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Instructions: You must show supporting work to receive full and partial credits. No textbook, lecture notes, or formula sheets are allowed.

- 1. (15 pts) True/False. For each of the following statements, please $circle\ T$ (True) or F (False). You do not need to justify your answer.
 - (a) T or F? The pivot columns of the reduced row echelon form of a matrix A form a basis for the column space of A.
 - (b) T or F? The nonzero rows of the reduced row echelon form of a matrix A form a basis for the row space of A.
 - (c) T or F? A matrix $A_{2\times 2}$ is always diagonalizable if it has two distinct eigenvalues.
 - (d) T or F? If A and B are similar, then both have the same eigenvectors.

2. (15 pts) Let
$$A = \begin{bmatrix} 1 & 1 & 7 & 1 \\ 0 & 2 & 8 & 2 \\ 2 & 2 & 14 & 3 \end{bmatrix}$$
.

(a) Find a basis for the column space of A

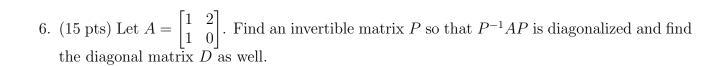
(b) Find a basis for the null space of A.

3.	(20 pts) Let $\mathcal{B} = \{1 - t, t - t^2, 1 + t^2\}$ be a basis of \mathbb{P}_2 and $\mathcal{C} = \{1, t, t^2\}$ be its standard basis. (a) Find the change-of-coordinate matrix from \mathcal{B} to \mathcal{C} , $P_{\mathcal{C} \leftarrow \mathcal{B}}$.				
	(b) Use (a) to find the change-of-coordinate matrix from \mathcal{C} to \mathcal{B} , $P_{\mathcal{B}\leftarrow\mathcal{C}}$. (Use calculator to save time.)				
	(c) Let $p(t) = 1$. Use (b) to find the coordinate of p with respect to \mathcal{B} , $[p]_{\mathcal{B}}$.				
	(d) Has (s) to write mass slinear combination of the polynomials in R				
	(d) Use (c) to write p as a linear combination of the polynomials in \mathcal{B} .				

- 4. (15 pts) Let $A = \begin{bmatrix} 3 & 2 \\ -4 & -1 \end{bmatrix}$.
 - (a) Find the characteristic equation for A.

(b) You are given the fact that $\lambda = 1 - 2i$ is a complex eigenvalue of A. Use this information to an complex-valued eigenvector of the eigenvalue.

5. (10 pts) You are given the fact that $\lambda = -3$ is an eigenvalue of $A = \begin{bmatrix} -2 & 1 & 1 \\ 1 & -2 & 1 \\ 1 & 1 & -2 \end{bmatrix}$. Find a basis for its eigenspace $E_{\lambda=-3}$. (You must show work to receive credits.)



7. (10 pts) (a) Let $M = \{\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} : a_{ij} \text{ are arbitrary real numbers} \}$. Assume M is a vector space. Show that the set of matrices $H = \{\begin{bmatrix} 0 & a \\ b & 0 \end{bmatrix} : a, b \text{ are arbitrary real numbers} \}$ is a subspace of M.

(b) What is the standard basis for H?