Question 1

mode MultipleChoice

text

A reduced row-echelon form of a 3 by 4 matrix can have how many leading one's?

choice must have 3

choice may have 1, 2, or 3

correct-choice may have 0, 1, 2, or 3

choice may have 0, 1, 2, 3, or 4

choice must have 4

Question 1

mode MultipleChoice

text

Consider the following statements about a 3 by 3 matrix X:

A. The rank of X equals 2.

B. The rank of X is ≤ 2.

C. One row of X is a multiple of another row.

Which of the following is correct?

choice A implies C, but C does not imply A

choice B implies C, but B does not imply A

choice C implies A, but A does not imply C

choice C implies A and A implies C

correct-choice C implies B, but B does not imply C

choice C implies B and B implies C

choice C does not imply B, and B does not imply C

Question 1

mode MultipleChoice

text Suppose A is a 3*3 matrix defining a linear transformation T from R^3 to R^3. such that
$T\begin{pmatrix}1\\0\\0\end{pmatrix} = ... \begin{pmatrix}1\\0\\0\end{pmatrix}$. Which statement is correct?

choice The first row of A is (1 0 0)

choice At least one row of A is (1 0 0) but we don't know which one

choice All rows of A are (1 0 0)

correct-choice The first column of A is $\begin{pmatrix}1\\0\\0\end{pmatrix}$

choice At least one column of A is $\begin{pmatrix}1\\0\\0\end{pmatrix}$ but we don't know which one

choice All columns of A are $\begin{pmatrix}1\\0\\0\end{pmatrix}$

choice None of the above and below

Question 2

mode MultipleChoice

text Let $A = \begin{pmatrix}0 & -2\\2 & 0\end{pmatrix}$. Which of the following is the correct geometric interpretation of the associated linear transformation?

choice rotates counterclockwise through 180 degrees

correct-choice rotates counterclockwise through 90 degrees and doubles the length

choice rotates counterclockwise through 90 degrees and halves the length

choice rotates counterclockwise through 90 degrees and quadruples the length

choice rotates clockwise through 90 degrees and doubles the length

Question 1

mode MultipleChoice

text Let T be a linear transformation from R^n to R^m and let $\vec{u} = T(\vec{0})$ where $\vec{0}$ is the zero vector in R^n. Choose the correct statement

choice $\vec{u}$ is a zero vector in R^n

choice $\vec{u}$ is a zero vector in R^m if and only if $n \leq m$

choice $\vec{u}$ is a zero vector in R^m if and only if $n = m$

choice $\vec{u}$ is a zero vector in R^m if and only if $n \geq m$

correct-choice $\vec{u}$ is a zero vector in R^m

choice none of the above and below

Question 2

mode MultipleChoice

text Let T be a rotation (with matrix A) through angle *alpha* in the plane. Choose the correct statement about the columns of A (as vectors)

correct-choice The columns of A are of length one and the dot product of the two distinct columns equals zero

choice The columns of A are of length one and the dot product of the two distinct columns equals $cos(\alpha)$

choice The columns of A have length $cos^2(\alpha)$

choice The columns of A have length grater than one

choice The dot product of the two distinct columns is always positive

choice The dot product of the two distinct columns is zero if and only if $\alpha = 0$

choice None of the above and below

Question 1

mode MultipleChoice

text Suppose T: $R^n \to R^m$ is a linear transformation and there exists a vector $\vec{v}$ (not zero) such that $T\vec{v} = \vec{v}$. Then

choice T might be a rotation, shear, reflection or a projection

choice T might be a reflection or projection, but not a rotation or shear

correct-choice T might be a reflection, projection or shear but not a rotation

choice T might be a reflection, shear or rotation but not a projection

choice T might be a projection, shear or rotation but not a reflection

choice none of the above and below

Question 2

mode MultipleChoice

text Let $T = proj_L$ and let $\vec{u}$ be a vector of length 1. Then the length of $T\vec{u}$ might be:

choice any positive number ($x > 0$)

choice any nonnegative number ($x \geq 0$)

choice any x satisfying $0 < x < 1$

correct-choice any x satisfying $0 \leq x \leq 1$

choice either 0 or 1

choice must be 1

Question 1

mode MultipleChoice

text The inverse of the matrix $\begin{pmatrix} 4 & 1 \\ 2 & 3 \end{pmatrix}$ is

choice $\begin{pmatrix} 3 & -1 \\ -2 & 4 \end{pmatrix}$

choice $\begin{pmatrix} -4 & 2 \\ 1 & -3 \end{pmatrix}$

choice $\begin{pmatrix} \frac{-4}{10} & \frac{2}{10} \\ \frac{1}{10} & \frac{-3}{10} \end{pmatrix}$

