



BIRZEIT UNIVERSITY

Faculty of Engineering & Technology

Department of Computer Since

Wireless and Mobile Networks, ENCS5323

Second Semester 2024

Project – Online Calculator for Wireless and Mobile Networks

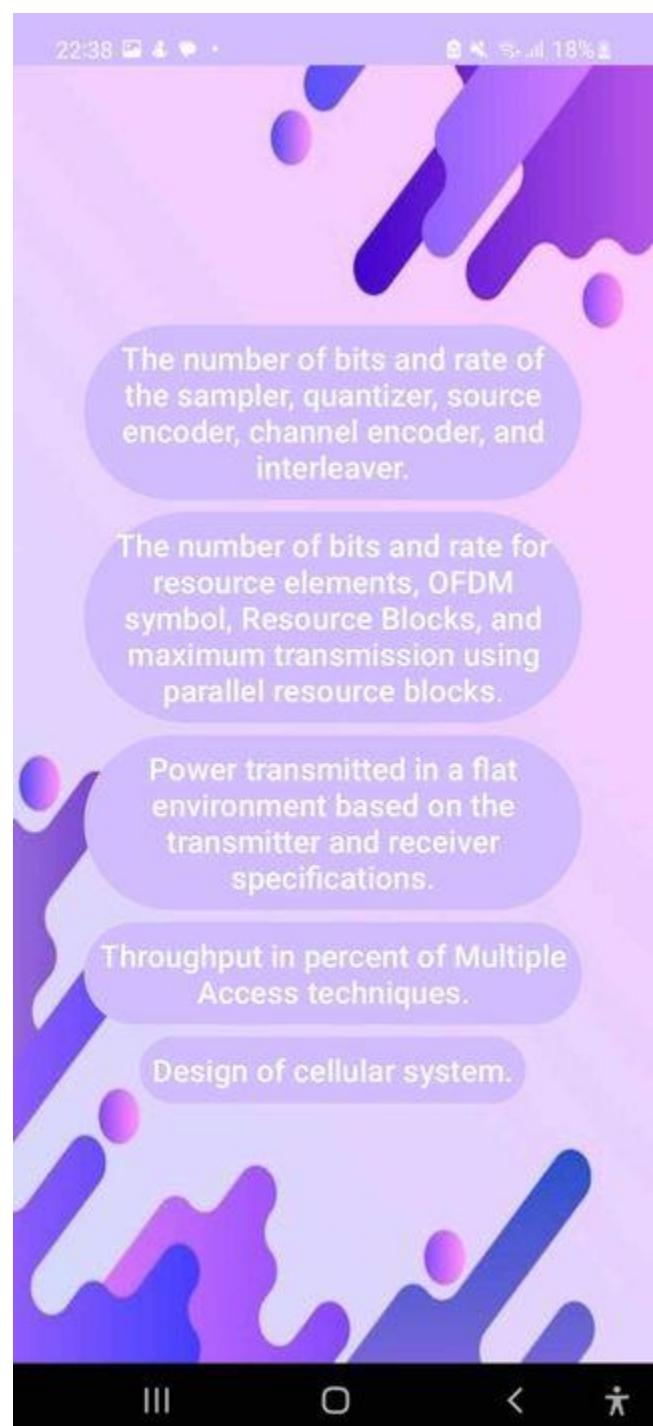
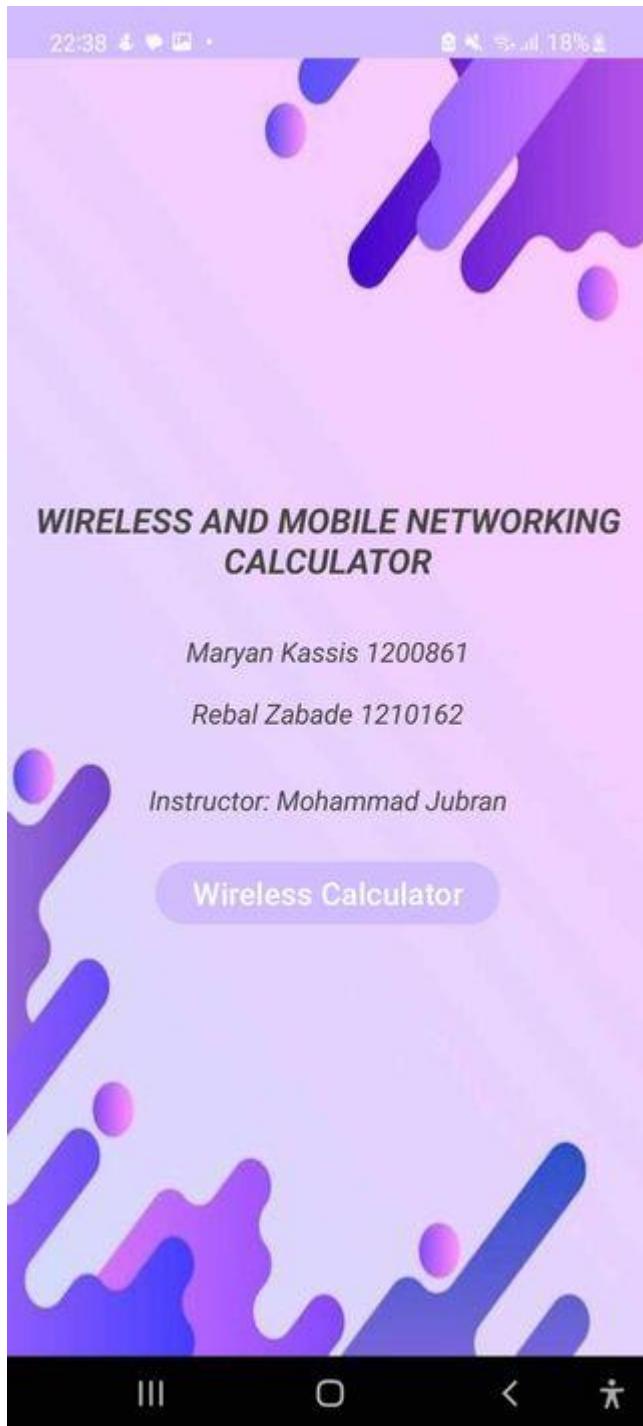
Prepared by:

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Design and build an online calculator for the following:



Question 1:

The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

Test case 1:

22:40 4G 19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

Sampling Frequency

Sampling Frequency: 8000.0 Hz

Show Output



22:41 4G 19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

Quantization Levels

Quantization Levels: 256.0

Show Output



22:41

音量 19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

4

kHz

8

0.25

0.5

1024

Source Encoder Input Rate

Source Encoder Input Rate: 64000.0 bps

Show Output

22:41

音量 19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

4

kHz

8

0.25

0.5

1024

Source Encoder Output Rate

Source Encoder Output Rate: 16000.0 bps

Show Output



22:41

19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

4

kHz

8

0.25

0.5

1024

Channel Encoder Output Rate

Channel Encoder Output Rate: 32000.0 bps

Show Output

22:41

19%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

4

kHz

8

0.25

0.5

1024

Interleaver Output Rate

Interleaver Output Rate: 32000.0 bps

Show Output



Test case 2:

22:46

22:46

22:46

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5 kHz

10

0.5

0.75

2048

Sampling Frequency

Sampling Frequency: 10000.0 Hz

Show Output

22:46

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5 kHz

10

0.5

0.75

2048

Quantization Levels

Quantization Levels: 1024.0

Show Output



22:46 4G 21%

22:46 4G 21%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5

kHz

10

0.5

0.75

2048

Source Encoder Input Rate

Source Encoder Input Rate: 100000.0 bps

Show Output

22:46 4G 22%

22:46 4G 22%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5

kHz

10

0.5

0.75

2048

Source Encoder Output Rate

Source Encoder Output Rate: 50000.0 bps

Show Output



22:47

22:47

22:47

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5

kHz

10

0.5

0.75

2048

Channel Encoder Output Rate

Channel Encoder Output Rate:
66666.6666666667 bps

Show Output

22:47

22:47

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

5

kHz

10

0.5

0.75

2048

Interleaver Output Rate

Interleaver Output Rate:
66666.6666666667 bps

Show Output



Test case 3:



Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6 kHz

12

0.3

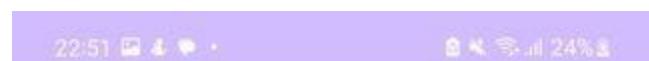
0.6

4096

Sampling Frequency

Sampling Frequency: 12000.0 Hz

Show Output



Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6 kHz

12

0.3

0.6

4096

Quantization Levels

Quantization Levels: 4096.0

Show Output



22:51

24%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6

kHz

12

0.3

0.6

4096

Source Encoder Input Rate

Source Encoder Input Rate: 144000.0 bps

Show Output

22:51

24%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6

kHz

12

0.3

0.6

4096

Source Encoder Output Rate

Source Encoder Output Rate: 43200.0 bps

Show Output



22:51

音量 24%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6

kHz

12

0.3

0.6

4096

Channel Encoder Output Rate

Channel Encoder Output Rate: 72000.0 bps

Show Output

22:51

音量 24%

Q) The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.

6

kHz

12

0.3

0.6

4096

Interleaver Output Rate

Interleaver Output Rate: 72000.0 bps

Show Output



Question 2:

The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

Test case 1:

22:57

26%

Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

180 kHz

15 kHz

7

0.5 ms

4

1024-QAM

Number of bits per Resource Element

Number of bits per Resource Element: 10.0

Show Output

22:57

26%

Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

180 kHz

15 kHz

7

0.5 ms

4

1024-QAM

Number of bits per OFDM Symbol

Number of bits per OFDM Symbol: 120.0

Show Output

22:57	26%	22:57	26%
Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.		Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.	
180	kHz	180	kHz
15	kHz	15	kHz
7		7	
0.5	ms	0.5	ms
4		4	
1024-QAM		1024-QAM	
Number of bits per OFDM Resource Block		Maximum Rate	
Number of bits per OFDM Resource Block:	840.0	Maximum Rate:	6720000.0 bps
Show Output		Show Output	
III	O	<	×

Test case 2:

23:00 28%

Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200

kHz

20

kHz

8

0.6

ms

3

256-QAM

Number of bits per Resource Element

Number of bits per Resource Element: 8.0

Show Output

23:01 28%

Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200

kHz

20

kHz

8

ms

3

256-QAM

Number of bits per OFDM Symbol

Number of bits per OFDM Symbol: 80.0

Show Output





Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200

kHz

20

kHz

8

0.6

ms

3

256-QAM

Number of bits per OFDM Resource Block

Number of bits per OFDM Resource Block:
640.0

Show Output



Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

200

kHz

20

kHz

8

0.6

ms

3

256-QAM

Maximum Rate

Maximum Rate: 3200000.000000005 bps

Show Output



Test case 3:

23:02	28%	23:03	29%
Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.		Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.	
150	kHz	150	kHz
10	kHz	10	kHz
6		6	
0.4	ms	0.4	ms
5		5	
64-QAM		64-QAM	
Number of bits per Resource Element		Number of bits per OFDM Symbol	
Number of bits per Resource Element: 6.0		Number of bits per OFDM Symbol: 90.0	
<input type="button" value="Show Output"/>		<input type="button" value="Show Output"/>	
III	O	<	✖
III	O	<	✖



Q) The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.

150

kHz

150

kHz

10

kHz

10

kHz

6

6

0.4

ms

0.4

ms

5

5

64-QAM

64-QAM

Number of bits per OFDM Resource Block

Maximum Rate

Number of bits per OFDM Resource Block:
540.0

Maximum Rate: 6750000.0 bps

Show Output

Show Output



Question 3:

Power is transmitted in a flat environment based on the transmitter and receiver specifications.

