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Mathematics MTL101 - Quiz 1 (SET A)
September 27, 2016

Max Marks 10 **Max Time 30 minutes**

ONLY ONE of the four choices is correct. Use PEN only to mark the choice.

Please use $\surd$ to mark the correct answer very carefully. Question with cross cutting, overwriting and more than one choice marked $\surd$ will NOT be evaluated.

NO negative marking.

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1. Let V be a vector space of $n \times n$ real-matrices over the field of reals, and W be a subspace of V comprising of all skew symmetric matrices. Then dim(W) is equal to

   (a) n^2

   (b) $\frac{n^2}{2}$

   (c) $\frac{n(n+1)}{2}$

   (d) $\frac{n(n-1)}{2}$ ✓

[2]

2. Let $A = \begin{pmatrix} 1 & 2 & -2 \\ 1 & 0 & -1 \\ 0 & 2 & -1 \end{pmatrix}$, and $W = \{N \in \mathbb{R}^{3\times 3} \mid AN = 0\}$, where $\mathbb{R}^{3\times 3}$ is set of 3×3 matrices with real entries. Then dim(W) is equal to

   (a) 6

   (b) 3

   (c) 2

   (d) 0 ✓

[2]

3. Let $W_1 = \{(x, y, z, w) \in \mathbb{R}^4 \mid x - y - z = 0,\ y - w = 0\}$ and $W_2 = \{(x, y, z, 0) \in \mathbb{R}^4 \mid x + y - z = 0\}$. Then which one of the following is correct?

   (a) $\dim(W_1 + W_2) = 3$ ✓

   (b) $W_1 + W_2 = \mathbb{R}^4$

   (c) $\dim(W_1 \bigcap W_2) = 0$

   (d) $\dim(W_2) = 1 + \dim(W_1)$

[2]

4. Consider the following three statements about a 3×3 matrix A:
   S_1 : rank$(A) = 2$
   S_2 : rank$(A) \leq 2$
   S_3 : One row of A is a multiple of the another row of A
   Which of the following is always correct?

   (a) $S_1 \Leftrightarrow S_3$
   (b) $S_2 \Leftrightarrow S_3$
   (c) $S_3 \Rightarrow S_1$ but $S_1 \not\Rightarrow S_3$
   (d) $S_3 \Rightarrow S_2$ but $S_2 \not\Rightarrow S_3$

[1]

5. Which of the following **CAN NOT** be a basis of the row space of the matrix $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}$?

   (a) $\{(1,0),(0,1)\}$
   (b) $\{(3,4),(4,3)\}$
   (c) $\{(1,2),(2,4)\}$
   (d) $\{(1,2),(1,4)\}$

[1]

6. Let A be a real 4×5 matrix of rank 3. Then the rank of the matrix $(A^T A)$ is

   (a) exactly 5
   (b) exactly 4
   (c) exactly 3
   (d) at most 3 but not necessarily equal to 3

[1]

7. Let A be a 10×10 matrix, $a =$ nullity(A) and $b =$ rank(A). Then the total number of pairs (a, b) is

   (a) 100
   (b) 11
   (c) 10
   (d) 9

[1]