

1.

a) The preferred M -values are:

1,3,4,7,9,12,13,16,19,21,25,27,28,31,36,37,39,43,48,49,(52,56,61,63,
64,67,73,76,79,81,83,84,91,97,100)

b&c)

n	$D/R \geq 1 + \sqrt[n]{60}$	$M \geq (D/R)^2 / 3$	$M_{preferred}$	$C/N_{carrier} = 756/M$
2	8.75	25.52	27	28
3	4.91	8.04	9	84
4	3.78	4.76	7	108
5	3.27	3.56	4	189

2.

$SFM_1 - SFM_2$	$n = 2$	$n = 3$	$n = 4$	$n = 5$
- 7.68	0.1706	0.3076	0.4130	0.4929
- 13.98	0.0400	0.1169	0.2000	0.2759

3.

M	I_{slc}	I_{mrc}	G_{slc}	G_{mrc}
2	$1.005 \cdot 10^2$	$2.003 \cdot 10^2$	10.20 dB	11.70 dB
4	$1.015 \cdot 10^6$	$2.427 \cdot 10^7$	15.78 dB	19.13 dB

4.

BEP	no div	div (SLC)	div.gain	div (MRC)	div.gain
10^{-2}	16.90	9.30	7.60	7.83	9.07
10^{-3}	26.98	14.79	12.19	13.30	13.68
10^{-4}	36.99	19.93	17.06	18.43	18.56

5. a) The spectrum mask must be changed to absolute values

$$f \in [0, 100 \text{ kHz}] \rightarrow G(f) = 1.122$$

$$f \in [100, 330 \text{ kHz}] \rightarrow G(f) = 10^{71.65/23} \cdot \exp(-7.05 \ln 10 \cdot f/230)$$

$$f \in [330, 1600 \text{ kHz}] \rightarrow G(f) = 10^{-7}$$

b) 1st adjacent channel: $SIR = 7.57$ dB
 2nd adjacent channel: $SIR = 64.62$ dB

3rd adjacent channel; $SIR = 70.02$ dB

6.

a) $P_{tx} = P_{\max} \left(\frac{r}{R} \right)^n$, when $P_{tx} > P_{\min}$, otherwise $P_{tx} = P_{\min}$

b) $r_{\min} = R \left(\frac{P_{\min}}{P_{\max}} \right)^{1/n}$

c)
$$P_{txm} = P_{\max} \left(\frac{P_{\min}}{P_{\max}} \right)^{(2+n)/n} + \frac{2P_{\max}}{(n+2)} \left(1 - \left(\frac{P_{\min}}{P_{\max}} \right)^{\frac{(2+n)}{n}} \right)$$

d)

P-ratio	$n = 2$	$n = 2.5$	$n = 3$	$n = 3.5$	$n = 4$	$n = 4.5$	$n = 5$
10 dB	2.97 dB	3.44 dB	3.84 dB	4.19 dB	4.51 dB	4.78 dB	5.03 dB
20 dB	3.01 dB	3.52 dB	3.98 dB	4.39 dB	4.76 dB	5.11 dB	5.42 dB
30 dB	3.01 dB	3.52 dB	3.98 dB	4.39 dB	4.77 dB	5.12 dB	5.44 dB
40 dB	3.01 dB	3.52 dB	3.98 dB	4.39 dB	4.77 dB	5.12 dB	5.44 dB

7.

a) $n = 3.5 \rightarrow R_{bm} = 29.704$ kbit/s

b) $n = 3.5 \rightarrow R_{bm} = 52.753$ kbit/s

8.

a) $233 \mu\text{s}$

b) i) $\Delta SNR = 2.45$ dB

ii) $\Delta SNR = 1.24$ dB

9.

a) $M = 321$

b) $\frac{r}{R_{\text{cell}}} = 0.233$

10.

a) $A = 17998744$ km²

b) $T_{\text{obs}} = 378.8$ s

