



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: NOVEMBER 2024

TIME: 2 HOURS

DATE: NOVEMBER 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) Explain the services offered by the following parts of the GSM Network
- i) Base Transceiver Station (BTS)
 - ii) Mobile Switching Centre (MSC)
 - iii) Gate way Mobile switching Centre (GMSC) **(6 marks)**
- b) i) Explain any TWO reasons why the concept of hexagonal cells is used in cellular communication
- ii) state any Two factors that affect re-use distance **(4 marks)**
- c) In a certain cellular system an average subscriber places three calls per hour during the busy hour and holds for an average of 8 minutes. Each cell has 120 channels. If blocked calls are cleared. How many subscribers can be served by each cell at a 2% grade of service **(4 marks)**
- d) A cellular system has a GOS of 1.5 %. Determine the % utilization for the following cases;
- i) a single group of 120 channels

- ii) two groups of 60 channels
- iii) Compare the results in i) and ii) and make a suitable comment **(6marks)**

Question TWO

- a) i) Distinguish between fixed and dynamic channel assignment strategies
- ii) Explain what is meant by the term **handover** as used in mobile communication systems **(4marks)**
- b) Describe the channels that come into play to enable a mobile phone establish a connection with the GSM network to allow communication to take place **(8 marks)**
- c) Draw the architecture of the GSM network **(4 marks)**
- d) A normal GSM burst consists of 6 trailing bits, 8.25 guard bits, 26 training bits and two traffic bursts of 57 bits of data find
 - i) the total overhead bits for the whole frame
 - ii) the frame efficiency **(4 marks)**

Question THREE

- a) explain any THREE factors that affect the capacity of a cellular system (3 marks)
- b) Explain the use of each of the following control channels
 - i) paging channels (PCH)
 - ii) Random Access Channel (RACH)
 - iii) Access Granted Channel (AGCH) **(6marks)**
- c) i) A total of 30MHz of Bandwidth is allocated to a particular Full Duplex division (FDD) cellular Telephone system which uses 25KHz simplex channels to provide full duplex voice and control channel. Compute the number of voice channels available per cell for a system using 7 cell reuse
- ii) If 2 MHz of allocated spectrum is dedicated to control channels Determine the number of control channels per cell **(4 marks)**
- d) Draw a block diagram of orthogonal frequency Division Multiplexing (OFDM) and explain the function of each block **(10 marks)**

Question FOUR

- a) Explain the functions of the following parts of the cellular phone
 - i) the microcontroller

ii) Duplexer

iii) Digital signal processor (DSP) (6 marks)

b)i) Suppose in the AMPS system a carrier to interference ratio (CIR) of 18dB is required. The path loss exponent $\gamma = 4$. Considering only the nearest sources determine the minimum cluster size

ii) If now sectors of 120° are used and the path exponent is maintained at $\gamma = 4$ calculate the Signal to interference ratio (6 marks)

c) Draw the block diagram of a GSM encoder and explain its operation (8 marks)

Question FIVE

a) Explain the following features of GSM network

i) Frequency Hopping

ii) Timing advance

(4 marks)

b) State any TWO methods of improving carrier to interference ratio of a cellular communication

(2marks)

b) Explain the functions of each of the following components of the Network switching centre

i) Visitor Location Register(VLR)

ii) Equipment Identity Register (EIR)

iii) Authentication Centre (AUC)

iv) Gateway Mobile Switching Centre (GMSC)

(8 marks)

c) A single analogue cell tower has 65 traffic channels. When all channels are busy, calls are blocked. Calls arrive according to a Poisson process at a rate of 2 call per active user an hour. the busy hour $\frac{3}{4}$ of the users are active. The call holding time is exponentially distributed with a mean of 150 seconds. Determine;

i) the maximum load the cell can support while providing 2% call blocking

ii) the maximum number of users supported by the cell during the busy hour

iii) the % utilization of the cell tower

(6 marks)

Table B.1 (Continued)

(Offered Load)		A in Erlangs												
n	P _B													
	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

