W & M Computing HW1 Date 9/8/21

① ⓐ $T = \frac{1}{f} = \frac{1}{1000} = .001s = \boxed{1ms}$ ← period

② ⓐ $\sin(2\pi ft - \pi) + \sin(2\pi ft + \pi)$
$= 2\sin(2\pi ft)\cos(\pi) = 2\sin(2\pi ft) \times -1$
$= \boxed{2\sin(2\pi ft)}$

ⓑ $\sin 2\pi ft + \sin(2\pi ft - \pi)$
$= \sin(2\pi ft) + \sin(2\pi ft)\cos(\pi) - \sin(\pi)\cos(2\pi ft)$
$= \sin(2\pi ft) + \sin(2\pi ft) \times (-1) - (0) \times \cos(2\pi ft)$
$= \sin(2\pi ft) + \sin(2\pi ft) \times (-1) - 0$
$= \sin(2\pi ft) - \sin(2\pi ft) = \boxed{0}$

③ relative frequency $= y - x$
wavelength $= \frac{\text{velocity}}{\text{frequency}}$

Note	C		D		E		F		G		A		B		C
Frequency	264		297		330		352		396		440		495		528
Relative frequency		33		33		22		44		44		55		33	
Wavelength	1.25		1.11		1		0.93		0.83		0.75		0.67		0.63

④ $A\sin(2\pi ft + \phi)$ $A = 2$; $f = 2$; $\phi = \pi$
$= 2\sin(2 \times \pi \times 2 \times t + \pi)$
$= \boxed{2\sin(4\pi t + \pi)}$

Page

5. $(1+0.1\cos 5t)\cos 100t = \cos 100t + .1\cos 5t \cos 100t$

$= \cos 100t + .1(1/2)(\cos(5t+100t) + \cos(5t-100t))$

$= \cos 100t + .05(\cos(105t) + \cos(95t))$

$= \boxed{\cos 100t + .05\cos 105t + .05\cos 95t}$ ✓

Freq

$100t = \left(100 \times \frac{1}{2\pi}\right) = \left(\frac{50}{\pi}\right) Hz$; amp = 1

$105t = \left(105 \times \frac{1}{2\pi}\right) = \left(\frac{52.5}{\pi}\right) Hz$; amp = .05

$95t = \left(95 \times \frac{1}{2\pi}\right) = \left(\frac{47.5}{\pi}\right) Hz$; amp = .05

6) $\cos^2 x = 1/2(\cos(2x)+1)$

$f(t) = (10\cos t)^2$

$= 100\cos^2 t$

$= 100(1/2(\cos(2t)+1))$

$= 50(\cos(2t)+1)$

$= \boxed{50\cos(2t) + 50}$ ✓

7. By the book it seems that $f(t)$ is periodic when B/A is a rational number.

8) From the book, the "0" value rep positive pulse, and "1" reps negative pulse. If it was opposite it will appear that the signal contains "low amplitude" and it will rapidly change waveform.

Date

(9.) $SNR = \text{sig. power}/\text{noise power}$; $C = B \log_2 (1 + SNR)$

$C = 300 \log_2 (1 + 10^{.3})$

$C = 300 \log_2 (2.995)$

$C = \boxed{474 \text{ bps}}$

(10.) $C = 2 B \log_2 M$

ⓐ $\frac{9600}{4} = \frac{2B \times 4}{4} = \frac{2400}{2} = \frac{2B}{2} = \boxed{1200 Hz = B}$ ✓

ⓑ $\frac{9600}{8} = \frac{2B \times 8}{8} = \frac{1200}{2} = \frac{2B}{2} = \boxed{600 Hz = B}$ ✓

(11.) The two are related in the terms of bandwidth, signal power and noise.

(12.) $C = B \log_2 (1 + SNR)$

ⓐ $C = 3000 \log_2 (1 + 400000)$

$C = \boxed{56 \text{ bps}}$ ✓

ⓑ $C = 56 - \left(\frac{.2}{100}\right)$

$C = \boxed{55.99 \text{ bps}}$

(13.) $C = B \log_2 (1 + SNR)$

$20 \times 10^6 = 3 \times 10^6 \times \log_2 (1 + SNR)$

$\log_2 (1 + SNR) = 6.67$

$1 + SNR (102) = \boxed{103}$ ✓

Page

Date

14. $L = 10 \log \left(\frac{4\pi d}{\lambda} \right)^2 dB$

$= 20 \log \left(\frac{4\pi d}{\lambda} \right) dB$

$= 20 \log \left(\frac{4\pi d f}{v} \right) dB$

$= 20 \log (2) dB$

$= \boxed{6.02 \approx 6 dB}$ ✓

15. power gain $= 10^{\frac{\text{decibels}}{10}}$ (exponent)

power loss $= \frac{1}{\text{powergain}}$

Decibles	1	2	3	4	5	6	7	8	9	10
Losses	.79	.63	.5	.39	.316	.25	.199	.15	.125	.1
Gains	1.26	1.58	2	2.51	3.16	3.98	5.01	6.3	7.94	10

16. voltage ratio $= \frac{\text{output voltage}}{\text{input voltage}}$; voltage gain $= 20 \log_{10} \frac{V_{out}}{V_{in}}$

$= 30 = 20 \times \log_{10} \frac{V_{out}}{V_{in}}$

$= \frac{V_{out}}{V_{in}} = 10^{\frac{30}{20}} = 10^{1.5}$

$= \frac{V_{out}}{V_{in}} = \boxed{31.622}$ ✓

17. $P_{dBW} = 10 \times \log_{10} \frac{P(W)}{1W}$

$P_{dBW} = 10 \times \log_{10} \frac{20}{1W}$

$P_{dBW} = 10 \log 20$

$P_{dBW} = \boxed{13 dBW}$ ✓