17/eng02/0010 Computer Engineering.

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1a) C.F $= m^2 + 5m + 6 = 0$

$(m+3)(m+2) = 0$

$m = -3$ and $m = -2$

$x = Ae^{-3t} + Be^{-2t}$

$f(t) = \cos t$

$x = C\cos t + D\sin t$

$dx/dt = -C\sin t + D\cos t$

$d^2x/dx^2 = -C\cos t - D\sin t$

subs

$= -C\cos t - D\sin t + 5(-C\sin t + D\cdot\cos t) + 6(C\cdot\cos t + D\sin t) = \cos t$

$= \cos t(-C + 5D + 6C) + \sin t(-D - 5C + 6D = \cos t$

$= \cos t(5D + 5C) + \sin t(5D - 5C) = \cos t$

$5D + 5C = 1$

$+ 5D - 5C = 0$

$10D = 1$

$D = 1/10$

$5\left(\frac{1}{10}\right) + 5C = 1$

$1/2 + 5C = 1$

$C = -1/10$

G.S $= x = Ae^{-3t} + Be^{-2t} + 1/10\cos t + 1/10\sin t$

subs $(x = 0.1)$ $t = 0$

$0.1 = Ae^{-3(0)} + Be^{-2(0)} + 1/10\cos(0) + 1/10\sin(0)$

$0.1 = A + B + 0.1$

$A + B = 0$ ——①

$dx/dt = -3Ae^{-3t} - 2Be^{-2t} - 1/10\sin t + 1/10\cos t$

$0 = -3A - 2B + 0.1$

$-0.1 = -3A - 2B$

$3A + 2B = 0.1$ ——②

$2A + 2B = 0$

$-3A + 2B = 0.1$

$-A = -0.1$

$A = 0.1$

To find B

$A + B = 0$

$0.1 + B = 0$

$B = -0.1$

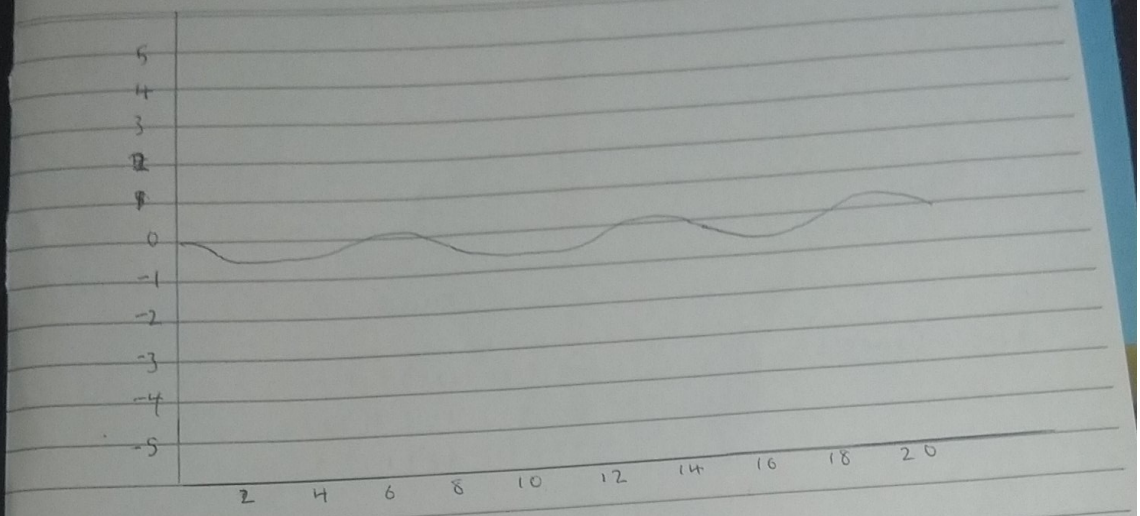
$$G.S = \frac{1}{10} e^{-3t} - \frac{1}{10} e^{-2t} + \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

$$= \frac{-1}{10} e^{-2t} + \frac{1}{10} e^{-3t} + \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

$$= \frac{1}{10} \left(-e^{-2t} + e^{-3t} + \cos t + \sin t \right)$$

b) mat lab

```
command window
clear
clc
close all
syms t
t = 0 : 0.01 : 15
x = 0.1 [-exp(-2*t) + exp(-3*t) + cos(t) + sin(t) ]
xn = subs (x)
plot (t, xn)
axis tight
grid on
grid minor
```



c) steady state

$x \quad x \leftrightarrow \infty = 0.1\cos t + 0.1\sin t = K\sin(t+a)$

Recall $K\sin(t+a) = K\sin t\cos a + K\cot\sin a$

$\therefore x_t \to \infty = 0.1\cos t + 0.1\sin t = K\sin t\cos a + K\cot\sin a$

Taking coefficient of cos & sin

$0.1 = K\sin a$

$0.1 = K\cos a$

Square both sides

$K^2\sin^2 a + K^2\cos^2 a = \frac{1}{100} + \frac{1}{100}$

$K^2(\sin^2 a + \cos^2 a) = \frac{1}{50}$

$K^2 = \frac{1}{50} \qquad K = \frac{\sqrt{2}}{10}$

$\frac{K\sin a}{K\cos a} = \frac{0.1}{0.1} = 1 \quad \therefore a = \pi/4$

$\tan a = 1$

$x_{ss} = \frac{\sqrt{2}}{10}\sin\left(t + \pi/4\right)$