

Practice Test 4B for Calculus II, Math 1502, November 14, 2010**Name:****Section:****Name of TA:**

This test is to be taken without calculators and notes of any sorts. The allowed time is 50 minutes. Provide exact answers; not decimal approximations! For example, if you mean $\sqrt{2}$ do not write 1.414.... Show your work, otherwise credit cannot be given.

Write your name, your section number as well as the name of your TA on EVERY PAGE of this test. This is very important.

Problem	Score
I	
II	
III	
IV	
Total	

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I: (25 points) a) The kernel of an $m \times n$ matrix A has the vectors

$$\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}$$

as a basis.

a) (2 points) What is n ?

b) (3 points) What is the dimension of $\text{Img}(A)$, $\text{Img}(A^T)$?

c) (8 points) Find a basis for $\text{Img}(A^T)$.

d) (12 points) Find the orthogonal projection onto $\text{Ker}(A)$ and $\text{Img}(A^T)$.

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II: Find the distance between the lines

$$\vec{x}_1(s) = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} + s \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \quad \vec{x}_2(t) = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + t \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}.$$

a) (5 points) Write this problem as a least square problem.

b) (10 points) Use the QR factorization method to find the solution.

c) (10 points) Solve the normal equation to check your solution found in b).

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III: a) (7 points) Are the following vectors linearly independent in \mathbb{R}^4 ?

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix} \begin{bmatrix} 2 \\ -1 \\ -4 \\ 3 \end{bmatrix} \begin{bmatrix} -4 \\ 7 \\ 18 \\ -1 \end{bmatrix}$$

b) (3 points) What is the dimension of the space they span?

c) (7 points) Find the orthogonal complement of the subspace S of \mathbb{R}^4 that is spanned by those vectors.

d) (8 points) Find the orthogonal projection onto S and S^\perp .

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IV: a) (13 points) Find the QR factorization of the matrix A given by

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 2 & 2 \\ -2 & 0 & 2 \end{bmatrix}.$$

b) (12 points) Find the orthogonal projection onto $\text{Img}(A)$.