

Lecture Questions III: 110.302 Differential Equations

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Question 1

Suppose a high-order, linear, homogeneous, constant coefficient ODE had a characteristic equation given by

$$(r - 2)(r^2 + 6r + 10)^2(r + 1)^3(r^2 - 2) = 0.$$

Which of the following is true?

- A. There is enough information here to determine the general solution completely.
- B. There is not nearly enough information to determine the general solution completely.
- C. Solutions will be a mix of real-valued and complex-valued solutions.
- D. We cannot write out the solutions, but we do know that the general solution will be a 7-parameter family of solutions, and need 7 bits of information to determine a particular solution.
- E. With only this information, we do not even know if solutions exist or are uniquely defined.

Question 2

Determine which one of the following statements about Fundamental Matrices is untrue:

- A. For every $t \in \mathbb{R}$ where solutions are defined, the determinant of the fundamental matrix is non-zero.
- B. The columns of a fundamental matrix consist of vector solutions to the ODE.
- C. For a given ODE system, a fundamental matrix is uniquely defined.
- D. Fundamental matrices are defined for linear systems with varying coefficients, as long as the system is homogeneous.
- E. There is a special fundamental matrix whose value at the initial time indicated is the identity matrix.

Question 3

Determine the truth of the following two statements about 2nd-order ODEs and 1st-order systems:

- (1) Any 2nd-order ODE of the form $y'' = F(y, y')$ can be written as a first-order system of 2 ODEs in 2 variables.
- (2) Any first-order system of 2 ODEs in two variables can be converted into a single 2nd-order ODE of the form $y'' = F(y, y')$.

- A. Both are true.
- B. (1) is true and (2) is false.
- C. (1) is false and (2) is true.
- D. Both are false.