ECE3204 Lecture 22

Wien Bridge Oscillator
Stability analysis (Ch. 10)

Handouts:
Wien Bridge with AGC
1-minute Quiz

$$\beta(s) = \frac{\frac{R}{1+sRC}}{\frac{R}{1+sRC} + R + \frac{1}{sC}} \cdot \frac{sC(1+sRC)}{sC(1+sRC)}$$

$$= \frac{sRC}{sRC + sRC(1+sRC) + 1 + sRC}$$

$$= \frac{sRC}{\underline{sRC} + \underline{sRC} + s^2R^2C^2 + 1 + \underline{sRC}}$$

$$\beta(s) = \frac{sRC}{s^2R^2C^2 + 3sRC + 1}$$

Wien Bridge Oscillator

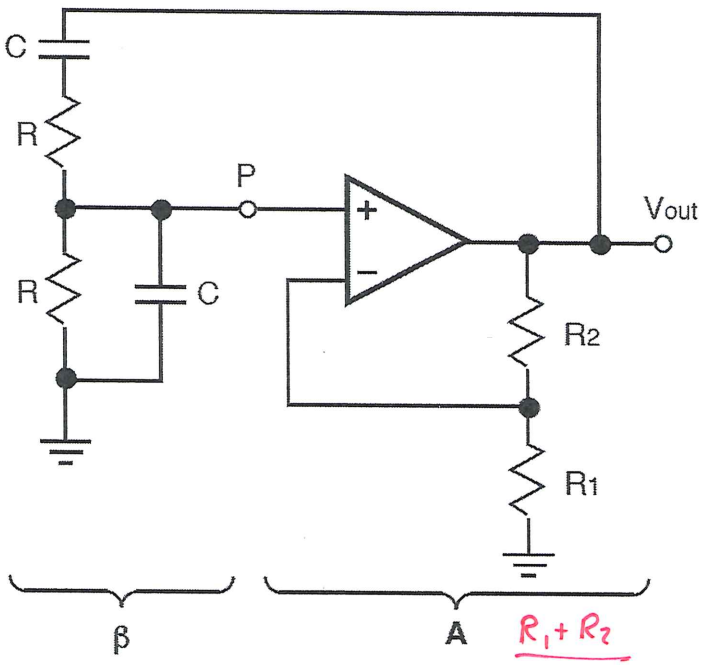


Figure 6.4

WHAT ω WILL HAVE 0° PHASE SHIFT? (PURELY REAL)

LET $s = j\omega$

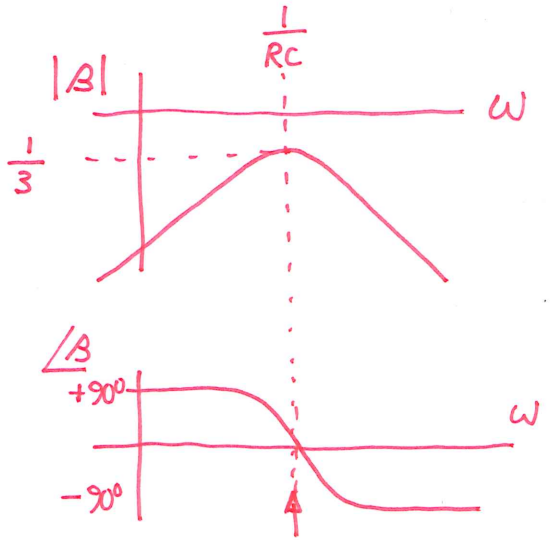
$$\frac{j\omega RC}{\underbrace{(1-\omega^2R^2C^2)}_{0} + 3j\omega RC}$$

