Dordt University
Engineering 304, Microprocessor Interfacing
Problem Set #9, Spring 2020

20/20

Answers for the questions below can be found in the *Universal Serial Bus Specification* Revision 2.0 (also known as the "USB Standard"). The standard is available in hard-copy via the reserve collection at the Dordt Library. It is also available for free downloading from the Web. (A link is given on the Canvas homework page for this course.)

For each question below, provide an answer that is as complete as possible subject to the constraint that it is **less than 100 words.**

What is an **Isochronous Transfer**? (Section 5.6)

4/4 Isochronous transfer requires constant-rate transmission and allows for some error. It has a guaranteed section/transmission in the USB standard and is only uni-directional. The maximum packet size is 1023 bytes at 1.5 MHz. Packets can only use 80% of the microframe, and error handling is effectively disregarded as time constraints are more important than correctness for this type of transmission. Audio and video often use isochronous transfer.

What is a **Bulk Transfer**? (Section 5.8)

4/4 Bulk transfer is used for large files and consumes a large amount of bandwidth (all that is accessable). Unlike isochronous transfer, bulk transfer uses error detection and will resend the packet if any errors are encountered. Thus, data delivery is guaranteed, but the time it takes may be significant.

How many **microframes** are there in a **frame**? (Section 8.4.3.1)

4/4 A frame is 1 ms and a microframe is 125 µs. Thus there are 8 microframes in one frame (with jitter tolerances).

What is **Bus Enumeration**? (Section 9.1.2)

4/4 Bus enumeration refers to the process that USB defines for attaching and removing devices. When a device is attached, the host is informed, and the device is in the powered stage. Next, the host determines the nature of the device and the port change, then resets the port and allows the power to stabilize. The host will then assign a unique address to the device and reads its function. After which, the device will be active and ready to perform its purpose. Once removed, the host is notified, and the port is deactivated.

What is **Dynamic Attachment and Removal**? (Section 9.2.1)

4/4 USB devices can be attached or detached at any time, and the device should still function properly after an initial configuration phase. This is the "hot-swappable" nature of USB.