1. (Wireless Communication: Nyquest’s Theorem and Shannon’s Theorem)
   - Given channel bandwidth \( B = 10 \text{ GHz} \) and noise level \( SNR = 40 \). Determine the maximum data rate \( C \) using Shannon’s theorem.
   - In order to theoretically reach the above rate, use Nyquist’s theorem to determine the minimum number of discrete signal levels/voltage values used.

2. (Cellular Architecture: Location Management)
   - Discuss the difference and similarity between location area and reporting center approaches in cellular architecture.
   - In an \( n \times n \) grid structured cellular network, can you come up an assignment of \( n \) reporting centers such that the average size of the vicinity of a reporting center (i.e., the size of reachable non-reporting cells from the center) is \( o(n^2) \) (i.e. less than \( n^2 \))? Briefly justify your conclusions.
   - Same as above. Assume the number of reporting centers is \( 4n - 4 \). Provide an assignment such that the maximum size of vicinity is minimized. Determine the minimized value assuming \( n = 3k + 2 \).

3. (Channel Assignment: Clustering)
   - Assume each cell is an \( R \times R \) square, discuss different ways of clustering.
   - Find out different \( N \) (cluster size) that can be used for clustering and show all possible clustering structures for \( N = 1, 2, ..., 9 \). (Note that cells are not necessarily aligned along rows and columns)
   - Determine the relationship(s) among \( R \), \( N \), and \( D \) (minimum distance between two cochannel cells).

4. (Channel Assignment: Graph Coloring)
   - Given a 7-cell graph with edge set \{ (A, B), (B, C), (B, F), (C, D), (D, E), (D, F), (F, G) \}.
     If the channel reuse distance is \( r = 2 \), determine the minimum number of colors needed to color the given graph. Show the color assignment and briefly describe why the coloring scheme uses the minimum number of colors.
   - If the channel reuse distance is \( r = 3 \), transfer the given graph to another graph with \( r = 2 \), and then, repeat the above step. Show all work.
   - Repeat the above step for \( r = 4 \).