SRM Institute of Science and Technology
College of Engineering and Technology

Set B

DEPARTMENT OF ECE

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Academic Year: 2024-2025 (ODD)

Answer key

Test: CLAT- 1 **Date:12.6.2024**

Course Code & Title: 18ECC301T Wireless Communication **Duration: 3.10-4.00pm**

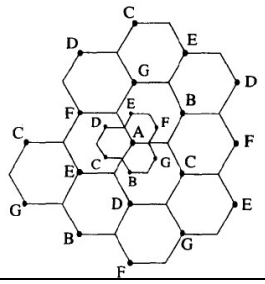
Year & Sem: IV& VII **Max. Marks: 25**

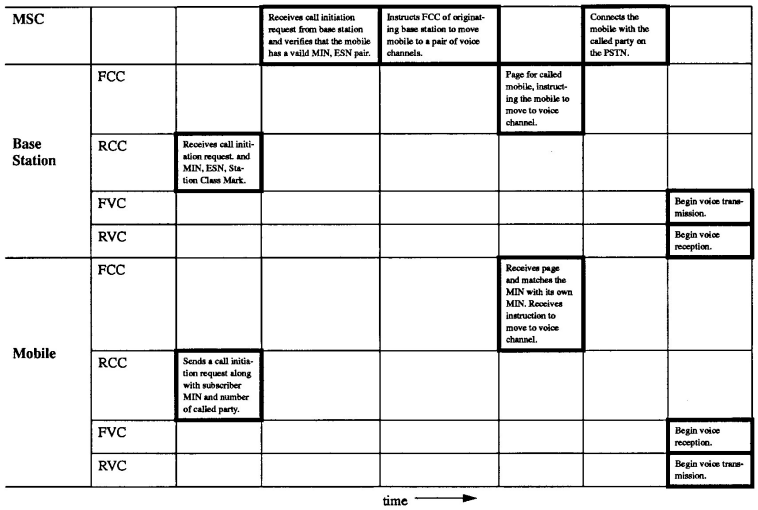
Course Articulation Matrix:

18ECC301T_Wireless Communication	PROGRAM OUTCOMES												PROGRAM STUDENT OUTCOMES		
COURSE OUTCOMES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
Interpret the concepts of Wireless communication and basic cellular networks	3	-	-	3	-	-	-	-	-	-	-	2	-	-	-
Analyze different Radio wave propagation models for cellular communication	-	3	-	3	-	-	-	-	-	-	-	-	-	-	3
Apply different multipath propagation channel models in wireless systems	-	3	3	-	-	-	-	-	-	-	-	-	-	-	2
Illustrate the Link performance improvement techniques	-	3	-	-	-	-	2	-	-	-	-	-	-	-	3
Summarize different wireless communication standards and systems	-	-	2	-	-	2	-	-	-	-	-	-	2	-	-

Part – A (5x1= 5Marks)					
Q. No	**Answer all the questions**	**Marks**	**BL**	**CO**	**PO**
1.	During the handoff process in the cellular system, the margin (Threshold) is given by a.Δ = Pr(HANDOFF) - Pr (MAX. USABLE) b.Δ = Pr(HANDOFF) - Pr (MIN. USABLE) c.Δ = Pr(SAR OF THE MOBILE) - Pr (MIN. USABLE) d..Δ = Pr(CELL) - Pr (BASE STATION) **Answer:b**	1	1	1	1
2.	A Spectrum of 30 MHz is allotted to a cellular system which uses two 25kHz simplex channels to provide full duplex voice channels. What is the number of channel available per cell for 4 cell reuse factor? a.150 channel b.600 channel c. 50 channel d. 85 channel Total bandwidth is 30 MHz. And the channel bandwidth is 50 KHz/duplex channel (25KHz*2). Therefore, total available channels are 600 channels (30,000/50). For 4 cell reuse factor, total number of channels available per cell will be 150 channels **Answer:a**	1	3	1	4
3.	In Trunked radio system(TRS) user is allocated the channel on a.Per frequency basis b.Per call basis c.Per channel basis d.Per Base station basis **Answer:b**	1	1	1	1
4.	What is the measure of the ability of user to access a trunked	1	1	1	1

