

A. Answers to Selected Problems

A.1. Chapter 2

2.5.	11016 km
2.7.	70.14°
2.9.	(a) 3.842 km/s; (b) 12605.85 ft/s; (c) 8594.89 mi/h
2.11.	42165 km; 0.00018973
2.17.	(a) 13.994 rev/day; (b) 0; (c) -3.158 deg/day
2.19.	2451248.5 day; 2451598.0 day; 2452700.1875 day; 2455382.125 day
2.21.	(a) Jan 3, 0 h; (b) July 4, 03:00 h; (c) Oct 27, 2 h 55 min 4.21 s; (d) Jan 3, 7 h 3 min 57.75 s; (e) January 31, 2 h 26 min 9.6 s
2.23.	(a) 27027 km; (b) 0.74718; (c) 12.277 rad/day; (d) 12.276 rad/day; (e) 737.024 min; (f) -0.149 deg/day; (g) 0.007 deg/day
2.25.	0.856°W
2.27.	(a) 54.53 rad/day; (b) -125.425°; (c) 10,509.1 km; (d) 36.66°S
2.29.	101.83°W
2.31.	249.8°; 84.96°; 290.7°; 289.52°; 6614.9 km
2.33.	-0.707 deg/day; -2.502 deg/day; 82.778 rad/day
2.35.	-0.206°; 110.063 min
2.37.	(a) 7234.6 km; (b) 0° Latitude approximately.
2.39.	73.521°
2.41.	(a) 07:00 h; (b) 05:00 h; (c) 15:00 h; (d) 20:00 h

A.2. Chapter 3

3.3.	Satellite on same longitude as the earth station, and latitude = 76.3°.
3.5.	Latitude zero; maximum possible longitudinal separation 76.3°.
3.7.	302.6°; 64.8°
3.9.	44.3°; 45°
3.15.	2.1°
3.21.	$\phi_{SS} = 60.025^\circ; \phi_{SS\text{mean}} = 59.989^\circ$
3.23.	35799.86 km; 35772.87 km

A.3. Chapter 4

4.3.	0.29 dB
4.7.	Horizontal 0.0067 dB; vertical 0.0055 dB
4.11.	(a) 1.12 dB; (b) 1.19 dB
4.13.	0.006 dB
4.15.	0.015 dB

A.4. Chapter 5

5.3.	For $E_{x\text{ max}}$ unity and $E_{y\text{ max}} = 3E_{x\text{ max}}$, the power relationship gives $E_{x\text{ max}} = 10V$
5.5.	0.5 W
5.7.	LH elliptical
5.9.	LH elliptical
5.13.	59°
5.17.	19°
5.21.	PL = 0.11 dB; XPD = 16 dB
5.25.	50.4 dB
5.27.	36.6 dB

A.5. Chapter 6

6.1.	26.78 dBW
6.3.	(1.41, 0.513, 2.598)
6.5.	-36.87° relative to the +y axis

6.7.	$23.87 \times 10^{-15} \text{ W/m}^2$
6.9.	51.8 dB
6.11.	1.56 dB
6.13.	$7.96 \times 10^{-6} \text{ m}^2$
6.19.	HPBE _H = 22°; HPBW _E = 25.2°; 18.72 dB
6.25.	0.9 m
6.27.	12.76 m^2 ; 48.07 dB
6.33.	Currents are in-phase
6.37.	(a) 1.172 cm; (b) 536.3 rad/m; 307.3 deg/cm
6.39.	$\Delta l = 1.13 \text{ mm}$

A.6. Chapter 9

9.1.	300–3400 Hz; -14.4 dBm
9.9.	$Y = 0.3R + 0.59G + 0.11B$; $Q = 0.21R - 0.52G + 0.31B$; $I = 0.6R - 0.28G - 0.32B$
9.13.	500 Hz
9.17.	152 kHz
9.21.	(a) 1.465; (b) 2.322; (c) 7.545
9.23.	(a) 12.6 dB; (b) 13.9 dB; (c) 5.5 dB
9.25.	(a) 62.6 dB; (b) 2686.9:1

A.7. Chapter 10

10.5.	(a) 11100001, 01100001; (b) 11011111, 01011111; (c) 11010100, 01010100; (d) 10011000, 00011000
10.7.	(a) 51.7 dB; (b) 16
10.9.	(a) 0.079; (b) 3.87×10^{-6} ; (c) approximately 0
10.15.	Approximately 1.91×10^{-4}
10.17.	Approximately 1.6×10^{-4}
10.19.	Approximately 1.1×10^{-6}

A.8. Chapter 11

11.3.	codewords 256; datawords 128
11.5.	(a) (0000000); (b) (1111111); (c) (0010101)