correct-choice $\begin{pmatrix} \frac{3}{10} & \frac{-1}{10} \\ \frac{-2}{10} & \frac{4}{10} \end{pmatrix}$

choice the matrix is not invertible

Question 2

mode MultipleChoice

text Suppose you need to solve a system of 4 equations in 4 unknowns $A\vec{x} = \vec{b}$ for a specific 4*4 matrix A and a specific 4-vector $\vec{b}$. You now know two methods:
(i) use Gauss-Jordan elimination on the augmented matrix $(A|\vec{b})$
(ii) find A^{-1} and then set $x = A^{-1}\vec{b}$
Choose the best statement comparing the relative amount of work that these methods require:

choice Both require the same amount of work

choice (ii) is easier because there is a formula for A^{-1}

choice (ii) is harder because computing A^{-1} is just as hard as (i) but then you have to do the matrix multiplication $A^{-1}\vec{b}$

correct-choice (ii) is harder because computing A^{-1} involves row reducing a larger matrix, and in addition you have to do the matrix multiplication

choice it depends on what A is

Question 1

mode MultipleChoice

text Let $B = \begin{pmatrix} 1 & -1 & 0 \\ 2 & 3 & 1 \end{pmatrix}$ and $A = \begin{pmatrix} 2 & 2 \\ 2 & 2 \\ 2 & 2 \end{pmatrix}$.... Then BA = ..?

choice $\begin{pmatrix} 0 & 12 \\ 0 & 12 \end{pmatrix}$

correct-choice $\begin{pmatrix} 0 & 0 \\ 12 & 12 \end{pmatrix}$

choice $\begin{pmatrix} 6 & 4 & 2 \\ 6 & 4 & 2 \\ 6 & 4 & 2 \end{pmatrix}$

choice $\begin{pmatrix} 6 & 6 & 6 \\ 4 & 4 & 4 \\ 2 & 2 & 2 \end{pmatrix}$

choice undefined

Question 2

mode MultipleChoice

text Let L_1 and L_2 be two distinct lines passing through the origin (of R^2), and let ref_{L_1} and ref_{L_2} denote the reflection inlines L_1 and L_2 respectively. What kind of linear transformation is the composition $ref_{L_1}(ref_{L_2}(\vec{x}))$?
(Suggestion: use geometry rather than algebra)

choice A reflection in another line

choice the identity

correct-choice a rotation

choice a shear

choice a projection

choice a dilation

choice a linear transformation, but not of the types listed here

choice not a linear transformation

Question 1

mode MultipleChoice
text Let A and B be invertible $n * n$ matrices. Then the inverse of ABA^{-1} is
choice $A^{-1}B^{-1}A$
correct-choice $AB^{-1}A^{-1}$
choice B^{-1}
choice ABA^{-1}
choice $A^{-1}BA$
choice the matrix is not necessarily invertible

Question 2

mode MultipleChoice
text Consider the following three statements about an invertible $n * n$ matrix A.
(i) $A = A^{-1}$
(ii) $AA = I$
(iii) $A^{-1}A^{-1} = I$
where I is an identity $n * n$ matrix. Choose the correct relationship among them:
choice (i) and (ii) are equivalent, but (iii) is different
choice (i) and (iii) are equivalent, but (ii) is different
choice (ii) and (iii) are equivalent, but (i) is different
choice all three statements are different
correct-choice all three statements are equivalent

Question 1

mode MultipleChoice

text Let T be the orthonormal projection in the plane onto the line (through the origin) L. Fill in the blank with a, b, c, d or e:
The image of T is:

correct-choice the line L

choice the origin

choice the whole plane

choice the line (through the origin) orthogonal to L

choice a line parralel to L

Question 2

mode MultipleChoice

text Let T be the orthonormal projection in the plane onto the line (through the origin) L. Fill in the blank with a, b, c, d or e:
The kernel of T is

