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| **Course Name:** | **MCAN Laboratory** | **Semester:** | **VI** |
| **Date of Performance:** | **20 / 01 / 2025** | **Batch No.:** | **B – 2** |
| **Faculty Name:** | **Dr. Rajashree Daryapurkar** | **Roll No.:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade / Marks:** | **\_\_\_ / 25** |

**Experiment No.: 2**

**Title: Frequency Reuse in Cellular System (VLAB)**

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| **Aim and Objective of the Experiment:** |
| To understand the cellular frequency reuse concept fulfilling the following objectives:   1. Finding the co-channel cells for a particular cell. 2. Finding the cell clusters within certain geographic area. |

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| **Tools Required:** |
| Access to Virtual Lab IIT Kharagpur |

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| **Theory:** |
| Cellular Frequency Reuse:  Each cellular base station is allocated a group of radio channels to be used within a small geographic area called a cell. Base stations in adjacent cells are assigned channel groups which contain completely different channels than neighboring cells. Base station antennas are designed to achieve the desired coverage within a particular cell. By limiting the coverage area within the boundaries of a cell, the same group of channels may be used to cover different cells that are separated from one another by geographic distances large enough to keep interference levels within tolerable limits. The design process of selecting and allocating channel groups for all cellular base stations within a system is called frequency reuse or frequency planning.  If a circle is chosen to represent the coverage area of a base station, adjacent circles overlaid upon a map leave gaps or overlapping regions. A square, an equilateral triangle and a hexagon can cover the entire area without overlap and with equal area. A cell must serve the weakest mobiles typically located at the edge of the cell within the foot print. For a given distance between the center of a polygon and its farthest perimeter points, the hexagon has the largest area of the three. Thus, with hexagon, the fewest number of cell scan cover a geographic region and close approximation of a circular radiation pattern that occurs for an omni-directional base antenna and free space propagation is possible. Base station transmitters are situated either at the center of the cell (center-excited cells) or at three of the six cell vertices (edge-excited cells). Normally, omnidirectional antennas are used in center-exited cells and sectored directional antennas are used in edge-exited cells. Practical system design considerations permit a base station to be positioned up to one-fourth the cell radius away from the ideal location.  Cell Cluster: Considering a cellular system that has a total of S duplex radio channels. If each cell is allocated a group of k channels (k < S)and if the S channels are divided among N cells into unique and disjoint channel groups of same number of channels, then,  S = kN.  The N cells that collectively use the complete set of available frequencies is called a cluster. If a cluster is replicated M times within the system, the total number of duplex channels or capacity,  C = M kN = MS.    Co-channel Cells:  A larger cluster size causes the ratio between the cell radius and the distance between co-channel cells to decrease reducing co-channel interference. The value of N is a function of how much interference a mobile or base station can tolerate while maintaining a sufficient quality of communications. Since each hexagonal cell has six equidistant neighbours and the line joining the centers of any cell and each of its neighbours are separated by multiples of 60 degrees, only certain cluster sizes and cell layouts are possible. To connect without gaps between adjacent cells, the geometry of hexagons is such that the number of cells per cluster, N, can only have values that satisfy, |

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| **Implementation Details:** |
| **Enlist all the Steps followed and various options explored.**  **Experiment 6A**   1. Choose Experiment 6A, click START, enter your name, and click OK. 2. Select the values for Cell Radius, i, and j. 3. Click Show Cells to view the Cluster-size N and the generated cells. 4. Identify the center cell (pink) and select Co-channel cells (orange) using the formula in the theory section. 5. Click CHECK to validate your selections.   **Experiment 6B**   1. Choose Experiment 6B, click START, enter your name, and click OK. 2. Select the values for Cell Radius and Cell Cluster. 3. Click Show Cells to view the generated cells. 4. Identify the two extreme cells (pink) and select other cluster cells (orange). 5. Click CHECK to validate your selections. |

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| **Output/ Snapshots after execution:** |
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| **Post Lab Subjective / Objective type Questions:** |
| **Consider a single high-power transmitter that can support 100 voice channels covering a given service area. Let the service area be divided into seven smaller areas (cells) each supported by lower power transmitters. The available spectrum of 100 voice channels is divided into 4 groups of 25 channels each. The cells (1, 7), (2, 4), (3, 5), and 6 are assigned distinct channel groups. Show that the total number of channels that can be supported is enhanced to 175 to cover the same service area. Comment on the results obtained.** |

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| **Conclusion:** |
| The experiment demonstrates how frequency reuse in cellular systems increases spectrum efficiency, allowing the same frequency channels to be reused in spatially separated cells. This approach significantly enhances the total channel capacity, enabling better utilization of limited resources. |

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| **Signature of faculty in-charge with Date:** |