Test case 1:

23:08		23:08	
Q) Power transmitted in a flat environment based on the transmitter and receiver specifications.		9.6	Kbps
140	dB	12	dB
900	MHz	20	dB
8	dB	8	dB
0	dB	0	dB
9.6	Kbps	24	dB
12	dB	6	dB
20	dB	290	K
8	dB	8	dB
0	dB	8-PSK	BER:10 ⁻⁴
24	dB	Output Unit	dB
6	dB	9.84548317339761	
<input type="button" value="Show Output"/>			
III	O	<	♂
III	O	<	♂

23:08	4G	31%	23:08	4G	31%
9.6	Kbps	▼	9.6	Kbps	▼
12	dB	▼	12	dB	▼
20	dB	▼	20	dB	▼
8	dB	▼	8	dB	▼
0	dB	▼	0	dB	▼
24	dB	▼	24	dB	▼
6	dB	▼	6	dB	▼
290	K	▼	290	K	▼
8	dB	▼	8	dB	▼
8-PSK	BER:10^-4	▼	8-PSK	BER:10^-4	▼
Output Unit	dBm	▼	Output Unit	Watt	▼
39.84548317339761			9.650466718945289		
Show Output			Show Output		
☰	○	◀	☰	○	◀

Test case 2:

23:10 4G

Batt 32%

Q) Power transmitted in a flat environment based on the transmitter and receiver specifications.

130 dB

128 Kbps

850 MHz

10 dB

10 dB

15 dB

2 dB

5 dB

128 Kbps

0 dB

10 dB

20 dB

15 dB

5 dB

5 dB

300 K

0 dB

10 dB

20 dB

Output Unit

5 dB

BER:10^-2

-2.757896892312317

Show Output



128	Kbps	128	Kbps
10	dB	10	dB
15	dB	15	dB
5	dB	5	dB
0	dB	0	dB
20	dB	20	dB
5	dB	5	dB
300	K	300	K
10	dB	10	dB
8-PSK	BER:10^- ?	8-PSK	BER:10^- ?
Output Unit	dBm	Output Unit	Watt
27.242103107687683		0.5299200000000012	
Show Output		Show Output	

Test case 3:

23:12 4G 33%

23:12 4G 33%

Q) Power transmitted in a flat environment based on the transmitter and receiver specifications.

145

dB

950

MHz

6

dB

1

dB

8.4

Kbps

11

dB

18

dB

6

dB

0

dB

22

dB

4

dB

8.4

Kbps

11

dB

18

dB

6

dB

0

dB

22

dB

4

dB

310

K

9

dB

8-PSK

BER:10^-6

Output Unit

dB

13.555200662973903

Show Output



23:12

33%

8.4 Kbps

11 dB

18 dB

6 dB

0 dB

22 dB

4 dB

310 K

9 dB

8-PSK BER:10^-6

Output Unit dBm

43.5552006629739

Show Output

III O < ⌂

23:13 33%

8.4 Kbps

11 dB

18 dB

6 dB

0 dB

22 dB

4 dB

310 K

9 dB

8-PSK BER:10^-6

Output Unit Watt

22.673578365364612

Show Output

III O < ⌂

Question 4:

Throughput in percent of Multiple Access techniques

Test case 1:



Q) Throughput in percent of Multiple Access techniques.

Unslotted Nonpersistent CSMA

20 Mbps

40 μ sec

10 Kbits

5 Kfps

Throughput: 0.7002

Show Output



Test case 2:



Q) Throughput in percent of Multiple Access techniques.

Slotted Nonpersistent CSMA

12 Mbps

25 μ sec

6 Kbits

4 Kfps

Throughput: 0.2162

Show Output



Test case 3:



Q) Throughput in percent of Multiple Access techniques.

Slotted 1-persistent CSMA

20 Mbps

40 μ sec

8 Kbits

2 Kfps

Throughput: 0.4656

Show Output



Question 5:

Design of cellular system.

Test case 1:

23:27 4G 40% 40%

Q) Design of cellular system.

