

## Sample Midterm II

1. (25 points) Suppose that you borrow 150,000 dollars to buy a house at 9 percent annual interest rate, compounded continuously.
  - (a) (15 points) What are your monthly payments, assuming a 30-year loan?
  - (b) (10 points) How much interest do you pay in total?
2. (30 points) Solve the following differential equations.
  - (a) (15 points)  $e^t(y - t) + (1 + e^t)y' = 0$ .
  - (b) (15 points)  $x' + x = t^2$  with  $x(0) = 0$ .
3. (45 points) Let  $x' + x = t$ .
  - (a) (10 points) Let  $x(0) = x_0$ . Find the general solution.
  - (b) (5 points) Identify the transient and steady-state parts of the solution.
  - (c) (20 points) Suppose that the actual initial condition is  $x_0 = 1$  and the measured initial condition is  $\hat{x}_0 = 2$ . Find the absolute error  $E_a$  and relative error  $E_r$ .
  - (d) (10 points) Find  $\lim_{t \rightarrow \infty} E_a$  and  $\lim_{t \rightarrow \infty} E_r$ .