CS-455 HW1 Summer 2023 30 points

Submission instructions

- ***Due date: Saturday, June 10, 11:59 pm Central Time (i.e. local time in Chicago)***
- *Late submissions will not be accepted.*
- ***Absolutely no handwritten submissions. No credit will be given for such submissions.***
- *Teamwork is allowed (max. 3 students/team). Individual submissions are also OK.*
- *Upload your HW assignment (**pdf format only**) to Blackboard. **Submissions in formats other than pdf will be disregarded.***
- ***One submission per team only.** Type names, A#, and section numbers of all the team members on the front page. Do **not** submit multiple copies of your HW (e.g. by each team member). It is very confusing and will be penalized.*

Show your work and explain all your solutions for full credit.

1. (2 points) What are advantages and disadvantages of a fully connected mesh topology of a network?
2. (2 points) We would like to send 4 bits per level of a digital signal. How many signal level are needed?
3. (2 points) A computer monitor has the resolution of 1200 by 1000 pixels. If each pixel uses 1026 colors, how many bits are needed to send the complete contents of a screen?
4. (4 points) Consider a sine wave $s(t)$ with the following parameters: period T=0.1 sec., amplitude A=10 V and phase $\alpha=\pi/2$. Find an analytical formula for the superposition of two such sine waves $f(t)=s(t)+s(t)$ and draw its time and frequency domain plots (t denotes time).
5. (2 points) What are the disadvantages of the baseband transmission of a digital signal?
6. (3 points) Explain why the original Shannon capacity formula can be simplified to

$$C = B\frac{SNR_{dB}}{3}$$

7. (3 points) A certain signal travels from source A via points B and C to destination D. Between the points A and B the signal is amplified by 10 dB. The points B and C are 10 km apart. They are

connected with a cable whose loss is 0.5 dB/km. Between the points C and D the signal is amplified by 15 dB. The power of the signal at the source A is 1 mW. What is the power of the signal at the destination D?

8. (2 points) Define a DC component and its effect on digital transmission.

9. (2 points) What is the role of a header added to a data unit in the OSI network model?

10. (2 points) What is the difference between a logical address and a physical address?

11. (3 points) What is the total delay for a file of 2.5 million bytes that is being sent over a link with a router having queuing time of 2 microseconds and processing time of 1 microsecond. The length of the link is 1000 km. The speed of the signal is 2×10^8 m/s. The link has a bandwidth of 5 Mbps. Which component of this delay is dominant? Which one is negligible?

12. The data input stream is 01001011. Draw a figure presenting the output from:
    (a) (1 point) AMI encoder;
    (b) (2 points) differential Manchester encoder.