choice the line L

choice the origin

choice the whole plane

correct-choice the line (through the origin) orthogonal to L

choice a line parralel to L

Question 3

mode MultipleChoice

text The kernel of $\begin{pmatrix} 1 & 2 \\ 2 & 4 \\ 3 & 6 \end{pmatrix}$ is

choice $\left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix} \right\}$

choice $\left\{ \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \right\}$

choice the line $x + 2y + 3z = 0 \ in \ R^3$

choice the plane $x + 2y + 3z = 0 \ in \ R^3$

correct-choice the line $x + 2y = 0 \ in \ R^2$

choice the line $y = 2x \ in \ R^2$

choice all of R^2

Question 1

mode MultipleChoice

text Let V be a subspace of R^n and $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ a set of vectors in V. Suppose every vector in V may be expressed as a linear combination of $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$. Then

choice $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ is a basis of V

choice $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ are linearly independent

correct-choice $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ span V

choice $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ span R^n

choice $\vec{v_1}, \vec{v_2}, ..., \vec{v_m}$ are linearly dependent

choice none of the above and below

Question 2

mode MultipleChoice

text In example 4 on page 113, which pairs of the vectors span image A?

choice all pairs

choice only $\{v_1, v_2\}$

choice only $\{v_1, v_2\}$ or $\{v_2, v_3\}$

choice only $\{v_1, v_2\}$, $\{v_2, v_3\}$ or $\{v_3, v_4\}$

correct-choice all pairs except $\{v_1, v_3\}$

choice all pairs except $\{v_1, v_3\}$ and $\{v_2, v_4\}$

Question 1

mode MultipleChoice
text Which one of the following statements is true of all $m * n$ matrices A:
correct-choice The columns of A span $im(A)$
choice The columns of A form a basis for $im(A)$
choice The columns of A span $Ker(A)$
choice The columns of A form a basis for $Ker(A)$
choice The columns of A are linearly independent
choice The columns of A are linearly dependent
choice none of the above and below

Question 2

mode MultipleChoice
text Let A vary over all $9 * 9$ matrices. How many different pairs of numbers (a,b) are there with $a = nullity(A)$ and $b = rank(A)$
choice 81
choice 100
choice 9
correct-choice 10
choice none of the above and below

Question 1

mode MultipleChoice

text Let $T : R^2 \to R^2$ be the linear transformation of multiplication by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$. With respect to the basis $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$, the matrix representing T is

choice $\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$

choice $\begin{pmatrix} 2 & 2 \\ 3 & -3 \end{pmatrix}$

choice $\begin{pmatrix} 2 & 3 \\ 2 & -3 \end{pmatrix}$

choice $\begin{pmatrix} 5 & 1 \\ 1 & 5 \end{pmatrix}$

choice $\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$

correct-choice $\begin{pmatrix} \frac{5}{2} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{5}{2} \end{pmatrix}$

Question 2

mode MultipleChoice

text Let A be an $n * n$ matrix of rank m. Any matrix similar to A:

choice may have rank $\leq n$

choice may have rank $\leq m$

choice may have any rank $\geq m$ and $\leq n$

correct-choice must have rank m

choice may have rank m or n, but not any other rank

Question 1

mode MultipleChoice

text Let P_n be the linear space of all polynomials of degree $\leq n$. Its dimension is:

choice 1

choice n-1

correct-choice n+1

choice n^2

choice infinite

Question 2

mode MultipleChoice

text Example 15 on page 155 gives one basis for P_2. Which of the following give another basis for P_2?

choice $(x-1)^2,\ x-1$ and 1

choice $(x+1)^2,\ (x-1)^2$ and 1

choice $x^2, (x+1)^2$ and $(x+2)^2$

choice none of these

correct-choice all of these

Question 1

mode MultipleChoice

text Let P_2 be the space of quadratic polynomials. Which of the following are linear transformations from P_2 to P_2?

choice $Tf(x) = xf(x)$

choice $Tf(x) = f(x)^2$

correct-choice $Tf(x) = f(x+1)$

choice none of these

choice all of these

Question 2

mode MultipleChoice

text In example 5 on page 162, the specific matrix $S = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ is used. More generally, for which 2*2 matrix S is the same conclusion valid?

choice all matrices

choice all nonzero matrices

correct-choice all invertible matrices

choice all matrices that commute with A

choice all matrices with integer entries

choice only the given matrix and its inverse

Question 1

mode MultipleChoice

text In definition 4.3.1, if we consider the basis B' consisting of the same vectors but listed in reverse order, $f_n, f_{n-1}, ..., f_2, f_1$, what do the B'-coordinates of f look like compared to the B-coordinates of f?

