



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

Bachelor of Technology in Electrical and Electronic Engineering

TEE 4426 MOBILE COMMUNICATION

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME: 2 HOURS

DATE: AUGUST 2024

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** Questions; Attempt Question ONE and any other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory 20 marks)

- a) i) Explain the term **handover** as applied to mobile communication and
- ii) Describe the following hand over strategies and state where they are applied
 - I) Hard handover
 - II) Soft handover **(4marks)**
- b) With the aid of sketches describe the following multiple access techniques as used in mobile communications
 - i) Frequency Division Multiple Access (FDMA)
 - ii) Time Division Multiple Access (TDMA) **(6 marks)**
- c) Given that the total number of channels per cluster is 280. Assuming that each cluster has 7 cells

Determine

- i) the number of channels per cell
- ii) the offered traffic in Erlang for a GOS of 3%
- iii) the number of subscribers supported by each cell assuming that 60% of the subscribers make a call during the busy hour and each user occupies the channel for 1.5 minutes
- iv) the cell radius if the user density = 2400 users / km² **(4marks)**

- d) i) With the aid of a diagram, describe the concept of cell sectoring referring to 120°
 ii) Explain why cell sectoring technique is used in mobile communication **(6 marks)**

Question TWO

- a) Draw a block diagram to show the architecture of the GSM system **(4 marks)**
 b) Explain the functions of the following components in the GSM system
 i) Base station controller (BSC)
 ii) Home location Register (HLR)
 iii) Transcoding rate adapter Unit (TRAU) **(6 marks)**
 c) Explain the uses of the following channels used in GSM
 i) Broadcast control channel (BCCH)
 ii) Synchronization channel (SCH)
 iii) Frequency correction channel (FCCH) **(6 marks)**
 d) A cellular system has a total of 959 radio channels per cluster available for handling traffic. The area of a cell is 8 km^2 and the area of the entire system is 2520 km^2 . Assuming a cluster size of 7, Calculate the system capacity. **(4 marks)**

Question THREE

- a) Describe the following CDMA systems
 i) Frequency hopping
 ii) Direct sequence **(4 marks)**
 b) Draw the GSM TDMA burst format and state the function of each field **(7 marks)**
 c) Consider a CDMA system consisting of two users X, Y with the binary codes 11001100, and 10101010 respectively. If X transmits a binary 0, Y transmits a binary 1,
 i) Show how the bits are recovered at the receiver.
 ii) State any TWO advantages of Code Division Multiple Access (CDMA) **(6 marks)**
 d) The spreading sequence in a DS-SS CDMA signal has a chip rate of 650000 chips per second. The input signal has a bit rate of 345.5 bits per second, determine
 i) the processing gain in dB
 ii) the number of shift registers required in the PN sequence **(3 marks)**

Question FOUR

- a) Draw a block diagram of OFDM communication system and Explain its operation **(8 marks)**
- b) Draw the block diagram of the speech processing circuits of the cellular phone (transmitter side) and state the function of each block **(8 marks)**
- c) A mobile system operates with 36 channels at a grade of service (GOS) of 2%. The average holding time of a subscriber is 2minutes and the average busy hour call per subscriber is 1.2calls per hour ,determine
 - i) the offered traffic in erlang using the Erlang B tables provided
 - ii) the carried traffic in erlang
 - iii) the average traffic per user
 - iv) the number of users that the system can support **(4 marks)**

Question FIVE

- a) Define the following terms as applied to teletraffic engineering
 - i) grade of service (GOS)
 - ii) carried traffic
 - iii) blocking **(3 marks)**
- b) Describe the following methods of handling lost calls and state an application of each
 - i) Lost Calls Delayed
 - ii) Lost Calls Cleared
 - iii) Lost Calls Held **(9 marks)**
- c) During a busy hour,1500 calls were offered to a group of trunks and 26calls were lost.The average call duration was 5 minutes .Determine
 - i) the offered traffic intensity in erlangs
 - ii) the grade of service (GOS) **(4 marks)**
- d)
 - i) A single GSM provider supports 10 digital speech channels Assume a blocking probability of 2%.Use the Erlang B chart provided to find the traffic intensity
 - ii) If the holding time of a call is 3 minutes , Find the calling rate per hour **(4 marks)**

Table B.1 (Continued)

