

# Information sheet for Math 304 Winter 2021

**Class meets:** MTRF 11:00 - 11:50 am (Zoom classes scheduled on Canvas)

**Credits:** four credits

**Teacher:** Branko Ćurgus, Professor of Mathematics

**Office Hour:** MTRF noon or by appointment (see Canvas for a Zoom link)

**Email:** [curgus@wwu.edu](mailto:curgus@wwu.edu)

**Course website:** [http://faculty.wwu.edu/curgus/Courses/304\\_202110/304.html](http://faculty.wwu.edu/curgus/Courses/304_202110/304.html)

**Text:** *Linear algebra and its applications, Fifth edition* by David C. Lay, Steven R. Lay, Judy J. McDonald, ISBN: 9780321982384

**Material covered:** We will review parts of Chapter 4 and study Chapters 5, 6 and 7.

**Course Objectives:** The successful student will demonstrate: (0) understanding of the concept of change of coordinates matrix and ability to calculate such matrices in simple examples; (1) the ability to compute eigenvalues and eigenvectors (of small matrices), establish whether or not a matrix is diagonalizable, and diagonalize a matrix when possible; (2) geometric understanding of the eigenvalues and eigenvectors of a real matrix, including the case of complex eigenvalues; (3) the ability to construct a matrix representation of a linear transformation, relative to given bases, and to choose a convenient basis for a representation of a linear transformation; (4) the ability to use eigenvalues and eigenvectors in the analysis of linear discrete dynamical systems; (5) understanding of the role of an inner product in the geometry of vector spaces; (6) geometric and analytic understanding of orthogonality and orthogonal projection, both in real  $n$ -dimensional space and in more abstract vector spaces, including vector spaces of functions; (7) the ability to construct an orthogonal basis for a subspace by using the Gram-Schmidt process; (8) understanding of least-squares problems, the ability to solve them, and knowledge of their applications to linear models and to approximation; (9) knowledge of the properties of symmetric matrices and their associated quadratic forms; (10) the ability to compute the singular value decomposition of a matrix and the understanding of its relationship to other concepts of linear algebra.

**On Your Written Work:** Students must submit their work electronically through Canvas Assignments. The only allowable file type is pdf. I cannot grade work submitted by email. Please make sure that you produce a high-quality, readable pdf file of your work.  $\LaTeX$  is a free software designed for typesetting high-quality mathematical documents. I encourage you to learn  $\LaTeX$  and use it for your writing. If you submit your handwritten work, write neatly on paper with a light-colored background using a dark pencil or ink. Please use a good scanning app to produce a high-quality, readable pdf file.

Since you will have enough time to work on the homework and assignments, your papers should be well-written. Presenting calculations alone without the context in which they occur and explanations of your reasoning is not sufficient for the full credit. I believe that writing mathematics in complete sentences organized in meaningful paragraphs enhances the learning process. As a guide for writing, you can use examples in the textbook or my writing on the class website.

**Assignments:** There will be no traditional exams. Instead of the exams there will be four assignments for which you will have a week to finish. The due dates for the assignments are Tuesday, January 19, Tuesday, February 9, and Tuesday, March 2 all at 11:59 pm. The final assignment will be posted on Canvas on the last Thursday of classes and it will be due on Thursday, March 18 at 11:59 pm.

**Homework:** A list of suggested homework problems will be posted daily on the class website. Homework will not be collected. To succeed in class you should do each problem on your own. While working on problems you should recognize which theoretical tools are being used to solve a particular problem. As a result you will acquire general problem solving strategies, which is one of the goals of higher education.

**Grading:** Each assignment will be graded by an integer between 0 and 100. Your final grade will be determined using the following formula

$$FG = \max\left\{\left\lceil \frac{A1 + A2 + A3 + A4}{4} \right\rceil, \left\lceil \frac{A1 + A2 + A3 + 2 * A4}{5} \right\rceil\right\},$$

where A1, A2, A3, A4 are the grades for the assignments. In the above formula the symbol  $\lceil x \rceil$  denotes the ceiling of a real number  $x$ . Your letter grade will be assigned according to the following table:

F : 0 - 49	D : 50 - 54	C- : 55 - 59	C : 60 - 64	C+ : 65 - 69
B- : 70 - 74	B : 75 - 79	B+ : 80 - 84	A- : 85 - 89	A : 90 - 100

**This course** is a continuation of Math 204. It relies heavily on concepts and methods learned in Math 204. Therefore it is essential that you keep up with the material presented every day; do the homework problems; review Math 204 material as needed; look for help if you encounter difficulties.

