

**Instructions:** Show all work. Answers without work required to obtain the solution will not receive full credit. Some questions may contain multiple parts: be sure to answer all of them. Give exact answers unless specifically asked to estimate.

1. Solve the second order ODEs for the general solution.

a.  $9y'' - 12y' + 4y = 0$

$$9r^2 - 12r + 4 = 0$$

$$(3r + 2)^2 = 0$$

$$r = -\frac{2}{3} \text{ repeated}$$

$$y(t) = c_1 e^{-\frac{2}{3}t} + c_2 t e^{-\frac{2}{3}t}$$

b.  $y'' + 6y' + 13y = 0$

$$r^2 + 6r + 13 = 0$$

does not factor

$$r = \frac{-6 \pm \sqrt{36 - 52}}{2} = \frac{-6 \pm \sqrt{-16}}{2} = \frac{-6 \pm 4i}{2} = -3 \pm 2i$$

$$y(t) = c_1 e^{-3t} \cos 2t + c_2 e^{-3t} \sin 2t$$