Mid ExamI. **Cellular 0953522** **29/3/2016**

Q.1 (13 Points, ABET Question 7x6)

Design a Digital Cellular system for an area of 20000Km^2, if the total number of available channels is 273 and 800K subscribers are **active** at busy hour. If the min C/I is 10dB, the average call duration is 3 min one control channel per cell, **(20% of customers are active at busy hour)** and γ=3. Then Find:

Configuration	BP=1%	BP=2%
Cell Configuration	3x3	3x3
Total No of **Cells**	455 718	679
Actual C/I	11.303dB	11.303dB
Cell Radius ($2.6R^2$)	10.35	336.58 m

If a micro cells (omni directional) is to be added to the system using 18 channels from the 273. Calculate the following for the same configuration as above:

	BP=1%	BP=2%
Total No of **Cells**	1442	300
Total No of micro **Cells**		
Actual C/I	11.303dB	11.303dB
Micro Cell Radius	1.74	1.79
Total customers	19234117	15632500

$\rightarrow \frac{C}{I} = 10dB$

$k=3 \rightarrow q=3 \rightarrow \frac{C}{I} = \frac{q\gamma}{6}$ $\rightarrow 10 \times 2 = q^3$ $\rightarrow q = \sqrt{\quad}$

$m=3$

$\therefore \frac{C}{I} = 18.302dB$

$\rightarrow A_T = \frac{Q_a \times \lambda}{60}$ $\rightarrow \frac{800 \times 10^3 \times 3}{60} = 40000\ E_r$

$N_{sec} = \frac{N_T - 9}{q} = \frac{273-9}{9} = 29.33$ $A_{sec} = 18.58 \rightarrow A_{cell} = 55.7$

$A_{cell} = 29.33 \times 3 = 88$

$\#of\ cells = \frac{40000}{88} = 454.5 \simeq 455$

$\#of\ cells = \frac{40000}{\quad} = 718$

Q.2 (7 Points 1x1x1x2x2)

A 3x3 configuration system contains only 7 cells as shown, R=1.5Km, γ=3.

1- Find the worst case C/I for each cell type.

Type 1: C/I= ~~9.030~~ 6.02 dB.

Type 2: C/I= ~~6.02~~ 3.02 dB.

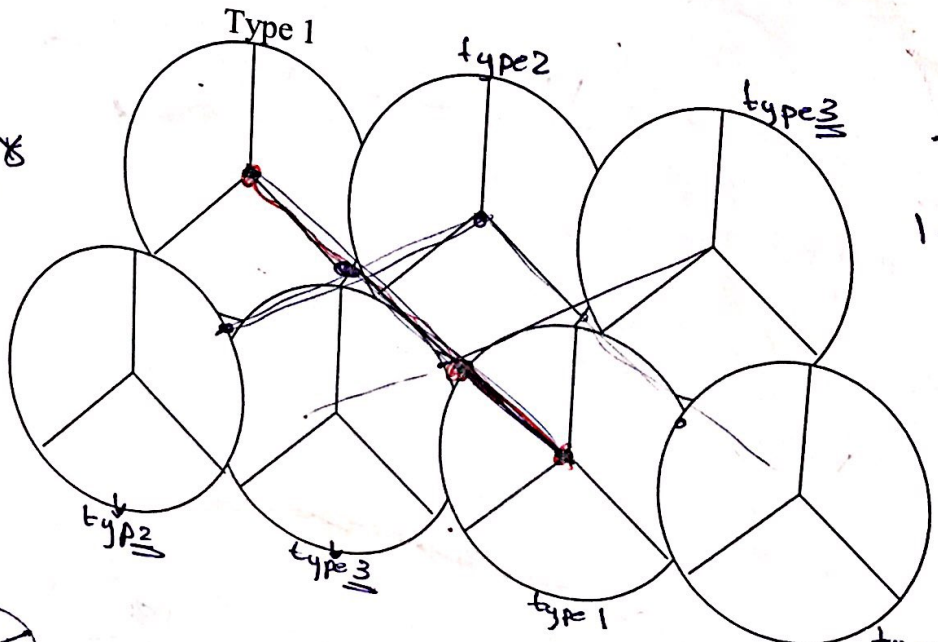
Type 3: C/I= ~~9.030~~ 6.02 dB.

2- Find the worest C/I for a user at 800m from his Base Station and 5200m from the co-channel base station.