PURELY REAL WHEN

$1 - \omega^2R^2C^2 = 0$

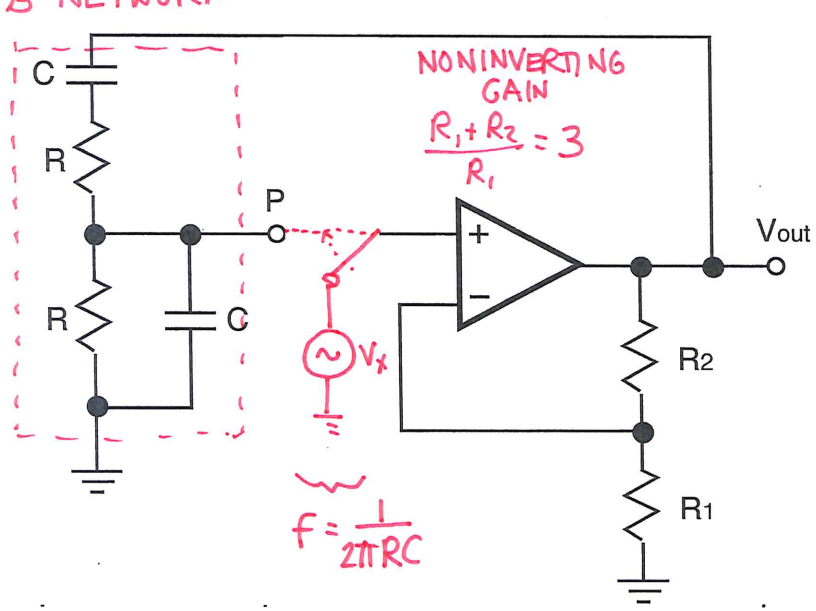
$\omega = \frac{1}{RC}$ AT THIS ω

$$\beta = \frac{j}{3j} = \frac{1}{3}$$

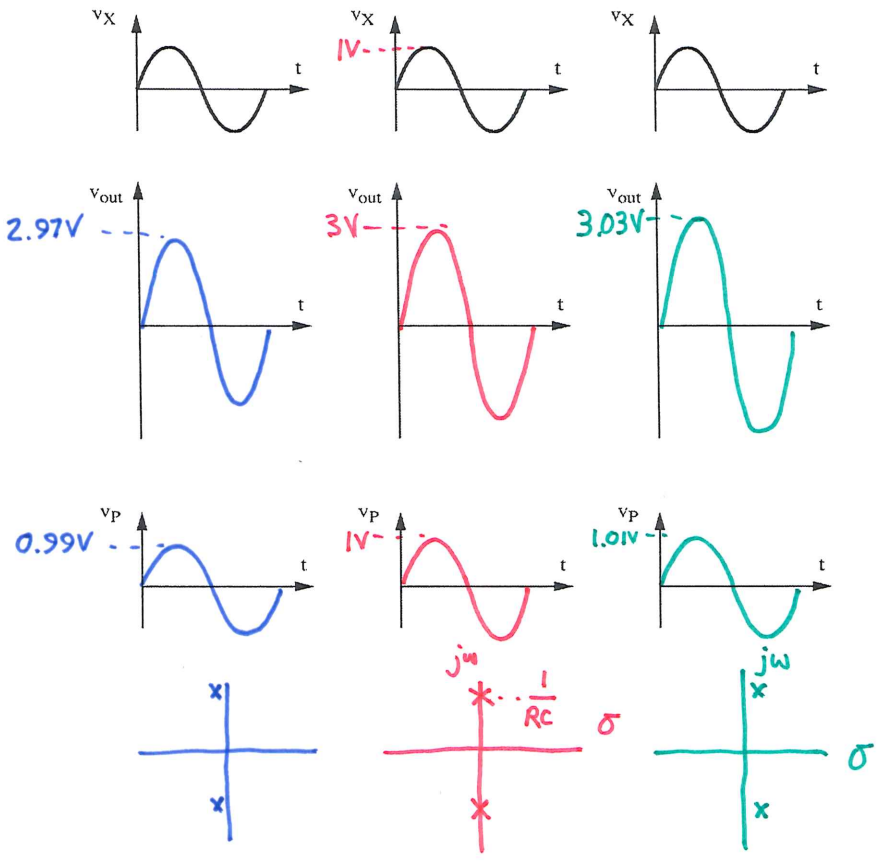


GAIN THROUGH β NETWORK $= \frac{1}{3}$ AT $\omega = \frac{1}{RC}$, $\angle = 0$

Intuitive View of Wien Bridge Oscillator



	1% LOW		1% HIGH
$\frac{R_1+R_2}{R_1}$	2.97	3	3.03



$|AB|=0.99$

GAIN AROUND AB LOOP = 1