**How to succeed:** Doing well in mathematics depends on understanding, not memorizing. Exercise critical thinking while reading the text and doing the problems since understanding cannot be achieved through superficial studying. Talking to other students is a good way to check your understanding. If you feel that you are not on your way to understanding the material do not hesitate to ask questions. Use the Math Center and my office hours. I will be glad to talk to you during the office hours, or you can make an appointment.

**Diversity, Equity, Inclusion:** Welcome to my class. I would love to have a face-to-face class with you. Until that is possible, we will make the best out of this mode of learning. We can make it better than a regular class since we can meet outside of class more often. I promise to keep my mind open for the mathematical experiences that you bring to this class. I want to help each one of you use those personal experiences in creative ways to build your own understanding of the material studied in this class. I will bring diverse approaches to most concepts. For example, to make this class more diverse, I looked into the history of our subject. Amazingly, the first known system of linear equations appears on old Babylonian tablet VAT 8389, which is between 3600 and 4000 years old (2000-1600 BC). The second oldest one is from ancient Egypt in the Rhind papyrus, which dates from around 1550 BC. This system involves five unknowns, but the solution in the papyrus is cryptic. The oldest treatment of systems of linear equations from antiquity which uses a method which resembles matrices is in Chapter 8 of the Chinese textbook *Nine Chapters of the Mathematical Art* which is at least 1800 years old.

I do understand that each one of you comes to this class with a diverse mathematical background. I believe that mathematics is so universally diverse that it offers a path to understanding to everybody. The only prerequisite is to be open to the human worth of rigorous thinking which is practiced in Mathematics. Let me help you build your own understanding of Linear Algebra. The goal is to create an environment where you can succeed in Mathematics and be proud of your achievement.

**Academic Honesty Policy:** Academic dishonesty is not tolerated at Western Washington University. Representing the work of another as one's own is an act of academic dishonesty. For a full description of the academic honesty policy and procedures at Western, see Appendix D in the University Catalog.

**Flexibility Statement:** This syllabus is subject to change. Changes, if any, will be announced in class or online. Students will be held responsible for all changes.