(Offered Load)		A in Erlangs											
<i>n</i>	<i>P_B</i>												
	1.0%	1.2%	1.5%	2%	3%	5%	7%	10%	15%	20%	30%	40%	50%
1	0.0101	0.0121	0.0152	0.0204	0.0309	0.0526	0.753	0.111	0.176	0.250	0.429	0.667	1.00
2	0.153	0.168	0.190	0.223	0.282	0.381	0.470	0.595	0.796	1.00	1.45	2.00	2.73
3	0.455	0.489	0.535	0.602	0.715	0.899	1.06	1.27	1.60	1.93	2.63	3.48	4.59
4	0.869	0.922	0.992	1.09	1.26	1.52	1.75	2.05	2.50	2.95	3.89	5.02	6.50
5	1.36	1.43	1.52	1.66	1.88	2.22	2.50	2.88	3.45	4.01	5.19	6.60	8.44
6	1.91	2.00	2.11	2.28	2.54	2.96	3.30	3.76	4.44	5.11	6.51	8.19	10.4
7	2.50	2.60	2.74	2.94	3.25	3.74	4.14	4.67	5.46	6.23	7.86	9.80	12.4
8	3.13	3.25	3.40	3.63	3.99	4.54	5.00	5.60	6.50	7.37	9.21	11.4	14.3
9	3.78	3.92	4.09	4.34	4.75	5.37	5.88	6.55	7.55	8.52	10.6	13.0	16.3
10	4.46	4.61	4.81	5.08	5.53	6.22	6.78	7.51	8.62	9.68	12.0	14.7	18.3
11	5.16	5.32	5.54	5.84	6.33	7.08	7.69	8.49	9.69	10.9	13.3	16.3	20.3
12	5.88	6.05	6.29	6.61	7.14	7.95	8.61	9.47	10.8	12.0	14.7	18.0	22.2
13	6.61	6.80	7.05	7.40	7.97	8.83	9.54	10.5	11.9	13.2	16.1	19.6	24.2
14	7.35	7.56	7.82	8.20	8.80	9.73	10.5	11.5	13.0	14.4	17.5	21.2	26.2
15	8.11	8.33	8.61	9.01	9.65	10.6	11.4	12.5	14.1	15.6	18.9	22.9	28.2
16	8.88	9.11	9.41	9.83	10.5	11.5	12.4	13.5	15.2	16.8	20.3	24.5	30.2
17	9.65	9.89	10.2	10.7	11.4	12.5	13.4	14.5	16.3	18.0	21.7	26.2	32.2
18	10.4	10.7	11.0	11.5	12.2	13.4	14.3	15.5	17.4	19.2	23.1	27.8	34.2
19	11.2	11.5	11.8	12.3	13.1	14.3	15.3	16.6	18.5	20.4	24.5	29.5	36.2
20	12.0	12.3	12.7	13.2	14.0	15.2	16.3	17.6	19.6	21.6	25.9	31.2	38.2
21	12.8	13.1	13.5	14.0	14.9	16.2	17.3	18.7	20.8	22.8	27.3	32.8	40.2
22	13.7	14.0	14.3	14.9	15.8	17.1	18.2	19.7	21.9	24.1	28.7	34.5	42.1
23	14.5	14.8	15.2	15.8	16.7	18.1	19.2	20.7	23.0	25.3	30.1	36.1	44.1
24	15.3	15.6	16.0	16.6	17.6	19.0	20.2	21.8	24.2	26.5	31.6	37.8	46.1
25	16.1	16.5	16.9	17.5	18.5	20.0	21.2	22.8	25.3	27.7	33.0	39.4	48.1

26	17.0	17.3	17.8	18.4	19.4	20.9	22.2	23.9	26.4	28.9	34.4	41.1	50.1
27	17.8	18.2	18.6	19.3	20.3	21.9	23.2	24.9	27.6	30.2	35.8	42.8	52.1
28	18.6	19.0	19.5	20.2	21.2	22.9	24.2	26.0	28.7	31.4	37.2	44.4	54.1
29	19.5	19.9	20.4	21.0	22.1	23.8	25.2	27.1	29.9	32.6	38.6	46.1	56.1
30	20.3	20.7	21.2	21.9	23.1	24.8	26.2	28.1	31.0	33.8	40.0	47.7	58.1
31	21.2	21.6	22.1	22.8	24.0	25.8	27.2	29.2	32.1	35.1	41.5	49.4	60.1
32	22.0	22.5	23.0	23.7	24.9	26.7	28.2	30.2	33.3	36.3	42.9	51.1	62.1
33	22.9	23.3	23.9	24.6	25.8	27.7	29.3	31.3	34.4	37.5	44.3	52.7	64.1
34	23.8	24.2	24.8	25.5	26.8	28.7	30.3	32.4	35.6	38.8	45.7	54.4	66.1
35	24.6	25.1	25.6	26.4	27.7	29.7	31.3	33.4	36.7	40.0	47.1	56.0	68.1
36	25.5	26.0	26.5	27.3	28.6	30.7	32.3	34.5	37.9	41.2	48.6	57.7	70.1
37	26.4	26.8	27.4	28.3	29.6	31.6	33.3	35.6	39.0	42.4	50.0	59.4	72.1
38	27.3	27.7	28.3	29.2	30.5	32.6	34.4	36.6	40.2	43.7	51.4	61.0	74.1
39	28.1	28.6	29.2	30.1	31.5	33.6	35.4	37.7	41.3	44.9	52.8	62.7	76.1
40	29.0	29.5	30.1	31.0	32.4	34.6	36.4	38.8	42.5	46.1	54.2	64.4	78.1

