

## ENGINEERING MATHEMATICS-I SAMPLE MIDTERM EXAM

April 2  $^{\rm th}\!\!,\,2017$ 





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Multiple Choice(50pts)					
Q1 Let $T : \mathbb{R}^2 \to \mathbb{R}^3$ be a linear mapping, satisfying $T(1,2) = (1,0,1)$ and $T(2,5) = (0,1,1)$ . Find T	(0,1).				
(A) $(0,2,3)$   (B) $(-1,1,2)$   (C) $(0,0,1)$   (D) $(1,0,0)$   (E) Non	e				
Q2 If $u = (-2, 1, 1)$ and $v = (1, 0, 1)$ , then $  \operatorname{proj}_{v} u  $ is					
(A) 0   (B) $1/2$   (C) $\frac{1}{\sqrt{2}}$   (D) 1   (E) Non	.e				
Q3 Parametric equation for the line passing through $(1, 1, -1)$ and which is perpendicular to the $2x - y + 3z = 4$ are:	plane				
(A) $x = 1 + 2t, y = 1 - t, z = -1 + 3t$ (D) $x = 1 + t, y = 1 - t, z = -1 + 3t$					
(B) $x =, y =, z =,$ (E) None					
(C) $x = 1 + t, y = 1 - t, z = -1 + t$					
Q4 Let $T : \mathbb{R}^2 \to \mathbb{R}^3$ be a linear mapping, satisfying $T(1,2) = (1,0,1)$ and $T(2,5) = (0,1,1)$ . Find $T(2,5) = (0,1,1)$ .	(0, 1).				
(A) $(0,2,3)$   (B) $(-1,1,2)$   (C) $(0,0,1)$   (D) $(1,0,0)$   (E) Non	.e				
Q5 Under what condition can a vector $(a, b, c)$ be written as a linear combination of $(1, 2, 0)$ and $(1, 1)$	, 1).				
(A) $a+b+c =   (B) a+2b+c =   (C) 2a-b-c =   (D) a2 + b +   (E) Non  0 0 0 2c = 0   (E) Non  2c = 0   (E)$	e				
Q6 The angle between $u = (0, 3, -3)$ and $v = (-2, 2, -1)$ is:					
(A) $\pi/3$   (B) $\pi/6$   (C) $\pi/2$   (D) $\pi/4$   (E) Non	e				
Q7 Find an equation of the plane which passes through the point $(1, -7, 8)$ and which is perpendicular to the line whose parametric equations are: $x = 2 + 2t, y = 7 - 4t, z = -3 + t; t \in \mathbb{R}$					
(A) $2x - 4y + (B) x - 4y + (C) x - 4y + (D) 2x - y + (E) Non  z = -38 z = 8 z = -18 z = 11880$	e				
<b>Q8</b> Suppose a linear system has augmented matrix $\begin{pmatrix} 1 & 1 & 1 &   & 0 \\ 0 & q & 0 &   & 0 \\ 0 & 0 & q &   & p \end{pmatrix}$ . Find all values of $p$ and $q$ such that	at this				
system has a unique solution.					
(A) $(0,2,3)$   (B) $(-1,1,2)$   (C) $(0,0,1)$   (D) $(1,0,0)$   (E) Non Q9 Which of the following functions $T : \mathbb{R}^2 \to \mathbb{R}^2$ is a linear transformation?.	e				
(A) $T(x,y) = (x,y+ $ (B) $T(x,y) = (x+ $ (C) $T(x,y) =  $ (D) $T(x,y) =$	(x, 0)				