**Syllabi@WWU** Please also check <https://syllabi.wwu.edu/>

# WINTER 2021    Math 304    Linear Algebra

The number highlighted in gray is the ordinal number of the particular class. That is, **1** means that Tuesday, January 5th is the first class. If two sections are listed in one day, then the corresponding assigned problems are separated by a boldface ; semicolon. More details about suggested homework problems will be posted on the class website. The dates highlighted yellow are related to the due-dates of assignments. For more details see the Canvas page.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
J A N	<b>Sec. to read</b> <span style="border: 1px solid black; padding: 2px;">4</span> Problems More Problems	<b>1</b> <b>4.1; 4.2; 4.3</b> <span style="border: 1px solid black; padding: 2px;">5</span>	<span style="border: 1px solid black; padding: 2px;">6</span> <b>2</b>	<b>4.4; 4.5</b> <span style="border: 1px solid black; padding: 2px;">7</span> <b>3</b>	<b>4.7</b> <span style="border: 1px solid black; padding: 2px;">8</span>
J A N	<span style="border: 1px solid black; padding: 2px;">4</span> <b>4.4; 4.7</b> <span style="border: 1px solid black; padding: 2px;">11</span>	<b>5</b> Review Q&A <span style="border: 1px solid black; padding: 2px;">12</span>	<span style="border: 1px solid black; padding: 2px;">13</span> <b>6</b>	<b>5.1</b> <span style="border: 1px solid black; padding: 2px;">14</span> <b>7</b> 1-8, 11, 15-17, 19, 20, 24-27, 29-31	<b>5.2</b> <span style="border: 1px solid black; padding: 2px;">15</span> <b>7</b> 1-9, 11-15, 18-21, 24-27
J A N	<span style="border: 1px solid black; padding: 2px;">18</span> Martin Luther King Day	<b>8</b> <b>5.3</b> <span style="border: 1px solid black; padding: 2px;">19</span> 2, 3, 5, 8-13, 16, 18, 20, 23, 24	<span style="border: 1px solid black; padding: 2px;">20</span> <b>9</b>	<b>5.3</b> <span style="border: 1px solid black; padding: 2px;">21</span> <b>10</b>	<b>5.4</b> <span style="border: 1px solid black; padding: 2px;">22</span> <b>10</b> 1, 3 - 13, 17, 19 - 23, 27, 28
J A N	<span style="border: 1px solid black; padding: 2px;">11</span> <b>5.4</b> <span style="border: 1px solid black; padding: 2px;">25</span>	<b>12</b> <b>5.5</b> <span style="border: 1px solid black; padding: 2px;">26</span> 1-6, 7-12, 13,	<span style="border: 1px solid black; padding: 2px;">27</span> <b>13</b>	<b>5.5</b> <span style="border: 1px solid black; padding: 2px;">28</span> <b>14</b> 16-18, 21, 25, 26	<b>5.6</b> <span style="border: 1px solid black; padding: 2px;">29</span> <b>14</b>
F E B	<span style="border: 1px solid black; padding: 2px;">15</span> Review Q&A <span style="border: 1px solid black; padding: 2px;">1</span>	<b>16</b> <b>6.1</b> <span style="border: 1px solid black; padding: 2px;">2</span>	<span style="border: 1px solid black; padding: 2px;">3</span> <b>17</b>	<b>6.1</b> <span style="border: 1px solid black; padding: 2px;">4</span> <b>18</b>	<b>6.2</b> <span style="border: 1px solid black; padding: 2px;">5</span> <b>18</b>
F E B	<span style="border: 1px solid black; padding: 2px;">19</span> <b>6.2; 6.3</b> <span style="border: 1px solid black; padding: 2px;">8</span>	<b>20</b> <b>6.3</b> <span style="border: 1px solid black; padding: 2px;">9</span>	<span style="border: 1px solid black; padding: 2px;">10</span> <b>21</b>	<b>6.4</b> <span style="border: 1px solid black; padding: 2px;">11</span> <b>22</b>	<b>6.4; 6.5</b> <span style="border: 1px solid black; padding: 2px;">12</span> <b>22</b>
F E B	<span style="border: 1px solid black; padding: 2px;">15</span> Presidents' Day	<b>23</b> <b>6.5</b> <span style="border: 1px solid black; padding: 2px;">16</span>	<span style="border: 1px solid black; padding: 2px;">17</span> <b>24</b>	<b>6.6</b> <span style="border: 1px solid black; padding: 2px;">18</span> <b>25</b>	<b>6.7</b> <span style="border: 1px solid black; padding: 2px;">19</span> <b>25</b>
F E B	<span style="border: 1px solid black; padding: 2px;">26</span> <b>6.7; 6.8</b> <span style="border: 1px solid black; padding: 2px;">22</span>	<b>27</b> <b>6.8</b> <span style="border: 1px solid black; padding: 2px;">23</span>	<span style="border: 1px solid black; padding: 2px;">24</span> <b>28</b>	<b>7.1</b> <span style="border: 1px solid black; padding: 2px;">25</span> <b>29</b>	<b>7.1; 7.2</b> <span style="border: 1px solid black; padding: 2px;">26</span> <b>29</b>
M A R	<span style="border: 1px solid black; padding: 2px;">30</span> <b>7.2</b> <span style="border: 1px solid black; padding: 2px;">1</span>	<b>31</b> <b>7.3</b> <span style="border: 1px solid black; padding: 2px;">2</span>	<span style="border: 1px solid black; padding: 2px;">3</span> <b>32</b>	<b>7.3; 7.4</b> <span style="border: 1px solid black; padding: 2px;">4</span> <b>33</b>	<b>7.4</b> <span style="border: 1px solid black; padding: 2px;">5</span> <b>33</b>
M A R	<span style="border: 1px solid black; padding: 2px;">34</span> Review Q&A <span style="border: 1px solid black; padding: 2px;">8</span>	<b>35</b> Review Q&A <span style="border: 1px solid black; padding: 2px;">9</span>	<span style="border: 1px solid black; padding: 2px;">10</span> <b>36</b>	Review Q&A <span style="border: 1px solid black; padding: 2px;">11</span> <b>37</b>	Review Q&A <span style="border: 1px solid black; padding: 2px;">12</span> <b>37</b>
M A R	<span style="border: 1px solid black; padding: 2px;">15</span>	<span style="border: 1px solid black; padding: 2px;">16</span>	<span style="border: 1px solid black; padding: 2px;">17</span>	<span style="border: 1px solid black; padding: 2px;">18</span>	<span style="border: 1px solid black; padding: 2px;">19</span>