ECE436 Solutions to Ex 3

1.

14.5(a) $G(j\,3.16) = -0.455$

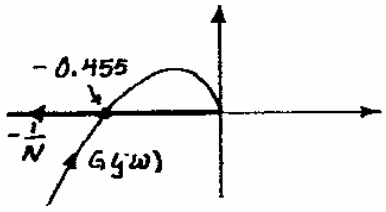
$N = \frac{4A}{\pi M} = \frac{8}{\pi M}$

$\therefore -\frac{1}{N} = -\frac{\pi M}{8} = -0.455$

$\therefore M = 1.16$

$m(t) = \underline{1.16 \sin(3.16t)}$ [checked by simulation]

Stable limit cycle.



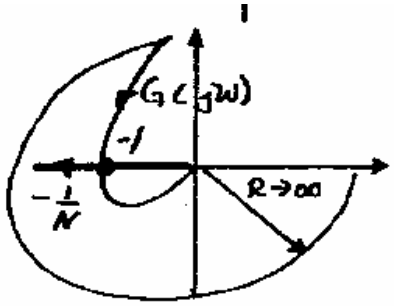
2.

(a) $G(j1) = -1 = -\frac{1}{N} = -\frac{\pi M}{8}$

$\therefore M = 2.55$

$m(t) = 2.55 \sin t$

Unstable limit cycle

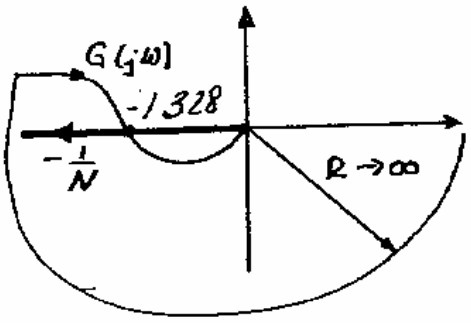


(b) $G(j\,3.88) = -1.328 = -\frac{\pi M}{8}$

$\therefore M = 3.38$

$m(t) = 3.38 \sin 3.88t$

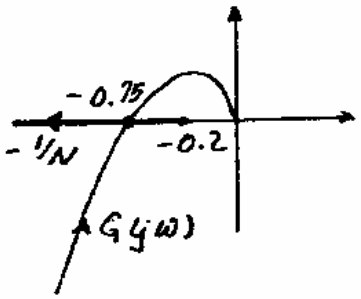
Unstable limit cycle



3.

14.7. (a) $K = 5$, $\therefore 1/K = 0.2$

$$G(j2) = \frac{12}{j^2(2+j^2)^2} = -0.75$$



$$\therefore G(j2) = -0.75 = -\frac{1}{N} = -\frac{1}{5N_3(\frac{M}{5})}$$

$$\therefore N_3(\tfrac{M}{5}) = \frac{1}{3.75} = 0.267$$

Linear interpolation, Table 14.2:

for $N_3(x) = 0.267$, $x = 4.75 = M/5$

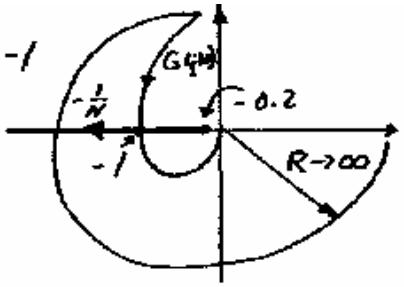
$\therefore M = 4.75 \times 5 = 4.75 \times 2 = 9.50$

$\therefore m(t) = \underline{9.50 \sin 2t}$ [checked by simulation]

Limit cycle is stable.

4.

14.8 (a) $K = 5$, $1/K = 0.2$, $G(j1) = -1$



$$G(j1) = -1 = -\frac{1}{5N_3(\frac{M}{5})}$$

$$\therefore N_3(\tfrac{M}{5}) = 0.2$$

From Table 14.2,

$N_3(x) = 0.2 \Rightarrow x = 6.34 = M/5$, $\therefore M = 12.68$

$\therefore \underline{m(t) = 12.68 \sin t}$, Unstable limit cycle.

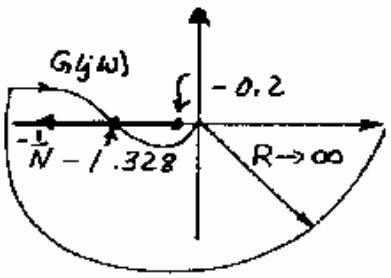
(b) $K = 5$, $1/K = 0.2$, $G(j3.88) = -1.328$

$$G(j3.88) = -1.328 = -\frac{1}{5N_3(\frac{M}{5})}$$

$$\therefore N_3(\tfrac{M}{5}) = 0.151$$

From Table 14.2, $x = \frac{M}{5} = 8.40$

$\therefore M = 16.80$



$\underline{m(t) = 16.80 \sin 3.88t}$ unstable limit cycle