choice the same

correct-choice the column listed in the reverse order

choice the same numbers written in a row, rather than a column vector

choice it depends on which vector f is

Question 2

mode MultipleChoice

text In Examples 4 and 5, the matrix B of the linear transformation T is computed in two ways. Use the result to find $im(T)$ in P_2. It is

choice the constants

correct-choice P_1 (all polynomials of degree ≤ 1)

choice P_2

choice the span of $x + 2x^2$ and $2x^2$

choice none of the above and below

Question 1

mode MultipleChoice

text Let M and M' denote the matrices representing the linear transformations $of Df = f'$ from P^3 to P^3 with respect to the bases $B = (1, x, x^2, x^3)$ and $B' = (1, x - 1, (x-1)^2, (x-1)^3)$ respectively. Which of the following is true?

choice $M' = M - I$

choice $M' = M + I$

correct-choice $M' = M$

choice $M' = M^{-1}$

choice none of the above or below

Question 2

mode MultipleChoice

text In Example 7 consider the transformation $T(M) = AM - MA$ for a specific matrix A. Now suppose A is any nonzero matrix. Which of the following is true?

choice The nullity of T is 2 because $T(I) = 0$ and $T(A) = 0$, hence the rank of T is 2.

correct-choice The nullity of T is at least 2, hence the rank of T is at most 2.

choice T is an isomorphism

choice The nullity of T is at most 2, hence the rank of T is at least 2.

choice T is linear only if A is invertible

choice none of the above and below

Question 1

mode MultipleChoice
text Let V be a subspace of R^n of dimension m. Then the dimension of $V^\perp$ is:
choice m
correct-choice n-m
choice any number between $n-m$ and n
choice any number between 0 and $n-m$
choice any number between 0 and n
choice none of the above or below

Question 2

mode MultipleChoice
text Which of the following sets of vectors constitute an orthonormal basis in R^3?
choice $\begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$
choice $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$
choice $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \\ 0 \end{pmatrix}, \begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \\ 0 \end{pmatrix}$
choice all of the three choices
correct-choice none of the three choices

Question 1

mode MultipleChoice

text Let $\vec{u}$ and $\vec{v}$ be orthonormal vectors in R^n. Then $\|u+v\|$ is

choice 2

correct-choice $\sqrt{2}$

choice 1

choice depends on n

choice any number between 0 and $\sqrt{2}$

Question 2

mode MultipleChoice

text Let $\vec{x}, \vec{y}$ be two nonzero vectors in R^n. Consider the 4 angles :
$a_1 =$ angle between $\vec{x}$ and $\vec{y}$
$a_2 =$ angle between $-\vec{x}$ and $\vec{y}$
$a_3 =$ angle between $\vec{x}$ and $-\vec{y}$
$a_4 =$ angle between $-\vec{x}$ and $-\vec{y}$.
Which of the following is true:

correct-choice $a_1 = \pi + a_2 = \pi + a_3 = a_4$

choice $a_1 = a_2 = a_3 = a_4$

choice $a_1 = \pi - a_2 = \pi - a_3 = a_4$

choice $a_1 = \pi + a_2 = a_3 = \pi + a_4$

choice $a_1 = a_4$ and $a_2 = a_3$, but there is no relationship between a_1 and a_2

choice none of the above and below

Question 1

mode MultipleChoice
text In Fact 5.2.2, what is the relationship between the numbers m and n?
choice n and m may be any positive integers
choice we must have $n \leq m$
correct-choice we must have $m \leq n$
choice we must have $m = n$
choice we must have $n < m$
choice we must have $m < n$

Question 2

mode MultipleChoice
text If you try to use the Gramm-Schmid process (Algorithm 5.2.1) on a set of vectors $\vec{v}_1, \vec{v}_2, .., \vec{v}_m$ that are linearly dependent, what will happen?
choice It will work exactly as in linear independent case
choice It will produce an orthonormal, basis but with fewer than m vectors
correct-choice For some j the formula for w_j will call for division by zero
choice It will produce a set of vectors that aren not orthogonal
choice You can't predict what will happen

Question 1

mode MultipleChoice

text Suppose A and B are invertible n-by-n matrices. Which of the following are true:

correct-choice $((AB)^{-1})^T = (A^{-1})^T(B^{-1})^T$

choice $((AB)^{-1})^T = (B^{-1})^T(A^{-1})^T$

choice $((AB)^{-1})^T = B^{-1}A^{-1}B^TA^T$

choice $((AB)^{-1})^T = B^TA^TB^{-1}A^{-1}$

choice none of the above and below

Question 2

mode MultipleChoice

text Suppose A and B are orthogonal n-by-n matrices. Which of the following is also an orthogonal matrix?

