MATH 461 EXAM # 2 Problem 1 March 30, 2005

Name: TA: Section:

For each of the following sets H, determine whether or not H is a subspace (and give adequate reasons for your answer). If it is a subspace, find a basis if possible and determine the dimension of H.

1a) [8] H is the set of $[x\ y\ z]^T$ in $\mathbb{R}^3$ so that $x + 2y + 4z^2 = 0$.

1b) [8] H is the set of diagonal 2×2 matrices in $\mathbb{M}_{2\times 2}$.

1c) [8] H is the set of polynomials $p(t)$ in $\mathbb{P}$ so that $\int_1^2 p(t)\,dt = 0$.

HONOR PLEDGE: I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

Signature _____

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Let $T: \mathbb{P}_3 \to \mathbb{P}_2$ be the transformation $T(p) = p' - p(0)$, so for example $T(t^3 - t + 2) = 3t^2 - 1 - 2 = 3t^2 - 3$.

2a) [8] Show that T is a linear transformation.

2b) [6] Find a basis for the kernel of T.

2c) [6] Find the dimension of the kernel of T and dimension of the range of T.

2d) [6] Is T one to one?_____ Is T onto?_____ Give reasons for your answers below.

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Let $A = \begin{bmatrix} 1 & 2 & 3 & 9 \\ 2 & 0 & -2 & 6 \\ 0 & 1 & 2 & 3 \\ 1 & 2 & 3 & 7 \end{bmatrix}$. You may use the following matlab output in this question:

```
EDU>A = [1 2 3 9; 2 0 -2 6; 0 1 2 3; 1 2 3 7];
EDU>rref(A)
ans =
   1   0  -1   0
   0   1   2   0
   0   0   0   1
   0   0   0   0
```

3a) [6] What is the rank of A?_____ What is the rank of A^T?_____

3b) [6] Find a basis of the column space of A.

3c) [6] Find a basis of the row space of A.

3d) [8] Find a basis of the null space of A.

3e) [4] What is the determinent of A?_____

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4a) [6] Is $\left\{ \begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}, \begin{bmatrix} 1 & 4 \\ 0 & 0 \end{bmatrix} \right\}$ a linearly independent set in the vector space $\mathbb{M}_{2\times 2}$ of 2×2 matrices? You must give an adequate reason for your answer.

4b) [6] Is $\{1, \cos^2(t), \sin^2(t)\}$ a linearly independent set of functions defined on $\mathbb{R}$? You must give an adequate reason for your answer.

4c) [8] Find a basis $\mathcal{B}$ for the span of $\{t^2,\ t-1,\ t^2+2t-2\}$ in $\mathbb{P}_2$. Find the coordinates of t^2+5t-5 relative to your basis $\mathcal{B}$.