Test #2 Review

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Second order Nonhomogeneous
(Repeated Roots)

Problem 3 From Webwork

$$y'' + 14y' + 49y = 16e^{-5t}$$

a) <u>characteristic polynomial</u>

$$r^2 + 14r + 49 = 0$$

b) <u>Roots</u>

$$r^2 + 14r + 49 = 0$$
$$(r+7)(r+7)$$
$$r = -7, -7$$

c) <u>y_1 and y_2</u>

$$y_1(t) = e^{-7t}$$
$$y_2(t) = te^{-7t}$$

d) homogeneous solution

<u>use A & B as arbitrary constants.</u>

$$y_h(t) = Ae^{-7t} + Bte^{-7t}$$

e) <u>Non homogeneous Solution</u>

$y_p(t) = Ce^{-5t}$ → C is the constant

$$y' = -5Ce^{-5t} \qquad y'' = 25Ce^{-5t}$$

$$25Ce^{-5t} + 14(-5Ce^{-5t}) + 49Ce^{-5t} = 16e^{-5t}$$

$$25Ce^{-5t} - 70Ce^{-5t} + 49Ce^{-5t} = 16e^{-5t}$$

$$4Ce^{-5t} = 16e^{-5t}$$

$$\cancel{4}Ce^{\cancel{-5t}} = \overset{4}{\cancel{16}}e^{\cancel{-5t}}$$

$$y_p(t) = 4e^{-5t}$$

$$C = 4$$

f) General Solution.

$$Ae^{-7t} + Bte^{-7t} + 4e^{-5t}$$

g) particular Solution Satisfying $y(0) = 11$
$y'(0) = -67$

$$y(t) = Ae^{-7t} + Bte^{-7t} + 4e^{-5t}$$

$$y'(t) = -7Ae^{-7t} + Be^{-7t} - 7Bte^{-7t} - 20e^{-5t}$$

$y(0) = 11$

$$11 = Ae^{-7\cdot 0} + B\cdot 0e^{-7\cdot 0} + 4e^{-5\cdot 0}$$

$$11 = A + 4$$

$$-4 \qquad -4$$

$$7 = A$$

$y'(0) = -67$

$$-67 = -7Ae^{-7\cdot 0} + Be^{-7\cdot 0} - 7B\cdot 0e^{-7\cdot 0} - 20e^{-5\cdot 0}$$

$$-67 = -7A + B - 20$$

$$-67 = -7(7) + B - 20$$

$$-67 = -49 + B - 20$$

$$+20 \qquad +20$$

$$-47 = -49 + B$$

$$+49 \qquad +49$$

$$B = 2$$

$$y(t) = 7e^{-7t} + 2te^{-7t} + 4e^{-5t}$$