$|AB|=1$

$\angle AB = 0°$

$|AB|=1.01$

"SELF CONSISTENT WAVEFORM"
SINUSOIDAL OSCILLATION

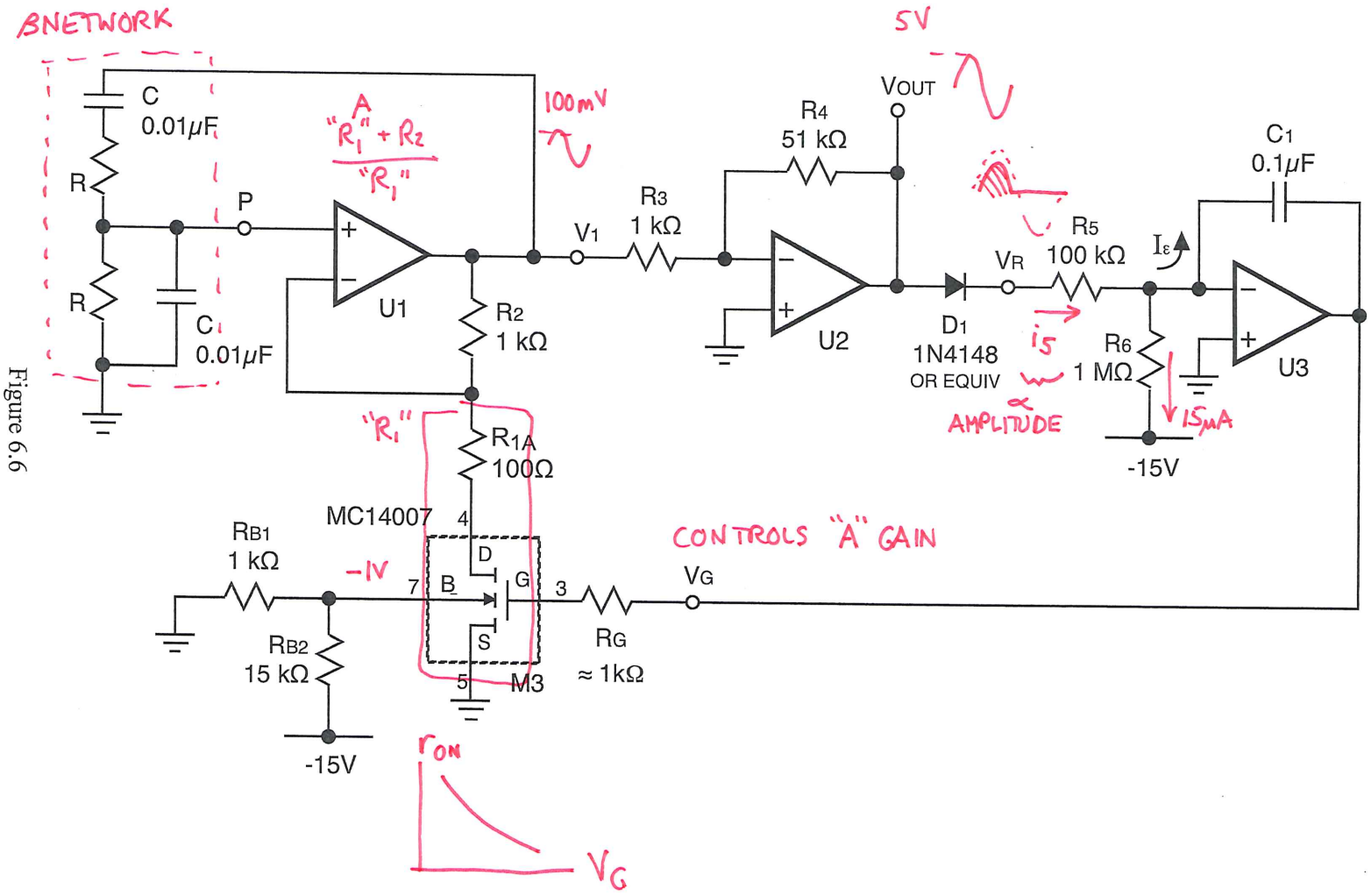

BNETWORK
C
0.01μF
R
R
P
C
0.01μF
A
"R1" + R2
"R1"
100mV
U1
R2
1 kΩ
V1
R3
1 kΩ
R4
51 kΩ
VOUT
U2
5V
D1
1N4148
OR EQUIV
VR
R5
100 kΩ
Iε
C1
0.1μF
U3
R6
1 MΩ
-15V
i5
∝ AMPLITUDE
15mA
"R1"
R1A
100Ω
MC14007
4
D
G
3
S
5
M3
7
B
RB1
1 kΩ
-1V
RB2
15 kΩ
-15V
VG
RG
≈ 1kΩ
CONTROLS "A" GAIN
rON
VG

Figure 6.6