UNIVERSITY OF MANITOBA
DEPARTMENT OF MATHEMATICS

MATH 1210 Techniques of Classical and Linear Algebra

SECOND TERM TEST

November 9, 2011 5:30 – 6:30 PM

LAST NAME: _____

FIRST NAME: _____

STUDENT NUMBER: _____

SIGNATURE: _____
(I understand that cheating is a serious offense)

Please indicate your instructor and section by checking
the appropriate box below:

☐	A01	MWF (9:30 – 10:20 AM, EITC E3 270)	G. Krause
☐	A02	MWF (1:30 – 2:20 PM, St. Paul's College 305)	A. Prymak
☐	A03	MWF (1:30 – 2:20 PM, EITC E2 155)	M. Despic

INSTRUCTIONS TO STUDENTS:

Fill in all the information above.

This is a 1 hour exam.

***No** notes, books, cell phones, calculators or other computing devices are permitted.*

***Show your work clearly** for full marks.*

This test has a title page, 6 pages of questions, and 1 blank page for rough work. Please check that you have all pages.

The value of each question is indicated in the left-hand margin beside the statement of the question. The total value of all questions is 100.

*Answer all questions on the exam paper in the space provided. If you need more room, you may continue your work on the **reverse** side of the page, but **clearly indicate** that your work is continued there.*

Question:	1	2	3	4	5	6	Total
Points:	27	17	17	13	19	7	100
Score:							

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1. Consider the polynomial $P(x) = x^5 - 2x^4 - 4x^3 + 4x^2 - 5x + 6$.

[6] (a) Use Descartes' rules of signs to state the number of possible positive and negative roots of $P(x)$

[4] (b) Use the Rational Root Theorem to list all possible rational roots of $P(x)$.

[12] (c) Given that i is a root of $P(x)$, find the other roots of this polynomial.

[5] (d) Express $P(x)$ as the product of linear factors only.

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2. Consider the vectors $\vec{v}_1 = a\vec{i} + 2\vec{j} + 4\vec{k}$ and $\vec{v}_2 = a\vec{i} + 2\vec{j} + a\vec{k}$, where a is a real number.

[7] (a) Determine for which values of a the vectors $\vec{v}_1$ and $\vec{v}_2$ are perpendicular.

[10] (b) Determine the values a for which $\vec{v}_1 \times \vec{v}_2 = \vec{0}$.

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3. Let $\mathcal{P}$ denote the plane that is determined by the points $P_1(1,1,0), P_2(1,0,1)$ and $P_3(0,1,1)$. Find

[12] (a) the point-normal equation for $\mathcal{P}$.

[5] (b) the equations in symmetric form of the line which is perpendicular to the plane $\mathcal{P}$ and contains the point P_1.

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4. Given the matrix $A = \begin{pmatrix} 1 & 0 & -1 \\ 0 & -1 & 1 \end{pmatrix}$, indicate whether or not the expressions below are defined. If an expression is defined, evaluate the resulting matrix; if it is not defined, explain why not.

[2] (a) A^T.

[3] (b) $A + A^T$.

[8] (c) AA^T.

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5. Consider the system of linear equations.

$$2x + 6w = 2; \quad z + 7w = 1; \quad 2x + y + 3w = 1; \quad 4x + 15w = 1.$$

[4] (a) Write down the augmented matrix of this system.

[15] (b) Solve the system by using Gauss-Jordan elimination. Clearly indicate the elementary row operations that you use.

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[7] **6.** Evaluate

$$\det \begin{pmatrix} 2 & 0 & 0 & 6 \\ 0 & 0 & 1 & 7 \\ 2 & 1 & 0 & 3 \\ 4 & 0 & 0 & 15 \end{pmatrix}.$$

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