	system during the busiest hour? a.Trunking b.Sectoring c.Multiplexing d. Grade of Service (GOS) **Answer:d**				
5.	What will be the total no of users if each user generates is 0.1 Erlang and the total offered traffic is 3.96. a.39 b.40 c.4 d.11 U = A/AU = 3.96/0.1 ≈ 39 users **Answer:a**	1	3	1	4
	Part – B(2x 4= 8Marks) **Answer Any two questions**				
6.	Illustrate the channel assignment strategies in mobile communication. **Marks 2:** Fixed Channel Assignment Strategy (FCAS) • In FCAS each cell is assigned a *predetermined* set of voice channels • Any call attempt within the cell can only be served by the *unused* channel in that particular cell • If all the channels in the cell are occupied, the call is *blocked*. The user does not get service. • In variation of FCA, a cell can *borrow channels* from its neighboring cell if its own channels are full. **Marks 2:** Dynamic Channel Assignment (DCA) • Voice channels are not allocated to different cells *permanently*. • Each time a call request is made, the *BS request* a channel from the MSC. • MSC allocates a channel to the requesting cell using an algorithm that takes into account – likelihood of future blocking – The reuse distance of the channel (should not cause interference) – Other parameters like cost • DCA reduce the likelihood of blocking and increases capacity • Requires the MSC to collect realtime data on channel occupancy and traffic distribution on continous basis. – DCA is more complex (real time), but reduces likelihood of blocking	4	4	1	4
7	Demonstrate the importance of cell splitting in wireless networks. **Marks** :**2** As number of users increases, number of channel assigned to a cell become insufficient to support large number of users. Therefore Cellular design techniques are required. ▪ The cellular design techniques which are required to provide more channels per unit coverage area are:	4	3	1	4

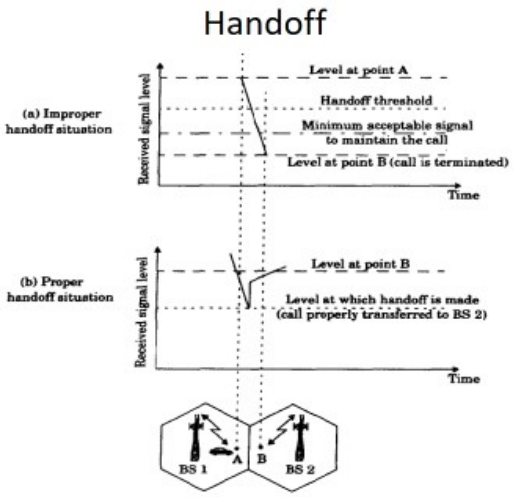
	1) Cell Splitting **2) Sectoring** **3) Microcell Zone Concept** **1) <u>Cell Splitting</u> :** ▪ The process of subdividing a congested cell into smallercells, each with its own base station & a corresponding reduction in antenna height & transmitted power. ▪ Cell splitting Reduces the transmitted power. ▪ The original base station A is surrounded by 6 new microcell. ▪ The smallest cells are added as to preserve the frequency reuse plan. Now G is placed halfway b/w the 2 larger stations utilizing same channel set G. ▪ Cell splitting increases the capacity of a cellular system: • It increases the number of times that channel are reused. By defining new cells which have a smaller radius than original cells & by installing smaller cell.Due to additional number of channels per unit area. **Marks** :**2** ▪ As New Area is ¼ of the older area (now one bigger cell include approximately 4 smaller cell), therefore the capacity of system is increased by 4 times. 				
8.	If a signal to interference ratio of 15 dB is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent is 4. Assume that there are 6 co-channels cells in the first tier, and all of them are at the same distance from the mobile. **Solution** (a) $n = 4$ First, let us consider a seven-cell reuse pattern. Using Equation (3.4), the co-channel reuse ratio $D/R = 4.583$. Using Equation (3.9), the signal-to-noise interference ratio is given by $S/I = (1/6) \times (4.583)^4 = 75.3 = 18.66$ dB Since this is greater than the minimum required S/I, $N = 7$ can be used.	4	4	1	4
	Part – C (1 x 12= 12Marks) **Answer all the questions**				