8

4 sq km

80000

8 per day

3 min

0.02

13 dB

10 m

-22 dB

3

7 uWatt

6

III O < ⌂



80000

8 per day

3 min

0.02

13 dB

10 m

-22 dB

3

7 uWatt

6

Maximum distance between base stations

Maximum distance between base stations:
96.59781878531683 meters

Show Output



23:27

Small 40%

80000

8

per day

3

min

0.02

13

dB

10

m

-22

dB

3

7

uWatt

6

Maximum cell size (hexagon)

Maximum cell size (hexagon):
24243.009206122435 sq meters

Show Output



23:28

40%

80000

8

per day

3

min

0.02

13

dB

10

m

-22

dB

3

7

uWatt

6

Number of cells in the area

Number of cells in the area: 165.0

Show Output



23:28

40%

80000

8

per day

3

min

0.02

13

dB

10

m

-22

dB

3

7

uWatt

6

Traffic load for the system

Traffic load for the system:
1333.333333333335 Erlangs

Show Output



23:28 📱 40%

80000

8 per day ▾

3 min ▾

0.02

13 dB ▾

10 m ▾

-22 dB ▾

3

7 uWatt ▾

6

Traffic load per cell

Traffic load per cell: 8.0808080808081
Erlangs

Show Output



23:28

40%

80000

8

per day

3

min

0.02

13

dB

10

m

-22

dB

3

7

uWatt

6

Number of cells in each cluster

Number of cells in each cluster: 9

Show Output



23:28

40%

80000

8

per day

3

min

0.02

13

dB

10

m

-22

dB

3

7

uWatt

6

Minimum number of carriers for
QoS

Minimum number of carriers for QoS: 14.0

Show Output



Test case 2:

23:32 42%

Q) Design of cellular system.

8

10 sq km ▾

100000

5 per day ▾

2 min ▾

0.01

12 dB ▾

10 m ▾

-20 dB ▾

4

10 uWatt ▾

6



23:32

42%

100000

5

per day

2

min

0.01

12

dB

10

m

-20

dB

4

10

uWatt

6

Maximum distance between base stations

Maximum distance between base stations:
56.2341325190349 meters

Show Output



23:32

42%

100000

5

per day

2

min

0.01

12

dB

10

m

-20

dB

4

10

uWatt

6

Maximum cell size (hexagon)

Maximum cell size (hexagon):
8215.83836257749 sq meters

Show Output



23:32

42%

100000

5 per day ▾

2 min ▾

0.01

12 dB ▾

10 m ▾

-20 dB ▾

4

10 uWatt ▾

6

Number of cells in the area ▾

Number of cells in the area: 1218.0

Show Output



23:32

42%

100000

5 per day

2 min

0.01

12 dB

10 m

-20 dB

4

10 uWatt

6

Traffic load for the system

Traffic load for the system:
694.4444444444445 Erlangs

Show Output



23:32

42%

100000

5 per day

2 min

0.01

12 dB

10 m

-20 dB

4

10 uWatt

6

Traffic load per cell

Traffic load per cell: 0.5701514322203978
Erlangs

Show Output



23:33

42%

100000

5

per day

2

min

0.01

12

dB

10

m

-20

dB

4

10

uWatt

6

Number of cells in each cluster

Number of cells in each cluster: 4

Show Output



23:33

42%

100000

5

per day

2

min

0.01

12

dB

10

m

-20

dB

4

10

uWatt

6

Minimum number of carriers for
QoS

Minimum number of carriers for QoS: 4.0

Show Output



Test case 3:

23:39

44%

Q) Design of cellular system.

8

5

sq km

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6



23:39

44%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Maximum distance between base stations

Maximum distance between base stations:
66.8740304976422 meters

Show Output



23:39

44%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Maximum cell size (hexagon)

Maximum cell size (hexagon):
11618.95003862225 sq meters

Show Output



23:39

45%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Number of cells in the area

Number of cells in the area: 431.0

Show Output



23:39

45%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Traffic load for the system

Traffic load for the system:
1020.833333333333 Erlangs

Show Output



23:39

45%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Traffic load per cell

Traffic load per cell: 2.368522815158546
Erlangs

Show Output



23:39

45%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Number of cells in each cluster

Number of cells in each cluster: 4

Show Output



23:39

45%

70000

7

per day

3

min

0.02

12

dB

10

m

-20

dB

4

5

uWatt

6

Minimum number of carriers for
QoS

Minimum number of carriers for QoS: 7.0

Show Output

