: Line Integrals ("Susan J. Colley")

  – Evaluate scalar and vector line integrals.

  – Know Green's Theorem and apply this theorem to solve a variety of problems.

  – Know Conservative Vector Fields, path-independent line integrals, gradient field, scalar potential and so on. Determine whether a given field is conservative or not, Find field potential when appropriate.

- Chapter 11: Surface Integrals ("Susan J. Colley")

  –Know surface parameterization and its application to evaluating surface integrals.

  –Know Stokes's and Gauss's Theorems and their uses in a variety of applications.