MA 266 Exam 2 Study Guide

Exam 2 will cover material from lessons 11-20. This is sections 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 4.1, 4.2, 4.3, and 6.1 in the textbook.

Exam 2 will be worth 100 points. There are some multiple choice problems and some free response problems. There is no partial credit for multiple choice questions, but partial credit may be awarded for free response questions. You must show all of your work for full credit on the free response questions.

You should be able to do every homework question. Calculators are not allowed on the exam, so the computations will be simple enough to do by hand.

Terminology you should know (not an exhaustive list):

- linear operator
- existence, uniqueness
- Principle of Superposition
- Wronskian, fundamental set of solutions
- characteristic equation/polynomial
- complex number, Euler's formula
- homogeneous, nonhomogeneous, complementary solution, particular solution
- Method of Reduction of Order
- Method of Undetermined Coefficients, Method of Variation of Parameters
- mass-spring system, Hooke's law, spring constant, spring force, gravity, damping force, damping coefficient, natural frequency, amplitude, phase, period, quasi-frequency, quasi-period, critically damped, overdamped, forcing function, resonance, g, kg, cm, m, N (Newtons: $\mathrm{kg} \cdot \mathrm{m}/\mathrm{s}^2$), lb, in, ft
- piecewise continuous function, Laplace transform

Techniques you should be able to do (not an exhaustive list):

- Find the general solution of second order linear homogeneous differential equations with constant coefficients when the characteristic polynomial has
  - Two distinct real roots
  - Complex conjugate roots
  - A repeated real root
- Compute the Wronskian of two functions, determine whether a set of functions is a fundamental set of solutions to a differential equation

- Write $c^{\lambda+\mu i}$ in $a + bi$ form for any positive real number c and real numbers λ, μ
- Use the method of reduction of order to find a second (algebraically distinct) solution to a second order linear homogeneous differential equation given one solution.
- Know how to solve nonhomogeneous second order linear differential equations using
  - Method of Undetermined Coefficients
  - Method of Variation of Parameters
- Set up IVPs representing the displacement of a mass attached to a spring, solve such IVPs, find the damping coefficient necessary for the system to be critically damped, find the values of the damping coefficient necessary for the system to be overdamped, convert expressions of the form $A\cos(\alpha t) + B\sin(\alpha t)$ to the form $R\cos(\omega_0 t - \delta)$, find the natural frequency, amplitude, phase, and period of a mass-spring system, find the quasi-frequency and quasi-period of a mass-spring system, find the frequency of an external force for which the system will experience resonance
- Determine intervals on which an nth order linear differential equation has solutions
- Solve an nth order linear homogeneous differential equation with constant coefficients
- Find the rational roots of any polynomial
- Be able to find a suitable form for $Y(t)$ using the Method of Undetermined Coefficients for a given nth order linear differential equation, solve an nth order linear nonhomogeneous differential equation with the Method of Undetermined Coefficients
- Determine whether a function is continuous, piecewise continuous, or neither
- Compute the Laplace transform of relatively simple continuous functions (using the definition of the Laplace transform), including the values of s for which the Laplace transform is valid.
- Solve IVPs
- Describe the behavior of solutions to a differential equation

As was said earlier, this is *not* an exhaustive list of material that could appear on the exam – it is only a list of the biggest ideas covered. You should be capable of doing every homework problem (even the ones which are too long and/or difficult to be placed on an exam – I can still ask you how to do parts of these problems, even if I don't ask you to do the full problem).