C/I= 24.38 dB.

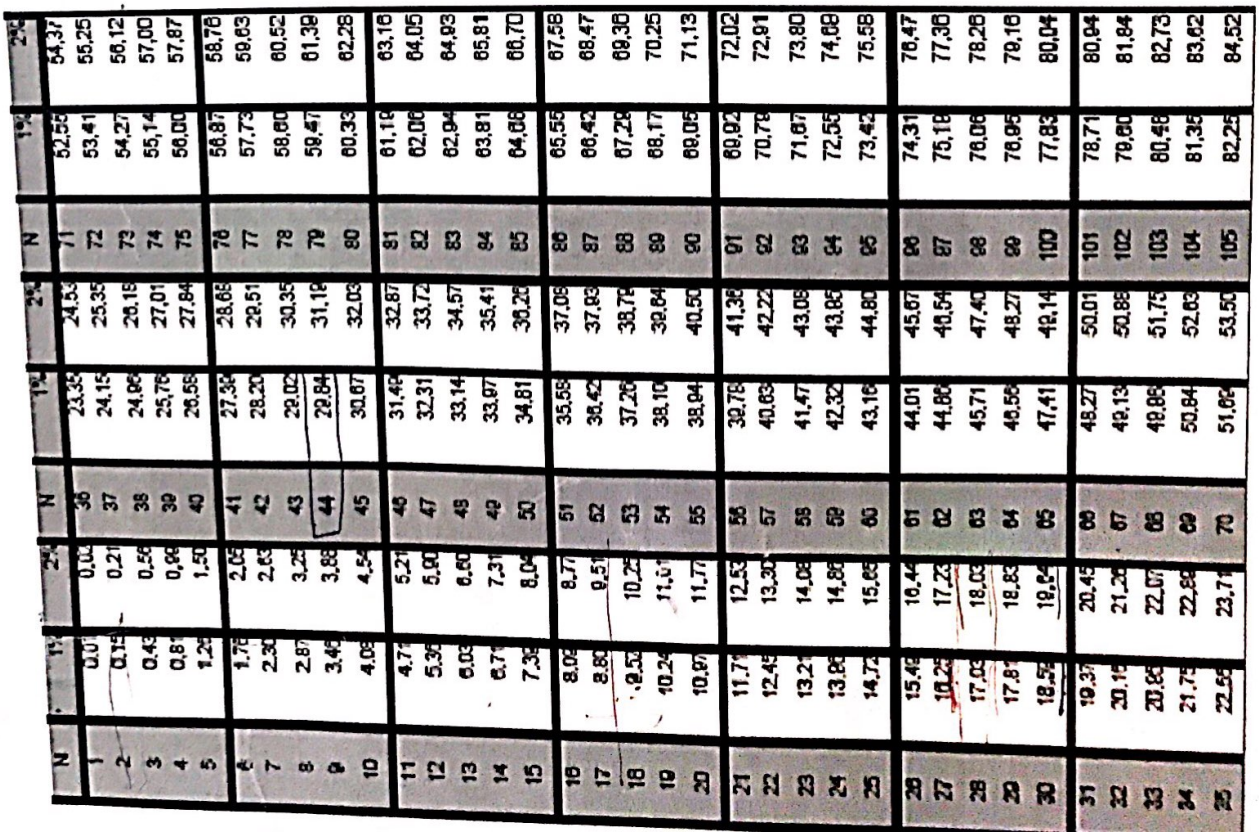
3- Find the best C/I for a user at 800m from his Base Station and 5700m from the co-channel base station.

C/I= 27.294 dB.



Q.3 (10 Points 1 each)

1.	Frequency plan reduces the effect of adjacent-channel interference	T	F
2.	Frequency reuse is implemented by creating full spatial orthogonality.	T	F
3.	Sectorization increases the Number of Cells for the same C/I.	T	F
4.	The propagation constant γ depends on the multi-paths in the channel.	T	F
5.	Increasing the required Channel BW increases the total no of cells.	T	F
6.	Imperfect frequency Orthogonality causes adjacent channel interference problem.	T	F
7.	Control Channels are used to update only active users data.	T	F
8.	Down Telting reduce the co-channel interference and the signal strength from Home Base Station.	T	F
9.	Near End Far End problem happens at the cell center.	T	F
10.	Users near cell center has better C/I.	T	F



