Instructions: The final exam will consist of 6 questions, although some questions may consist of multiple parts, and be worth 150 points. Be sure to show as much work as possible in order to demonstrate that you know what you are doing. The point value for each question is listed after each question. A scientific calculator may be used but no graphing calculators or calculators on any device (cell phone, iPod, etc.) which can be used for any other purpose. The concepts and types of questions on the final exam will be similar to the previous tests, previous reviews, and this review, although the numbers and functions may be different on each question on the exam. If you wish to use the list of Laplace Transforms or Common Taylor Series I have provided online you may do so, but you must bring your own copy as I will not provide it on the test and sharing is not allowed. Be sure that there is no writing on the list. Each of the 6 questions can be found in the following places:

1. Exam #1, Problem #4 (15 points)
2. Exam #1, Problem #5 (15 points)
3. Exam #2, Problem #3 (20 points)
4. Exam #3, Problem #4 (40 points)
5. Exam #4, Problem #3 (25 points)
6. Exam #4, Problem #4 (25 points)
(1) Find a general explicit solution of the differential equation. (15 points)

\[ \frac{2 \, dy}{x \, dx} = \frac{y}{\sqrt{x^2 - 16}} \]
(2) Find the general solution to the differential equation. Primes denote derivatives with respect to $x$. (15 points)

$$y' + (\tan x) y = \sec x$$
(3) Find the general solution of each differential equation. (20 points)

\[ y'' - 5y' + 4y = 8e^x + \cos x \]
(4) Use Laplace transforms to solve the initial value problem. (20 points each)

(a) $y' - y = 2 \cos 5t; \ y(0) = 1$
(b) \( y'' - 4y' + 4y = t^3 e^{2t}; \ y(0) = 0, \ y'(0) = 0 \)
(5) Use the power series method to solve the given initial-value problem. Identify the series solution in terms of familiar elementary functions. (25 points)

\[ y'' + 4y = 0; \quad y(0) = 0, \quad y'(0) = 3 \]
(5) (continued)
(6) Find two power series solution of the given differential equation. Write out the first four terms of each series solution. (25 points)

\[(x + 1)y'' - (2 - x)y' + y = 0\]
(6) (continued)