choice AB-BA

correct-choice $\begin{pmatrix} A & 0 \\ 0 & B \end{pmatrix}$

choice $\begin{pmatrix} A & I \\ I & A \end{pmatrix}$

choice $A^2 - B^2$

choice none of the above and below

Question 1

mode MultipleChoice

text Let $\{\vec{v}_1, \vec{v}_2, ..\vec{v}_m\}$ be an orthonormal basis of a subspace V of R^n and let $\{\vec{w}_1, \vec{w}_2, ..\vec{w}_k\}$ be an orthonormal basis of $V^\perp$. Then the union $\{\vec{v}_1, \vec{v}_2, ..\vec{v}_m, \vec{w}_1, \vec{w}_2, ..\vec{w}_k\}$ is

choice a linearly independent set but not necessarily orthogonal

choice an orthonormal set but not necessarily a basis for R^n

choice a spanning set for R^n but not necessarily linearly independent

correct-choice an orthonormal basis for R^n

choice none of the above and below

Question 2

mode MultipleChoice

text Is an orthogonal projection onto a subspace V also an orthogonal transformation?

choice yes, because they are both orthogonal

choice No, because an orthonormal projection is not a square matrix.

correct-choice No, unless $V = R^n$, because projection does not preserve distance

choice No, because an orthogonal projection is not a linear transformation

choice Only if V is a line

choice none of the above and below

Question 1

mode MultipleChoice

text Fact 5.4.8 says that $A(A^TA)^{-1}A^T$ is the matrix of the orthogonal projection onto V.
But $(A^TA)^{-1} = A^{-1}(A^T)^{-1}$ so $A(A^TA)^{-1}A^T = AA^{-1}(A^T)^{-1}A^T = I * I = I$ so the matrix is always identity.
This argument is:

choice valid

choice invalid because matrix multiplication is not associative

choice only valid if $\vec{v}_1, \vec{v}_2, ..., \vec{v}_m$ is an orthonormal basis

correct-choice invalid unless $m = n$ because A is not a square matrix

choice invalid unless $m = n$ because A is a square matrix but is not invertible

Question 2

mode MultipleChoice

text At the end of example 4 on p.218-219, the book says: "The sum of the squares of the vertical distances...".
Why vertical distances?

choice The vertical distance is the shortest distance to the curve

choice The author is too lazy to compute the shortest distance

correct-choice the vertical distance is the actual error in using the curve rather than the data point

choice using anything other than the vertical distance would be unpatriotic, and subject to the author penalties under the Patriot Act

choice why not?

choice none of the above and below

Question 1

mode MultipleChoice

text If the entrie sof a square matrix are positive integers, the determinant could be:

choice a positive integer

choice a nonnegative integer

correct-choice any integer

choice any rational number

choice any real number

Question 2

mode MultipleChoice

text In definition 6.1.2, some products are added and some products are substracted. Let A and S denote the number of products that are added and substracted; For example when $n = 3$, $A = S = 3$. Which of the following is true:

correct-choice $A = S$ for all n

choice $A \geq S$ with equality when n is odd

choice $A \leq S$ with equality when n is odd

choice there is no relationship between A and S when n is large

choice $A = 3$ for all n

choice $S = 3$ for all n

Question 1

mode MultipleChoice

text Let A be an $n * n$ matrix, and $B = kA$ for some constant k. Then $det(B)$ is equal to

choice $kdet(A)$

correct-choice $k^n det(A)$

choice $\frac{1}{k} det(A)$

choice $\frac{1}{k^n} det(A)$

choice $k + det(A)$

choice $k^n + det(A)$

choice cannot be determined in terms of k and $det(A)$ alone.

