Topics for final exam, MATH308-SPRING 2015

The final exam will be on the topics below:

1. Part of section 7.5 related to the case when there are repeated roots but the basis of the eigenvectors exists. In particular, you have to know how to find independent eigenvectors if the eigenspace is of dimension greater than 1.

2. Linear systems of differential equations with constant coefficients and complex eigenvalues (in the cases $n = 2$ and $n = 3$) (section 7.6);

3. Section 7.7: Fundamental matrices: to know what is the fundamental matrix of a linear system; to know what is the exponential of the matrix and how it is related to the solution of IVP for linear systems with constant coefficients; to know to calculate exponential for diagonal matrices and for the Jordan blocks of size 2 and 3, i.e. the matrices $\begin{pmatrix} \lambda & 1 \\ 0 & \lambda \end{pmatrix}$, $\begin{pmatrix} \lambda & 1 & 0 \\ 0 & \lambda & 1 \\ 0 & 0 & \lambda \end{pmatrix}$.

4. Section 7.8: Linear systems of differential equations with constant coefficients and repeated eigenvalues (in the cases of $n = 2$ and $n = 3$). In particular, you have to know how to find

   - the algebraic and geometric multiplicities of an eigenvalue discussed in class (see also page 380 of the text book);
   - a basis of generalized eigenvectors in different situations and how to write down the general solution of the original system in terms of these generalized eigenvectors (however the case of eigenvectors of algebraic multiplicity 3 will not be given in the test).

5. Section 7.9: Nonhomogeneous linear systems: method of variation of parameters;

6. Section 9.1: The phase portrait of planar linear systems: to know all types of critical (equilibrium) points and their stability property (see Table 9.1.1 on page 494 for the summary); also to know to sketch the corresponding phase portraits.

7. Section 9.2: To know the notion of critical points of general (nonlinear) system, the notion of *stable, unstable*, and *asymptotically stable* critical point (pages 498-499 of the text).

8. Section 9.3: To know how to find critical points of a given nonlinear (but locally linear) system, how to find the linear system corresponding to each critical point, and how to determine the stability properties of the critical point on the base of the corresponding linear system (as in Table 9.3.1 of page 513).

It is *recommended to review all problems in homework assignment 14-17 (except bonus problem 3 of assignment 16) and the examples given during the class on the topics listed above. In addition, it is useful to review homework assignments 16-18 of Fall 2013 term posted at http://www.math.tamu.edu/ zelenko/F13308Hmwk.html*