

REVIEW SHEET FOR TEST 3

The best way to prepare for a test is to review homework problems, examples from the textbook and class notes. Make sure that you can solve these problems in a reasonable amount of time without reference to the textbook or class notes. It is important that on the test you show all your work and explain your answers. Just answers (especially wrong ones!) without any explanation will earn you no credit.

List of major topics covered in class.

• Linear systems: matrix notation (pp. 243 -246). Linearity principle (pp. 249-255). Applications of Linearity principle to solving initial value problems (pp. 252-255). Linear independence and general solution (pp. 255-256). Undamped harmonic oscillator (pp. 256 -258). #5, 9, 11, 16, 17, 24, 25, 27, 30 after section 3.1.

1. Section 3.2. Straight-line solutions, equation for finding straight-line solutions, definition of eigenvalues and associate eigenvectors, lines of eigenvectors. Computation of eigenvalues and eigenvectors, characteristic polynomial, formulas for straight-line solutions. Linear independence of eigenvectors corresponding to distinct eigenvalues. #1, 2, 3, 7, 8, 11, 13, 16, 21, 23 after 3.2.

2. Section 3.3. Geometry of a phase plane for linear systems with real eigenvalues: saddles, sinks, and sources. Stability of equilibrium point (0,0). You should be able to draw an approximate phase portrait of a system from the information about its eigenvalues and eigenvectors (pp. 270-291, class notes, handouts). You also should be able to draw approximate graphs of $x(t)$ and $y(t)$ from a given solution curve. # 1, 2, 3, 5, 6, 9, 11, 13, 14 after 3.3.

3. Section 3.4. Systems with complex eigenvalues: Euler's formula, obtaining two real solutions from a complex solution. General solution in complex form and in real form. Theorems from class: complex eigenvalues and eigenvectors of a real matrix come in conjugate pairs, and real and imaginary parts of a complex solution are also solutions. Spiral sources, spiral sinks, centers. Natural frequency, natural period. Direction of spiraling: clockwise or counterclockwise. Stability of equilibrium point. You should be able to determine the type of equilibrium point and draw an approximate phase portrait by computing eigenvalues of the system (section 3.4, class notes, handouts). # 1, 2, 3, 4, 5, 6, 8, 10, 11, 14, 17, 22 (see handout) after 3.4.

4. Section 3.6. Second-order linear equations - two methods of solutions: guess-and-test and reduction to a system. Classification of harmonic oscillators: undamped, underdamped, critically damped, and overdamped oscillators. For each type of oscillators you need to know: eigenvalue condition, condition on the discriminant $D=b^2-4mk$ corresponding to this type, typical phase-plane portraits and $y(t)$, $v(t)$ graphs (section 3.6 and class notes). # 9, 11, 16, 23, 24, 30, 31 after 3.4.

GOOD LUCK!