Question 2

mode MultipleChoice

text Let A be an $n * n$ matrix such that $det(A^2) = 1$. Then

choice $det(A) = 1$

choice $det(A) = 0$ or 1

choice $det(A) = -1$, 0 or 1

correct-choice $det(A) = -1$ or 1

choice $det(A)$ may be any positive number

choice $det(A)$ may be any real number

Question 1

mode MultipleChoice

text Let A be an $n * n$ matrix with $det(A) = 1$, and let $T(\vec{x}) = A\vec{x}$. Then

choice T must be a rotation

correct-choice T must preserve volume

choice T may be any isomorphism

choice T may be any orthogonal transformation

choice none of the above and below

Question 2

mode MultipleChoice

text Let A_{ij} denote the minors of an $n * n$ matrix A. What is the relationship between $det(A_{ij})$ and $det(A_{ji})$?

choice They are always equal

choice $det(A_{ij}) = -det(A_{ji})$ if $i \neq j$

correct-choice They are equal if A is a symmetric matrix

choice If $det(A_{ij}) = 0$ then $det(A_{ji}) = 0$

choice Their product equals 1.

choice none of the above or below

Question 1

mode MultipleChoice

text Suppose A is an $n * n$ matrix with integer entries with $det(A) = 1$. What can you say about the entries of A^{-1}?

correct-choice They must be integers

choice They must be rational numbers, but not necessarily integers

choice They could be any real numbers

choice A^{-1} might not exist

choice The answer depends on whether or not n is even or odd

Question 2

mode MultipleChoice

text Let A be an invertible $n * n$ matrix, with $adj(A)$ defined in **Fact 6.3.10**. What is the relationdship between $det(adj(A))$ and $det(A)$?

choice $det(adj(A)) = det(A)$

choice $det(adj(A)) = \frac{1}{det(A)}$

correct-choice $det(adj(A)) = (det\ A))^{n-1}$

choice $det(adj(A)) = \frac{1}{(det\ A)^{n-1}}$

choice $det(adj(A)) = (det\ A)^{n+1}$

choice they are not related

Question 1

mode MultipleChoice

text In definition **7.1.1** it says "A nonzero vector $\vec{v}$ ...". Why is it that $\vec{v}$ is required to be nonzero?

choice Zero is not allowed to be an eigenvalue

correct-choice The zero vector would satisfy the equation for any eigenvalue

choice The zero vector does not satisfy the equation for any eigenvalue

choice All the entries of an eigenvector must be nonzero

choice The author dislikes the zero vector

Question 2

mode MultipleChoice

text If A is a $2 * 2$ matrix with eigenvalues 1 and -1, then what can you say about A^2?

choice A^2 also has eigenvalues 1 and -1

correct-choice A^2 is the identity matrix

choice A^2 is the zero matrix

choice you can't determine the eigenvalues of A^2

choice $A^2 = A^{-1}$

Question 1

mode MultipleChoice

text What are the eigenvalues of the matrix $\begin{pmatrix} 2 & 4 \\ 4 & 3 \end{pmatrix}$?

choice 2 and 3

choice 5 and 10

choice -5 and -10

correct-choice $\frac{5+\sqrt{65}}{2}$ and $\frac{5-\sqrt{65}}{2}$

choice $\frac{5+\sqrt{10}}{2}$ and $\frac{5-\sqrt{10}}{2}$

choice the matrix has no real eigenvalues

Question 2

mode MultipleChoice

text What are the roots of $det(A - \lambda I_n)$?

choice The negatives of the eigenvalues of A

correct-choice The eigenvalues of A

choice The eigenvalues of A when n is even, and the negatives of the eigenvalues of A when n is odd

choice Only the eigenvalues of A that are positive

choice Only the eigenvalues of A that are negative

choice none of the above and below

Question 1

mode MultipleChoice

text Let $T(\vec{x}) = A\vec{x}$ be the orthogonal projection onto a line L in R^3. What can you say about the eigenvalues and eigenspaces of T?

choice it depends on the line L

choice The eigenvalues are $-1, 0, 1$ with each eigenspace of dimension 1

choice The eigenvalues are 0,1 with eigenspaces of dimension 1

choice The eigenvalues are 0,1 with corresponding eigenspaces of dimension 1,2

correct-choice The eigenvalues are 0,1 with corresponding eigenspaces of dimension 2,1

Question 2

mode MultipleChoice

text Suppose A is an $n * n$ matrix which has an eigenbasis. To what extent is the eigenbasis unique?

