Have Fun !!!!!

- Name:

- Identification Number:

- Please do not write in the following table. It will be used for grading.

<table>
<thead>
<tr>
<th>Problem 1</th>
<th>Problem 2</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Please read the following instructions carefully before answering the problems: You have 110 minutes to complete this exam. The point value of each part is indicated. Read the questions carefully. You are only allowed to keep a half of page of single-sided class notes (cheat sheet) with you during the exam. Note that this cheat sheet will contain only formulas (not solved problems or proofs). After the exam, please staple the cheat sheet with your answer sheets and hand over that to the instructor. Good Luck !!!!
Problem 1: (30 Points) Problem on Cellular System: Assume the downlink (base-to-mobile) communication of a cellular system, where the radius of a cell is $R$ and the distance to the center of the nearest co-channel cell is $D$. The term $N = 4$ denotes the channel reuse factor and $\gamma$ is the path loss exponent. Assume the transmit power of each base station is equal and thermal noise at the mobile is negligible. For your convenience, a hexagon worksheet is attached. Note that unreasonable approximations will not get any credit.

1. (15 points) Assume the mobile is at the location, where it would receive the weakest signal from its own base station. Assuming co-channel interfering cells in the first tier, solve the following problems.

   (a) (10 points) Derive the formula of the signal-to-interference ratio (S/I or SIR) at the mobile when the base stations are using the $60^\circ$-sector antennas.

   (b) 5 points What is the SIR of the mobile for $\gamma = 4$?

2. (15 points) Now consider the interference from the co-channel cells in the second tier along with the interference from co-channel cells in the first tier.

   (a) (10 points) Modify the formulas of the SIRs of 1a.

   (b) (5 points) What is the SIR of the mobile for $\gamma = 4$?

Problem 2: (20 Points) Problem on GOS in Cellular System: Assume that there are 84 cells in the system and 360 voice channels are available. Users are uniformly distributed over the area covered by the cellular system, and the offered traffic by the system is 0.04 Erlang/user. Also assume that blocked calls are cleared and the designated blocking probability is $P_b = 1\%$. Please determine the maximum carried traffic per cell and the maximum number of users that can be supported by the system. Please note that this problem is a continuation of the above problem.