9a.	Explain through the aid of a timing diagram, the step-by-step procedure for establishing a call from a mobile subscriber to a mobile recipient. **Marks:6(Explanation)** Call initiation by a mobile user: Once a call is in progress, the MSC adjusts the transmitted power of the mobile and changes the channel of the mobile unit and base stations in order to maintain call quality as the subscriber moves in and out of range of each base station. This is called a handoff. Special control signaling is applied to the voice channels so that the mobile unit may be controlled by the base station and the MSC while a call is in progress. When a mobile originates a call, a call initiation request is sent on the reverse control channel. With this request the mobile unit transmits its telephone number (MIN), electronic serial number (ESN), and the telephone number of the called party. The mobile also transmits a station class mark (SCM) which indicates what the maximum transmitter power level is for the particular user. The cell base station receives this data and sends it to the MSC. The MSC validates the request, makes connection to the called party through the PSTN, and instructs the base station and mobile user to move to an unused forward and reverse voice channel pair to allow the conversation to begin. Figure shows the sequence of events involved with connecting a call which is initiated by a mobile user in a cellular system. • A call initiation request is sent on the reverse control channel (RCC).Mobile unit transmits its telephone number (MIN), Electronic Serial Number (ESN), Station Class Mark (SCM) which indicates power level and telephone number of called party. The cell BS receives this information and sends it to MSC. The MSC validates the request, makes connection to called party through the PSTN.MSC instructs BS and mobile user to move to an unused voice channel pair to allow the conversation to begin **Marks:6(Diagram)**  	12	3	1	12
	(OR)				
9b.	Explain the term "handoff" in wireless communication systems and enumerate the different classifications of handoff with a neat diagram.	12	2	1	1

Marks:5

- When a mobile moves into a different cell while conversation is in progress, the MSC automatically transfers the call to a new channel belonging to new base station is known as Handoff.
- Handoff operation not only involves identifying a new base station, but also requires that the voice & control signals be allocated to channels with the new base station.
- Handoff must be performed successfully & as infrequently as possible.
- For this system designer must specify an optimum signal level at which to initiate a handoff.
- Once a particular signal level is specified as the minimum usable signal for acceptable voice quality at the base station receiver, a slightly stronger signal level is used as a threshold at which a handoff is made.
- This margin (Threshold) is given by:

$\Delta = P_r(\text{HANDOFF}) - P_r(\text{MIN. USABLE})$



Source : Wireless Communications: Principles and Practice, Theodore S. Rappaport, pp 63.

Marks:7

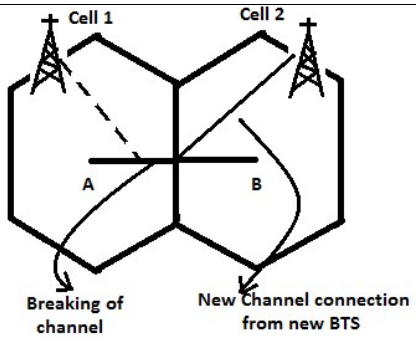
Classification

- Handoff can be classified as:

1) Hard Handoff
2) Soft Handoff

1) <u>Hard Handoff</u> :

- Also known as Break Before Make.
- It is one in which the channel in the source cell is released & only then the channel in the target cell is engaged.
- Thus the connection to the source is broken before the connection to the target is made.
- Hard handoffs are intended to be instantaneous in order to minimize the disruption to the call.
- It is not necessary that there is always a connection b/w base station & mobile station

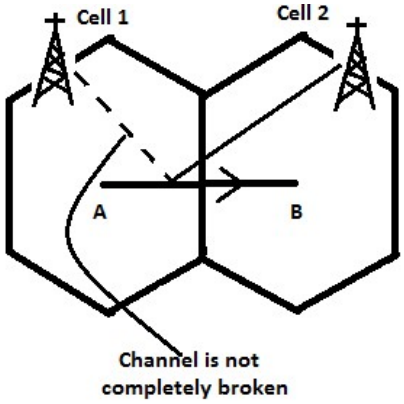


2) <u>Soft Handoff</u> :

- Also known as Make Before Break.

It is one in which the channel in the source cell is retained & used for a while in parallel with the channel in target cell.

- Thus the connection to the target is established before the connection to the source is broken.
- In this kind of handoff, there is always a connection b/w base station & mobile station.



Signature of Course Teacher