choice any other eigenbasis must consist of nonzero multiples of the vectors of a given basis

correct-choice if the eigenvalues are distinct, any other eigenbasis must consist of nonzero multiples of the vectors of a given basis

choice if all the eigenvalues are different from 0, any other eigenbasis must consist of nonzero multiples of the vectors of a given basis

choice if A is a diagonal matrix, any other eigenbasis must consist of nonzero multiples of the vectors of a given basis

choice none of the above or below

Question 1

mode MultipleChoice
text Which of the following conditions on A implies that A has an eigenbasis?
choice A is upper triangular
correct-choice A is upper triangular with distinct values on the diagonal
choice A is upper triangular with nonzero values on the diagonal
choice A is upper triangular with all zeros on the diagonal
choice A is upper triangular with $det(A) = 1$
choice none of the above or below

Question 2

mode MultipleChoice
text
choice Suppose the $n * n$ matrices A and B commute, and $\vec{v}$ is an eigenvector of A with eigenvalue λ. Which of the following statements is always true?
choice $\vec{v}$ is an eigenvector of B
choice $B\vec{v} = 0$
correct-choice $B\vec{v}$ is an eigenvector of A with eigenvalue λ
choice $B\vec{v}$ is an eigenvector of A but its eigenvalue may be any real number
choice B must have an eigenbasis

Question 1

mode MultipleChoice

text Suppose A is diagonalizable with $S^{-1}AS$ diagonal. What can you say about A^T?

choice A^T may or may not be diagonalizable

choice A^T is diagonalizable with $S^{-1}A^TS$ diagonal

choice A^T is diagonalizable with $(S^T)^{-1}A^TS^T$ diagonal

correct-choice A^T is diagonalizable with $S^TA^T(S^T)^{-1}$ diagonal

choice A^T is diagonalizable but you can't say anything about the matrix that diagonalizes it

Question 2

mode MultipleChoice

text Suppose A is diagonalizable and $lim_{t\to\infty}A^t$ exists. What can you say about the eigenvalues $\{\lambda_k\}$ of A?

choice $\lambda_k \geq 0$ for all k

choice $0 \leq \lambda_k \leq 1$ for all k

choice $-1 \leq \lambda_k \leq 1$ for all k

choice $0 < \lambda_k < 1$ for all k

correct-choice $-1 < \lambda_k \leq 1$ for all k

choice $-1 < \lambda_k \leq 1$ for all k and $\lambda_k = 1$ for some k

Question 1

mode MultipleChoice

text Use the standard basis $\{1, i\}$ to represent C as R^2. Then the operation of multiplication by a fixed complex number is a linear transformation from R^2 to R^2, so may be represented by a $2 * 2$ matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$. See example 4 on page 344 for one case. What can you say about the form of this matrix?

choice it is symmetric

choice it is skew-symmetric

choice it is orthogonal

correct-choice it satisfies $a = d$ and $b = -c$

choice it satisfies $a = -d$ and $b = c$

choice it may be any $2 * 2$ matrix

Question 2

mode MultipleChoice

text In DeMoirre's formaula (p.345) the angle ϕ is only determined up to a multiple of 2π. How do different choices of ϕ affect this formula?

correct-choice It doesn't matter because the sine and cosine are also periodic

choice The formula requires $0 \leq \phi < 2\pi$

choice The formula requires $-\pi < \phi \leq \pi$

choice There are in general n different n^{th} powers of a complex number

choice When n is odd, the n^{th} power is only determined up to a sign (plus or minus).

Question 1

mode MultipleChoice

text Suppose A is an $n*n$ (real) matrix, with m distinct real eigenvalues and k distinct complex eigenvalues. What are the allowed values of m and k?

choice $m + k = n$, and m is even

choice $m + k = n$, and k is even

choice $m + k \leq n$, and m is even

correct-choice $m + k \leq n$, and k is even

choice $m + 2k \leq n$

Question 2

mode MultipleChoice

text Suppose A is a $3 * 3$ matrix with complex eigenvalues $a + ib, a - ib$ (for $b \neq 0$) and real eigenvalue λ. What condition implies $det(A) > 0$?

choice $a > 0$

choice $b > 0$

correct-choice $\lambda > 0$

choice $det(A)$ is always positive

choice $det(A)$ is never positive

choice You can't tell from eigenvalues alone

Question 1

mode MultipleChoice

text Suppose the initial values are close to zero. Under what conditions on the matrix A will the solution to the linear system $\frac{d\vec{x}}{dt} = A\vec{x}$ stay close to zero for all positive times?

