This first page will be removed from the actual crib sheet.

*** DISCLAIMER ***

These pages merely show you what formulas I will place on the crib. It is not meant to be a review or summary of the material.

- You are still responsible for knowing the concepts related to all the methods we've studied, even if it does not appear on this crib.
- The appearance of a formula on this crib does not necessarily mean you will use it on the exam.
- The absence of a formula or topic on this crib does not necessarily mean that it will not appear on the exam.

No other formulas will be given on the crib for Matrices. For example, you should know:

1. how to perform matrix multiplication, matrix addition, matrix transpose, and other matrix operations we studied,
2. how to use Gauss elimination **as it was presented in class** to solve a linear system,
3. how to use Gauss elimination to obtain the determinant of a matrix and know what it tells us,
4. how to obtain the different norms of matrices and vectors,
5. concepts and theorems regarding inverses and determinants,
6. how to obtain the condition number of a matrix and know what it tells us,
7. concepts and theorems regarding determinants and how they apply to existence and uniqueness of solutions,
8. concepts regarding severity of truncation error, ill-conditioning, etc.,
9. *etc.*

Advice for improved test-taking:

- **Show all your formulas and all your work.** Consider this simple truth: the exam is your opportunity to demonstrate your understanding and mastery of the material. Some students believe that skipping steps impresses faculty. On the contrary, *showing your steps in a clear, systematic, and legible manner impresses faculty.*
- Work the problem using the method stated in the problem and using the method as it was presented in class. For example, if a problem says to use a particular method, then that problem is testing you on that specific method. Using a different method will result in substantial point loss or no credit at all on that problem. Furthermore, I already know that your calculator can do some of these problems, so you must show all steps and all calculations. Merely copying a formula from the crib sheet and writing some numbers will result in substantial point loss or no credit at all on that problem. Rule of Thumb: *When in doubt, show steps.*
- The exam is not a race. Work at a pace that helps reduce your chance of making errors. If you finish the exam with time remaining, carefully check your work. Double check that you answered all questions being asked.
- **Circle your answer to each problem.** It would surprise you to know how many students can do these calculations but don't really know what it is we're trying to find. So I require you to circle your answer because I am checking to see if you really understand what it is you're doing.
- If a problem asks you to print a Maple command, then I expect you to print the command exactly as it must be entered in Maple. On Exams 1 & 2, I might have given a little bit of leeway (with misspelled words, for example). This time I will require you to print the command precisely as it must be entered to work in Maple. (To illustrate what I mean, the Maple command to make a graph is `plot`. It is not `Plot`, `PLOT`, `Plot`, etc.)
- If I require that you write calculations to 6 decimal places, you do **NOT** have to write **exact** numbers like 4, 5.37, 109 as 4.000000, 5.370000, 109.000000. You can also write exact numbers like $8.66666\ldots$ as $8.\overline{6}$.

FINAL EXAM CRIB

For all topics and methods, you should know: how to use them, their properties and characteristics, their pros and cons, etc. — that is, you should also know concepts. You are also responsible for knowing anything we covered that does not appear on this crib. The absence of a topic on this crib does not mean that you are not responsible for knowing it.

Richardson extrapolation:

$$F^* \approx F_h + \frac{F_h - F_H}{\left(\frac{H}{h}\right)^p - 1}$$

Trapezoidal rule template on Section 1:

$$\int f(x)\,dx \approx \frac{h}{2}\big(f_0 + f_1\big)$$

Simpson's–1/3 rule template on Section 1:

$$\int f(x)\,dx \approx \frac{h}{3}\big(f_0 + 4f_1 + f_2\big)$$

Simpson's–3/8 rule template on Section 1:

$$\int f(x)\,dx \approx \frac{3}{8}\,h\,\big(f_0 + 3f_1 + 3f_2 + f_3\big)$$

Transformation to use Gauss Quadrature:

$$\int_a^b f(x)\,dx = m\int_{-1}^1 F(t)\,dt\,, \qquad x = mt + p\,, \qquad m = \frac{b-a}{2}\,, \qquad p = \frac{b+a}{2}.$$

I would give you the weights and the abscissas. However, you need to know how to use Gauss Quadrature to approximate the integral and know the characteristics of Gauss Quadrature.

Newton–Gregory interpolating polynomial:

You must know how to construct the Newton-Gregory polynomial through prescribed points and use it to interpolate. You must also know the "next term rule" and what it means.

Approximating Derivatives:

For exam problems that use a difference formula to approximate a derivative, I would give you the difference formula that I want you to use and its global error. You need to know how to use the formula.

Euler Method: $$y_{n+1} \;=\; y_n + hf(x_n, y_n)$$

Implicit Euler Method: $$y_{n+1} \;=\; y_n + hf(x_{n+1}, y_{n+1})$$

Trapezoidal Method: $$y_{n+1} \;=\; y_n + \frac{h}{2}\Big[f(x_n, y_n) \;+\; f(x_{n+1}, y_{n+1})\Big]$$

Modified Euler Method:

I expect you to know which methods to combine to produce the modified Euler method and be able to apply it to a given initial value problem. Could I be clearer?

- Classical Runge–Kutta Method
- Runge–Kutta–Fehlberg Method
- Runge–Kutta–Verner Method

I would not have you apply any of these three methods to a problem. However, you should be familiar with the properties and behavior of these methods and know what makes them special.

You should know the global errors of <u>ALL</u> methods we studied for solving initial value problems and know whether each is implicit or explicit.

Gauss Elimination: To solve system $\mathbf{Ax} = \mathbf{b}$

You should know how to use Gauss elimination **as it was presented in class** to solve a linear system $\mathbf{Ax} = \mathbf{b}$. You should also know the other properties and characteristics of this method.