 $(y^2, xy)$ 

(A) $\begin{pmatrix} 4\\58 \end{pmatrix}$	(B) $\begin{pmatrix} 2\\51 \end{pmatrix}$	(C) $\begin{pmatrix} 11\\ -7 \end{pmatrix}$	(D) $\begin{pmatrix} 4\\68 \end{pmatrix}$	(E) None				
Q11 Suppose that A is $3 \times 4$ . Then the number of solutions to the system $A\mathbf{x} = 0$ is								
(A) infinite	(B) one	(C) two	(D) zero	(E) None				
True& False(20 pts)								
Q1 A consistent linear system with 2 equations and 3 variables must have infinitely many solutions. T F								
Q2 Homogeneous T	systems are always con	sistent.						
Q2 There exists a T	Q2 There exists a linear transformation $T$ that maps $(1,0)$ to $(5,3,4)$ and maps $(3,0)$ to $(1,3,2)$ . T							
	F	ill in the blanks(10p	ots					
Q1 A subset $\{v_1, \ldots, v_n\}$	$\ldots, v_d$ of $\mathbb{R}^n$ is							
if there are $a_1, \ldots, a_d \in \mathbb{R}$ , not all zero, such that								
	$a_1, \ldots, a_l$	$v_1 + a_2 v_2 + \dots + a_d v_d =$	= 0.					
	$a_1, \ldots, a_l$	$v_1 + a_2 v_2 + \dots + a_d v_d =$	= 0.					
Q2 Given two vec	tors $u, v \in \mathbb{R}^n$ which ar	$v_1 + a_2 v_2 + \dots + a_d v_d =$	= 0. then $  u + v  ^2 =   u  ^2 +   u  ^2$	-   v   <sup>2</sup> .				
Q2 Given two vec Q3 A general $m \times r$	tors $u, v \in \mathbb{R}^n$ which ar n matrix $A$ has $m$	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ \_ and n \_$	= 0. then $  u + v  ^2 =   u  ^2 + $ . Th	-    <i>v</i>    <sup>2</sup> . ie				
Q2 Given two vec Q3 A general $m \times r$ in the matrix are ca	tors $u, v \in \mathbb{R}^n$ which ar n matrix $A$ has $m$ alled the	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ and n \_ and n \_$ $of A.$	= 0. then $  u + v  ^2 =   u  ^2 + $ The	-    <i>v</i>    <sup>2</sup> . 				
Q2 Given two vec Q3 A general $m \times r$ in the matrix are ca Q4 A system which	tors $u, v \in \mathbb{R}^n$ which ar n matrix $A$ has $m$ alled the h has a	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ and n \_ $	= 0. then $  u + v  ^2 =   u  ^2 + $ The The	-   v   <sup>2</sup> . 				
Q2 Given two vec Q3 A general $m \times n$ in the matrix are ca Q4 A system which inconsistent.	tors $u, v \in \mathbb{R}^n$ which ar n matrix $A$ has $m$ alled the h has a	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \ and n \_$ $\ of A.$ $\ is called \_ \_ \_$	= 0. then $  u + v  ^2 =   u  ^2 + $ Th Otherwise	-   v   <sup>2</sup> . ne it is				
Q2 Given two vec Q3 A general $m \times n$ in the matrix are ca Q4 A system which inconsistent. Q5 Any set of vec	$a_1, \dots, a_n$ etors $u, v \in \mathbb{R}^n$ which ar n matrix $A$ has $malled theh has aetors containing the$	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ \qquad and n \_$ $and n \_$ $is called \_$ $is line$	= 0. then $  u + v  ^2 =   u  ^2 +$ Th Otherwise hearly dependent	-   v   <sup>2</sup> . ne it is				
<ul> <li>Q2 Given two vec</li> <li>Q3 A general m×n</li> <li>in the matrix are ca</li> <li>Q4 A system which</li> <li>inconsistent.</li> <li>Q5 Any set of vec</li> <li>Q6 If T is a Linear</li> </ul>	$a_1$ $a_2$ $a_1$ $a_1$ $a_2$ $a_1$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_1$ $a_2$ $a_2$ $a_1$ $a_2$ $a_2$ $a_1$ $a_2$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_1$ $a_2$ $a_3$ $a_4$ $a_4$ $a_5$	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ and n \_ $	= 0. then $  u + v  ^2 =   u  ^2 +$ Th Otherwise hearly dependent	-   v   <sup>2</sup> . ne it is				
<ul> <li>Q2 Given two vec</li> <li>Q3 A general m×n</li> <li>in the matrix are ca</li> <li>Q4 A system which inconsistent.</li> <li>Q5 Any set of vec</li> <li>Q6 If T is a Linea</li> </ul>	tors $u, v \in \mathbb{R}^n$ which ar <i>n</i> matrix <i>A</i> has <i>m</i> alled the th has a etors containing the ar transformation then <i>f</i> <b>ssical problems(20pt</b> )	$v_1 + a_2 v_2 + \dots + a_d v_d =$ $e \_ and n \_ $	= 0. then $  u + v  ^2 =   u  ^2 + $ Th Otherwise hearly dependent  rork. No work=No cr	-   v   <sup>2</sup> . ie it is edit				
Q2Given two vecQ3A general $m \times r$ in the matrix are caQ4A system whichinconsistent.Q5Any set of vecQ6If T is a LineaClassQ1Balance the form	tors $u, v \in \mathbb{R}^n$ which ar <i>n</i> matrix <i>A</i> has <i>m</i> alled the th has a etors containing the ar transformation then <i>A</i> <b>ssical problems(20pt</b> pllowing chemical reaction	$v_{1} + a_{2}v_{2} + \dots + a_{d}v_{d} =$ $e \_ \qquad and n \_ \\ and n \_ \\ of A. \\ is called \_ \\ is called \_ \\ is line $ $T(0) = \_ \\ s) . Show all your workson $	= 0. then $  u + v  ^2 =   u  ^2 +$ . Th . Otherwise hearly dependent rork. No work=No cr	-   v   <sup>2</sup> . ne it is edit				
Q2 Given two vec Q3 A general $m \times r$ in the matrix are ca Q4 A system which inconsistent. Q5 Any set of vec Q6 If T is a Linea Class Q1 Balance the for	tors $u, v \in \mathbb{R}^n$ which ar <i>n</i> matrix <i>A</i> has <i>m</i> alled the th has a extors containing the ar transformation then <i>A</i> <b>ssical problems(20pt</b> bllowing chemical reaction <i>CC</i>	$v_{1} + a_{2}v_{2} + \dots + a_{d}v_{d} =$ $e \_ \qquad and n \_ \\ \_ of A. \\ \_ is called \_ \\ \_ is line \\ T(0) = \_ \\ s) . Show all your work on D_{2} + H_{2}O \rightarrow C_{6}H_{12}O_{6} + C_{6}H_{12}O_{6}O_{6} + C_{6}H_{12}O_{6}O_{6}O_{6}O$	= 0. then $  u + v  ^2 =   u  ^2 + $ Th Otherwise hearly dependent  rork. No work=No cr - $O_2$ .	-   v   <sup>2</sup> . ie it is edit				

(i) is inconsistent;

(ii) has infinitely many solutions;

(iii) has a unique solution.

Q3 Identify the **elementary row** operation performed to obtain the new row-equivalent matrix.

$$\begin{bmatrix} 3 & -1 & | & -4 \\ -4 & 7 & | & 9 \end{bmatrix} \sim \begin{bmatrix} 3 & -1 & | & -4 \\ 8 & 3 & | & -7 \end{bmatrix}$$

Q4 Let  $T: \mathbb{R}^2 \to \mathbb{R}^2$  be the linear transformation defined by

$$T\begin{pmatrix} x\\y \end{pmatrix} = \begin{pmatrix} x+y\\x-2y \end{pmatrix}$$

Draw the image of the unit square under T, label all of its vertices.

Q5 Show that the vectors  $u = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$  and  $v = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$  are linearly independent.