1. Know how to classify each differential equation (DE) as an ordinary differential equation (ODE) or partial differential equation (PDE), give its order and indicate whether its linear or nonlinear.

2. Know how to identify solutions and know the existence and uniqueness theorem for the solution of an initial value problem (IVP).

3. Know how to construct a direction field using the method of isoclines and how to use it to sketch an approximate solution.

4. Know Euler's method for constructing an approximate solution to an IVP for a first-order DE.

5. Know how to solve a first-order DE using separation of variables.

6. Know the method for solving linear first-order DEs.

7. Know how to solve exact equations.

8. Know how to solve first-order DE using special integrating factor.

9. Know how to solve homogeneous and Bernoulli equations.

10. Know how to solve equations of the form  $\frac{dy}{dx} = G(ax + by)$  and equations with linear coefficients.

11. Know how to form population models and solve mixing problems.

16. Know the improved Euler's method and Runge-Kutta methods and how to use them to find an approximate solution to an IVP.

17. Know how to solve second-order homogeneous linear differential equations.

18. Know how to solve second-order nonhomogeneous linear differential equations using the method of undetermined coefficients.

19. Know how to solve second-order nonhomogeneous linear differential equations using the method of variation of parameters.

20. Know the superposition principle and how it relates to the general solution of a second-order nonhomogeneous linear differential equation.

21. Know how to solve second-order homogeneous and nonhomogeneous Cauchy-Euler equation.

22. Know how to solve the mass-spring system when it is undamped, damped, free, and has a cosine forcing function.

23. Know to solve 2 by 2 systems of differential equations using the elimination method and using determinants.

24. Know how to solve higher order DE with constant coefficients using the annihilator method (method of undetermined coefficients).

25. Know how to solve higher order DE with constant coefficients using the method of variation of parameters.

26. Know how to obtain series solution to second-order linear DE about ordinary points.

27. Know how to identity ordinary and singular points of a linear DE.

28. Know how to determine the minimum radius of convergence for a series solution to a DE.

29. Know how to identify regular and irregular singular points of a linear DE.

Example exercises: Quiz & Homework questions; Ch.1 Review Problems, #1 - 17;
Ch. 2 Review Problems, #1 - 30, 35, 38, 40;
Ch. 3.6 #7-13; 3.7 #7-9, 19;
Ch. 4 Review Problems, #1 - 39;
Ch. 5 Review Problems, #1 - 4;
Ch. 6 Review Problems, #1 - 10;
Ch. 8 Review Problems, #2 - 5.