choice A is diagonalizable

choice $det(A) < 0$

choice A is diagonalizable and all eigenvalues are > 0

correct-choice A is diagonalizable and all eigenvalues are < 0

choice no condition on A will be sufficient

Question 2

mode MultipleChoice

text For a continuous dynamical system, we are interested in whether an eigenvalue is > 0 or < 0. For a discrete dynamical system, the distinction was whether $\lambda > 1$ or $0 < \lambda < 1$ (we didn't even discuss the interpretation of negative eigenvalues). How are these questions related?

correct-choice $e^{\lambda} > 1$ if and only if $\lambda > 0$

choice $0 < 1$

choice continuous time is exact, whereas discrete time is only approximate

choice these questions are unrelated

Question 1

mode MultipleChoice

text Suppose $\frac{d\vec{x}}{dt} = A\vec{x}$ has a periodic orbit. What does this imply about the matrix A?

choice All the eigenvalues of A are real

choice All the eigenvalues of A are complex

correct-choice Some of the eigenvalues of A are purely imaginary

choice All of the eigenvalues of A are purely imaginary

choice A is diagonalizable

Question 2

mode MultipleChoice

text Suppose A is a $2 * 2$ matrix, and one solution of $\frac{d\vec{x}}{dt} = A\vec{x}$ is an outward spiral. What can you say about all nonconstant solutions?

choice Some are outward spirals and some are inward spirals

correct-choice All are outward spirals

choice Some will spiral clockwise and others will spiral counterclockwise

choice Not all will be spirals

choice You can't predict, since the answer depends on A

Question 1

mode MultipleChoice

text In exaple 5 on p.429, all solutions of the equation $f'' + 2f' - 3f = 0$ are formed to be of the form $c_1e^t + c_2e^{-3t}$. Suppose we want a solution with $f(0) = a$ and $f'(0) = b$ for specified constants a and b.

choice take $c_1 = a$ and $c_2 = b$

choice take $c_1 = \frac{1}{4}(a - b)$ and $c_2 = \frac{1}{4}(3a + b)$

correct-choice take $c_1 = \frac{1}{4}(3a + b)$ and $c_2 = \frac{1}{4}(a - b)$

choice take $c_1 = 3a$ and $c_2 = -b$

choice it is not possible to find a solution in general

Question 2

mode MultipleChoice

text In fact 9.3.13 there is an indefinite integral. Such integrals are only defined up to an additive constant. Does it matter which constant we choose?

choice Any choice of the constant leads to the same solution

choice Different choices of the constant lead to solutions of the equation which differ by a constant

correct-choice Different choices of the constant lead to different solutions of the inhomogeneous equation which differ by a multiple of e^{at}(a solution of the homogeneous equation)

choice You have to choose zero for the constant

choice There is only one allowable choice for the constant, and it depends on a

Question 1

mode MultipleChoice

text Is a subspace of an inner product space also an inner product space (using the same inner product)?

correct-choice Yes

choice Only when it is an orthogonal subspace

choice Only when it is the whole space

choice Only when you can verify condition (d) of Definition 5.5.1

Question 2

mode MultipleChoice

text Consider the inner product in Exaple 1 on page 226. Suppose f is orthogonal to g, and g is a positive function. What can you say about f?

choice f is a positive function

choice f is a nonnegative function

choice f is a negative function

choice f is never zero

correct-choice f has at least one zero

choice f has exactly one zero

Question 1

mode MultipleChoice

text Let f_n and f_m be the Fourier approximations of f defined in $Fact 5.5.5$ with $n < m$. What can you say about the same coefficients $b_k, c_k \ and \ a_0$ for the two approximations?

choice they are the same

correct-choice they are the same for $k \leq n$

choice they are the same for $k \leq n$ and $b_k = c_k = 0$ for $k > n$

choice a_0 is the same, but b_k adn c_k are unrelated

choice they are all unrelated

Question 2

mode MultipleChoice

text Suppose we know for a particular value of n that the error $||f - f_n|| \leq \frac{1}{1000}$, where f_n is the Fourier approximation of f. What can be said about $|f(t) - f_n(t)|$ for a particular value of t?

choice $|f(t) - f_n(t)| \leq \frac{1}{1000}$ for all t

choice $|f(t) - f_m(t)| \leq \frac{1}{1000}$ for all t if m is large enough

correct-choice $|f(t) - f_n(t)| \leq \frac{1}{1000}$ on average, but nothing can be said for a specific value of t.

choice $|f(t) - f_n(t)| \leq \frac{1}{1000}$ except for a finite value number of t values

choice it is possible that $|f(t) - f_n(t)| > \frac{1}{1000}$ for all t