$A_{sec} = 19.64 \rightarrow A_{cell} = 3 \times 19.64 = 58.92$

$\frac{40000}{58.92} = 679$ cells

BP/cl

$\rightarrow A_{area/cell} = \frac{200000 \times 10^3}{718} \rightarrow \sqrt{\quad} = 10.35$

$\sqrt{2.6}$

BP/c2

$= \frac{200000}{679}$

→ micro

18 channels from 273

$A_{sec} = 9.25$ → $A_{cell} = 3 \times 9.25$

$A_{cell} = 27.75$

~~$\rightarrow 18 \times 9 = 162$ ch./sec~~ ~~$A_{cell} = 3$~~

$A_{sec} =$

$A_{\mu a} = 9.25 \times 718 = 6641.5$

$Q_{T_\mu} =$

$\frac{1442}{480}$

$\frac{\#\text{of cells}}{} = \frac{40000}{27.75} = 1441.4 = 1442$

BP = 2%

$A_{sec} = 10.25 \rightarrow A_{cell} = 3 \times 10.25$

$Q_{T_\mu} = 1442 \times 9.25$

18 ① Loss without knife edge $L = 40 + 34 \log(r)$

$P_t = P_r + G\square - L$

② @ what Point you have knife edge

- Calculate L_k
- $r = ?$
- $G = ?$
- is it realistic? why?

r	Pr	C
100	-30	
200	-40	
300	-53	
400		
500		
100		

-30
Knife → -53
-40
-50

② You have 5 cells, 3x2
(20 voice channel 1 control) تقل إلى مجانة
Per Sector

① # of control channel

②

③ C/I min

④ C/I max

density

③ You have 3x3, 66 channel, 1000 user/km^2, 1500 km^2
with 1 control channel Per Sector
find λ

① Diversity Solution for fading
② Mobity causes fading
③ ...

Q.2 **(8 Points)**

1- For a 3x3 configuration system. Down tilting increases the home signal by 1.5dB and reduces the interference by 1dB each. Find the new C/I.

C/I = dB

$\frac{C}{I} = \frac{10}{10}$ = 1.77 = 2dB

2

2- If a user at 500m from base station has C/I=11dB. What is the C/I for a user at 1000m in the same cell.

C/I = 5.5 dB.

3- Discuss briefly (in points) the call setup procedure.

(1) search network
(2) Authtication
(3) call research
(4) ring
(5) call (hold)
(6) call drop

1) search network ✓
2) Authtication ✓
3) call research
4) ring
5) call (hold) ✓
6) call drop

2-

4X1 OR 3X1

8.4 dB min 6.5 dB min

(a) ? I

$\left(\frac{C}{I}\right)_{1000} = \left(\frac{C}{I}\right)_{500} + 10\log\left(\frac{r_1}{r_2}\right)$

= 2dB < min

1) network search
2) network login (authetication)
3) call request
4) channel search
5) call establish
6) call drop - not always be occure
7) END

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Mid Exam1. 29/3/2017

Q.1 (12 Points, ABET Question)

Design a Digital Cellular system for an area of 40000Km², if the total number of available channels is 287 and 800K subscribers are active at busy hour. If the average call duration is 3 min one control channel per cell, γ=3 and BP/ 1%. Then Find.

Configuration	3x3	7x1
Total No of Cells	662	1505
C/I	11.3	12.05
Cell radius	4.82	3.14

Repeat for BP=2%.

Configuration	3x3	7x1
Total No of Cells	628	1437
C/I	11.3	12.05

Q.3 (10 Points 1 each)

1.	Frequency plan reduces the effect of both co-channel and adjacent-channel interference	T	(F)
2.	Frequency reuse is implemented by creating partial spatial orthogonality.	T	(F)
3.	Frequency hopping increases the C/I for all active users.	(T)	F
4.	The propagation constant γ depends on the multi-paths in the channel.	(T)	F
5.	Control data is transmitted over the control channel while the user is active.	T	(F)
6.	You get the message "The phone is unreachable" if it is turned off.	T	(F)
7.	Control Channels are used to update only active users data.	T	(F)
8.	Down Telting reduce the co-channel interference and the signal strength from Home Base Station.	T	(F)
9.	Near End Far End problem happens at the cell center.	T	(F)
10.	Hand over failure is only due to no available channel in the interred cell.	T	(F)