11.7.	s = 001
11.9.	0.839
11.11.	3
11.17.	2.117 MHz; 1.059 MHz
11.19.	2.78×10^{-4}
11.21.	-3 dB
11.23.	For 111, the Euclidean metric is 3.942, and for 000, it is 4.143. This is closest to 111; therefore, the soft decision decoding produces a binary 1. For hard decision, majority vote results in a binary 0.
11.25.	0.201

A.9. Chapter 12

12.1.	(a) 14.6 dB; (b) 23.6 dBW; (c) 75.6 dBHz; (d) 28.2 dB; (e) 23 dBK
12.3.	(a) 42.9 dB; (b) 50.3 dB
12.5.	1.98 m ²
12.7.	(a) 4.33 pW/m ² ; (b) 195.8 pW
12.9.	-98.6 dBW or 138.6 pW
12.11.	(a) 20 dB; (b) 220 K
12.13.	(a) 8.45 dB; (b) 1740 K
12.15.	940.8 K
12.19.	108.1 dBHz; 32.5 dB
12.21.	6 dB
12.23.	(a) 178.6 pW/m ² ; (b) -97.5 dBW/m ²
12.25.	45.6 dBW
12.27.	78.1 dBHz
12.29.	73.5 dBW
12.31.	92.1 dBHz; 86.1 dBHz
12.33.	14.6 dB
12.35.	76.1 dBHz
12.37.	14.5 dB
12.39.	26.52 dB

A.10. Chapter 13

13.3.	For earth station 1, 2.83°, and for earth station 2, 2.85°
13.5.	0.5°; 314.2 km

13.7.	4.5 dB
13.9.	45.4 dB
13.11.	25.1 dB
13.13.	21.1 dB
13.15.	51.35 dB
13.17.	Yes for 13.12; no for 13.13
13.19.	(a) 22.4 dB; (b) 25 dB

A.11. Chapter 14

14.9.	6
14.11.	26.5 dB
14.13.	(a) -146.8 dBWK^{-1} ; (b) 15.7 dBW
14.15.	(b)(1) 2.2 MHz; (b)(2) 11.2 MHz
14.21.	0.85
14.23.	0.51
14.25.	0.93; 872
14.27.	0.962; 1797
14.33.	60 Mb/s
14.35.	(a) 75.89 dBHz; (b) 49.3 dBW
14.37.	50.5 dBW
14.39.	24 modes
14.41.	8 mV; -21 dB
14.49.	199 (rounded down)

A.12. Chapter 15

15.11.	33.92 Mbps
15.23.	40 kb/s
15.25.	251.7 Mb/s
15.31.	1904 kilobytes
15.33.	0.327 s; 0.267 s

A.13. Chapter 16

16.1.	(a) 22 at 148°, 10 unassigned; 30 at 166°, 2 unassigned; 27 at 157°, 5 unassigned; 32 at 119°, 110°, and 101°; 30 at 61.5°,
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	2 unassigned. (b) Continental 22; DBSC 22; DirecTV 54; Dominion 16; Echostar 24; Echostar/Direcstsat 44; MCI 28; TIC/Tempo 11; USSB 16; unassigned 19.
16.3.	54 dBW
16.5.	175°: DBSC 440 Mb/s; Echostar/Direcstsat 440 Mb/s
	166°: Continental 440 Mb/s; Dominion 320 Mb/s; Echostar/ Direcstsat 440 Mb/s
	157°: DirecTV 1080 Mb/s
	148°: Echostar 960 Mb/s; USSB 320 Mb/s
	119°: Echostar/Direcstsat 840 Mb/s; TIC/Tempo 440 Mb/s
	110°: Echostar/Direcstsat 40 Mb/s; MCI 1120 Mb/s; USSB 120 Mb/s
	101°: DirecTV 1080 Mb/s; USSB 200 Mb/s
	61.5°: Continental 440 Mb/s; DBSC 440 Mb/s; Dominion 320 Mb/s
16.13.	31 dB; 33 dB; 34 dB; 3.67°; 2.76°; 2.21°
16.15.	$[E_b/N_0] = -0.46$ dB; therefore, signal is completely lost.
16.17.	6.9 dB. This is just satisfactory.
16.19.	With an antenna diameter of 20 in., a rain rate of 18 mm/h will just lose the signal. This corresponds to a time percentage of about 0.49 percent (see Table 16.2).
16.21.	11.48 MHz; 33.44 MHz

A.14. Chapter 17

(Values rounded off to 1 decimal place).

17.7.	144.6 dB
17.9.	71.1 dBHz; 23.5 dB
17.11.	57.3 dBHz; 20.5 dB
17.13.	56.2 dBHz and 9.2 dB for both cells
17.15.	Cell-1:51.4 dBHz, 4.4 dB; cell-16:52.1 dBHz, 5.1 dB
17.17.	Rain conditions 4.8 dB; clear sky conditions 7.8 dB
17.19.	No sun: 78.9 dBHz, 4.9 dB; sun: 78.5 dBHz, 4.6 dB.