Homework 2

Ex 3

- (3a) 0 dB
- (3b) ~= 3 dB
- (3c) ~= -3 dB
- (3d) ~= 6 dB
- (3e) ~= -6 dB
- (3f) ~= 9 dB
- (3g) ~= -9 dB
- (3h) 10 dB
- (3i) ~= -10 dB
- (3j) ~= 13 dB
- (3k) ~= -13 dB
- (3l) 20 dB
- (3m) -20 dB
- (3n) ~= 23 dB
- (3o) 30 dB
- (3p) ~= 43 dB
- (3p) ~= 46 dB

Ex 4

- (4a) 100
- (4b) ~= 200
- (4c) 10000
- (4d) ~= 40000
- (4e) ~= 0.000025
- (4f) 1
- (4g) 0.1
- (4h) ~= 0.05
- (4i) ~= 0.005

Ex 5

-10dB, 0.5, 0dB, 2, 10dB, 10, 100, 30dB

or

-10dB, 0.5, 0dB, 2, 10, 10dB, 100, 30dB

Ex 6

- (5a) ~= 13 dBW
- (5b) ~= 43 dBm
- (5c) ~= 16 dBW / 46 dBm
- (5d) Assuming was PT = 40W, after the 6 dB drop we will have PT ~= 10W = 10000 mW

Ex 7

C ~= 475 bps

Ex 8

- (8a) C ~= 56 kbps
- (8b) ceil(9.3) = 10 bits/symbol

Ex 9

~= 100 (or 20 dB)

Ex 10

- (10a) B >= 1200 Hz
- (10b) B >= 600 Hz

Homework 3

Ex 2

wavelength = 20 m

frequency = 15 MHz

Ex 3

- (3a) 500 km
- (3b) 150 MHz

Ex 4

- (4a) ~17 dBW or ~47 dBm
- (4b) ~ –24.52 dBm
- (4c) ~ –64.52 dBm
- (4d) ~ –61.52 dBm

Ex 5

- (5a) 2.7 to 3.5
- (5b) ~ -46 dBm
- (5c) ~ -108 dBm
- (5d) ~ -105 dBm

Ex 6

- increase transmission power at least by 2, or
- decrease transmission frequency at least by sqrt(2), or
- change transmission antenna (or receive antenna) to a new one with a gain of at least 2 (3 dB)

Ex 7

- (7a) G = 351.85 (25.46 dB)
- (7b) 35.185 W
- (7c) –55.14 dBm

Ex 8

- (8a) ~17 cm
- (8b) ~ 10^(-16) W (-160 dBW)
- (8c) ~ -180 dB
- (8d) must be at least 6 db more sensible (i.e. -166 dB)

Ex 9

~3,279 km (note that UMTS --> f ~ 2 GHz)

Homework 4

Ex 2

- (2a) 4800 bps
- (2b) 256 QAM
- (2c) BER would increase

Ex 3

modulation | a | b | c | d |

ASK | amplitude | 1 bit/symbol | 6k symbols/second | NO

BPSK | phase | 1 bit/symbol | 6k symbols/second | NO

64QAM | phase | 6 bit/symbol | 1k symbols/second | YES

FSK | frequency | 1 bit/symbol | 6k symbols/second | NO

8PSK | phase | 3 bit/symbol | 2k symbols/second | YES

We can not answer (e) because the SNR was not provided.

Ex 4

- (4a) 3k symbols/second
- (4b) 18 kbits/second

Ex 5

- (5a) 4 bits/second/Hz
- (5b) 4 kbits/s | 1 bits/second/Hz

Ex 6

- (6a) 1 bits/second/Hz
- (6b) 2 bits/second/Hz
- (6c) 2 bits/second/Hz
- (6d) 4 bits/second/Hz
- (6e) 10 bits/second/Hz
- (6f) 3 bits/second/Hz
- (6g) 1 bits/second/Hz