CS 549: Performance Analysis of Computer Networks
Theory Assignment 1

Assigned: January 31, 2025 *Due*: February 5, 2025

Write your answers by hand on plain paper, scan and submit on Moodle. Descriptive answers must be written in your own words, copying verbatim from the textbook will not fetch you any marks.

1. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). When such an application starts, it will continue running for a relatively long period of time. Describe some real-world scenario that generates such traffic, and answer the following questions, briefly justifying your answer:

   (a) What kind of a network would be appropriate for this application? A packet-switched or a circuit-switched network? Justify your answer?

   (b) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

2. Why are standards important for protocols? Discuss an incident from your daily life where you faced consequences because of lack of a standard protocol.

3. The functionality of airline travel can be structured as a horizontally layered architecture. This architecture provides a framework for discussing airline travel, and is analogous to the layering in the network protocol stack. Discuss the end-to-end argument of system design in the context of layering of airline functionality.

4. You have been asked the measure the distance between the two end points of the new road connecting the North Campus and South Campus of IIT Mandi, *i.e.* the length of the road. Identify 3 tools you would use for this measurement experiment. Arrange these tools in (a) increasing order to accuracy, (b) increasing order of precision. Justify your answer.

5. A user can connect to a server through either wireless channel or a twisteddpair cable for transmitting a 1460 bytes file. The transmission rate of the wireless channel is 2 Mbps and that of the cable is 100 Mbps. Assume that the propagation speed in air is 3×10^8 m/s, while the speed in the twisted pair cable is 2×10^8 m/s. If the user is located 500 m away from the server, what is the total delay experienced by the user when using each of the two access technologies.

6. An ATM is used to withdraw cash from a bank account. The user inserts the card in the ATM, the card number is verified, then the user is prompted for a PIN. If this is valid, she is asked for the amount. If the amount is greater than Rs. 10,000, the bank sends an OTP which the user is required to enter in the ATM for verification. If there is sufficient balance, the money is dispensed. Draw a neat UML Sequence Diagram depicting this sequence of events involving 3 entities: User, ATM and Bank.