FINAL STUDY GUIDE

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

1. Derive the EOMs for an electrical system. Find the transfer function or the state space model between the input and the output. Apply the concept of complex impedance to simplify circuits. Find the transfer function for circuits with op-amps. (§ 6-1, 6-2, 6-6)

2. Identify from a transfer function $G(s)$ the following: the effective mass m_{eq}, the effective damping b_{eq}, the effective stiffness k_{eq}, the natural frequency ω_n, the damping ratio ς, and the time constant T of the system. (Note, not all of these are applicable to every system.) Identify if the system is first-, second-, or higher-order. Determine the qualitative behavior (e.g. stable/unstable, oscillatory/non-oscillatory) and the quantitative behavior (frequency, rate of growth/decay) of a system from the location of its characteristic roots in the s-plane. (§ 8-2, 8-3, notes)

3. From the free response of a system, determine the qualitative behavior (e.g. stable/unstable, oscillatory/non-oscillatory) and the quantitative behavior (frequency, rate of growth/decay) of a system. Determine the characteristic roots of the system. (§ 8-3, notes)

4. Solve a state space system through use of the matrix exponential $e^{\mathbf{A}t}$. (§ 8-5)

5. Compute the frequency transfer function $G(i\omega)$ from the transfer function $G(s)$. Use the amplitude and phase angle frequency plots to sketch the steady-state response of a system given a sinusoidal input. (§ 9-2)

6. Compute the force or displacement transmissibility of a vibrating or rotating system. Use this to design the vibration isolator to meet requirements on transmissibility. (§ 9-3, 9-4)

You will also be responsible for the following major concepts from the midterm exam:

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

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

5. Calculate the transfer function or state space model for a vibrating system given the equation of motion. (§ 4-1, 5-1, 5-3)

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