MA 16020 Final Exam Memo
Monday, December 15, 2025
7:00-9:00pm (plan to arrive no later than 6:45pm)

1. The exam will consist of 24 multiple choice questions covering lessons 3-35. Topics will be evenly distributed.
2. The location of the exam will depend upon your instructor:
   (a) STEW 183 (Loeb Playhouse - Main Floor) - Ruipeng Zou, Dave Norris
   (b) STEW 183 (Loeb Playhouse - Balcony) - Tyler Dunaisky, General Ozochiawaeze
3. Since the Final is in Loeb Playhouse, you will need to get a lapboard from the lobby before entering the auditorium. Return the lapboard to the stations in the lobby before leaving.
4. You will be emailed an assigned seat before the exam. Bring this seating assignment with you to the exam.
5. Non-graphing and non-programmable scientific calculators may be used on the exam.
6. You MUST bring your PUID to the exam.
7. Since the exams will be machine graded, the only thing that will be graded is the scantron sheet. Make sure that you have correctly filled in all of the information (name, PUID, test form number, section number, and all of your answers) on the answer sheet.
8. Please reread the section on the syllabus regarding exams. Exceptions for any make-up exams are listed on the syllabus.
9. Exam Penalty: Remember that there is a 5 point penalty for filling out your PUID incorrectly on the scantron, and a 5 point penalty for missing/incorrect Test Number on the scantron.
10. Please reread the section on the syllabus regarding exams. Exceptions for any make-up exams are listed on the syllabus
11. There are review problems in Achieve. There are also old exams for practice and practice exam problems from material after Exam 3 in Brightspace under Contents->Old Exams.
12. No one will be permitted to leave during the first 20 minutes of the exam; after the first 20 minutes, no one will be permitted to take exam.
13. There will be a formula sheet attached to the exam. The formulas that will be given are on the second page of this memo.

Formula Sheet - MA 16020

First-Order Linear Differential Equations
Any solution $y = f(x)$ of a first-order linear differential equation in standard form

$$\frac{dy}{dx} + P(x)y = Q(x)$$

must satisfy $y \cdot u(x) = \int u(x)Q(x)dx$ where $u(x) = e^{\int P(x)dx}$.

Geometric Series:
The geometric series $\sum_{n=0}^{\infty} ar^n$ with common ratio r converges if $|r| < 1$ with the sum

$$S = \sum_{n=0}^{\infty} ar^n = \frac{a}{1-r}$$

Power Series/Maclaurin Series:

$$\begin{aligned}
\frac{1}{1-x} &= \sum_{n=0}^{\infty} x^n = 1 + x + x^2 + x^3 + ... \qquad |x| < 1 \\
e^x &= \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + ... \\
\sin x &= \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{(2n+1)!} = \frac{x}{1!} - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + ... \\
\cos x &= \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(2n)!} = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + ... \\
\ln(1+x) &= \sum_{n=1}^{\infty} (-1)^{n-1} \frac{x^n}{n} = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + ... \qquad |x| < 1
\end{aligned}$$

Second Derivative Test
Given the critical point (a, b), such that $f_x(a, b) = 0$ and $f_y(a, b) = 0$, and let

$$D(a, b) = f_{xx}(a, b) f_{yy}(a, b) - [f_{xy}(a, b)]^2$$

- If $D > 0$ and $f_{xx}(a, b) > 0$ then $f(a, b)$ is a relative minimum.
- If $D > 0$ and $f_{xx}(a, b) < 0$, then $f(a, b)$ is a relative maximum.
- If $D < 0$, then $f(a, b)$ is a saddle point.
- If $D = 0$, the test is inconclusive.