MIDTERM STUDY GUIDE

In order to do well on the midterm exam, you should be able to do the following:

1. Given a function $f(t)$, compute its Laplace transform $F(s)$. Given a function $F(s)$, compute its inverse Laplace transform $f(t)$. Identify which "case" the function pertains to, and perform partial fraction expansion, completing the squares, etc. as necessary. Put the equation in the form necessary to use the provided Laplace transform tables. (§ 2-3, 2-4)

2. Solve a linear ODE using the Laplace transform, i.e. compute the Laplace transform of the equation of motion, use partial fraction expansion to get the solution $X(s)$ in the proper form, and use the provided Laplace transform tables to find $x(t)$. (§ 2-5)

3. Explain in your own words the elementary components of mechanical vibrating systems and how energy flows between the components. (§ 3-2)

4. Identify the number of DOFs in a vibrating system. (§ 3-2)

5. Calculate the effective spring stiffness and damping coefficient of a system that may include: springs/dampers in parallel or series, linear and torsional springs/dampers, or springs/dampers attached at various points along a rigid bar. (§ 3-2, 3-3)

6. Calculate the effective mass/inertia of a system that may include a combination of rotational and translational motion (e.g. rack and pinion gear) or use of the Parallel Axis Theorem. Any needed moments of inertia (e.g. bar or disc) will be given. (§ 3-2, 3-3)

7. Derive the equation(s) of motion of a mechanical system using force/moment balance or energy methods. (§ 3-3, 3-4)

8. Compute the response of a spring-mass-damper system given its initial conditions using Laplace transform methods. (§ 3-3, 2-5)

9. Describe the concept of the transfer function in terms of the inputs, outputs, and the system itself. Which of these three appear in the transfer function and why? Calculate the transfer function for a vibrating system given the equation of motion. (§ 4-1)

10. Compute the impulse, step, and ramp response of a system given its transfer function. (§ 4-4)

11. Use the initial or final value theorem to find $\lim_{t \to 0+} x(t)$ or $\lim_{t \to \infty} x(t)$. (§ 2-3)

12. Compute the response of a system to an impulse/impact. Use the convolution (Duhamel) integral to find the response to an arbitrary input. (§ 4-4)

13. Write the equations of motion for a mechanical system in state-space form. Identify the inputs, states, and outputs. (§ 5-1, 5-3)

14. Convert a transfer function to state space, and vice versa. (§ 5-2, 5-4)