Instructions:

I. You must submit your homework electronically only in .pdf format. All word processed, no handwriting.
II. Submit your homework via Blackboard no later than **11:59 pm November 14, 2022**.
III. Late homework is subject to 10% penalty for each day past the due date, and before the solutions are posted. No homework will be accepted after the solutions are posted.
IV. Students can discuss problems and share their ideas among themselves but MUST work out the homework problems individually. Any deviation from this policy may result in an "F" grade for the course.
V. You must start working on these problems immediately. Otherwise, you may not have enough time to submit them on time.

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1. In Figure 4.4 (p 268) of the text, the performance of 7 protocols in terms of throughput are compared, particularly for higher number of users (attempts). Besides throughput, delay is another important factor, particularly for real-time applications such as voice and video. Compare these protocols in terms of delay. Which one is faster than the others in terms of delay. Rank these protocols based on speed and justify your answers.

2. Compare the throughput and the delay performance between basic bit map and adaptive tree protocols. Which one gives more throughput? Which one suffers more delay? Which is less fair?

3. A group of N stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on average once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of N?

Problem 2, page 351 of the text.

4. How long does a station, *s*, have to wait in the worst case before it can start transmitting its frame over a LAN that uses the basic bit-map protocol?

Problem 7, page 351 of the text.

5. Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B and D. D can communicate with A, C and E. E can communicate A, D and B.

   (a) When A is sending to B, what other communications are possible?

   (b) When B is sending to A, what other communications are possible?

   (c) When B is sending to C, what other communications are possible?

   Problem 10, page 351 of the text.

   Hint: Draw communication graphs, look for hidden and exposed nodes.