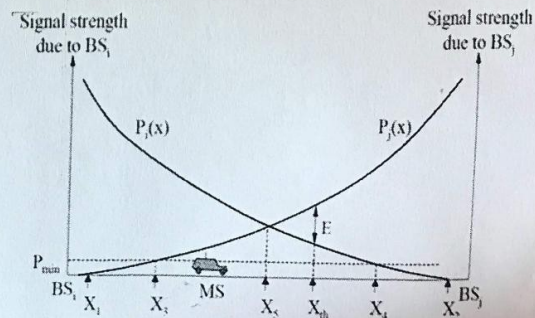Please make sure to write down **your name and student ID number** on the answer sheet. Submit your answer sheet along with this question sheet in return. You may answer in English or in Chinese.

1. Please explain the below five terms <u>in details</u>.   [15%]
   a) frequency hopping
   b) ALOHA protocol
   c) Please draw a figure to represent a simplified wireless communication system.
   d) random backoff
   e) fast fading

2. Consider a cruise with 10 passengers and two public phone sets (no waiting seats available). On the average, each passenger will use the public phone to make 3 calls per hour with each call of 4-minute duration. You need to compute the values, but not just to show the equations.
   a) Please draw the Markov Chain for the system. [4%]
   b) Please calculate the probability of two phones being occupied while another person wishes to make a call. (Namely, please calculate the blocking probability.) [6%].
   c) Please compute the efficiency (i.e. utilization) of the phone system in the cruise. [4%]

3. Please calculate the maximum transmission rate for a transmission system if the delay spread is 4 ns (nano-seconds). [6%]

4. Consider an antenna transmitting at 900 MHZ. The receiver is traveling at a speed of 36 km/h toward the antenna. (light speed = 3×10^8 m/sec)
   a) Calculate its Doppler shift. [5%]
   b) Assume the receiver is in free space and the antenna gain is 1. What is the path loss (in dB) if the receiver reaches a distance of 1 km away from the antenna? (given: log π = 0.4971, log 3 = 0.4771, log 2 = 0.3010) [5%]

5. Consider a mobile communication system in which a total bandwidth of 30 MHz is available and each channel consists of 25kHz. The city is covered by 10 clusters of cells. Each cell is deployed so that the radius of a cell is 2 km and the frequency-reuse distance is 12 km. Each channel is multiplexed (shared) among 8 users in a cell. How many users can be simultaneously processed by the system if total channels are equally allocated to all cells in a cluster? (Recall the purpose of frequency reuse.) [10%]

6. Define the **first-meter path loss** as the received signal strength (in dB) when the receiver stands one meter away from the transmitter. Now, if we have found the first-meter path loss to be 20 dB. Please calculate the free-space path loss for a receiver if the distance between the transmitter and receiver is [6%]
   a) 10 meters,   b) 500 meters,   c) 3 KM.

7. Please describe the following protocols in Pseudo code. [30%]
   a) *p*-persistent CSMA
   b) CSMA/CD
   c) CSMA/CA

8. Consider the right figure. Two base stations, BS$_i$ and BS$_j$ are located at the left and right sides respectively. In the class, three handoff schemes were advised: always-the-strongest, threshold, and minimum strength. Please come up with another feasible handoff scheme. Your design must be clearly explained. Figures and tables are welcomed to illustrate your design.   [9%]

無線通訊網路 期中考

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Signal strength

due to BS

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X X

BS

MSX

X

X