

## Assignment 2

### Due October 10, 12:59pm

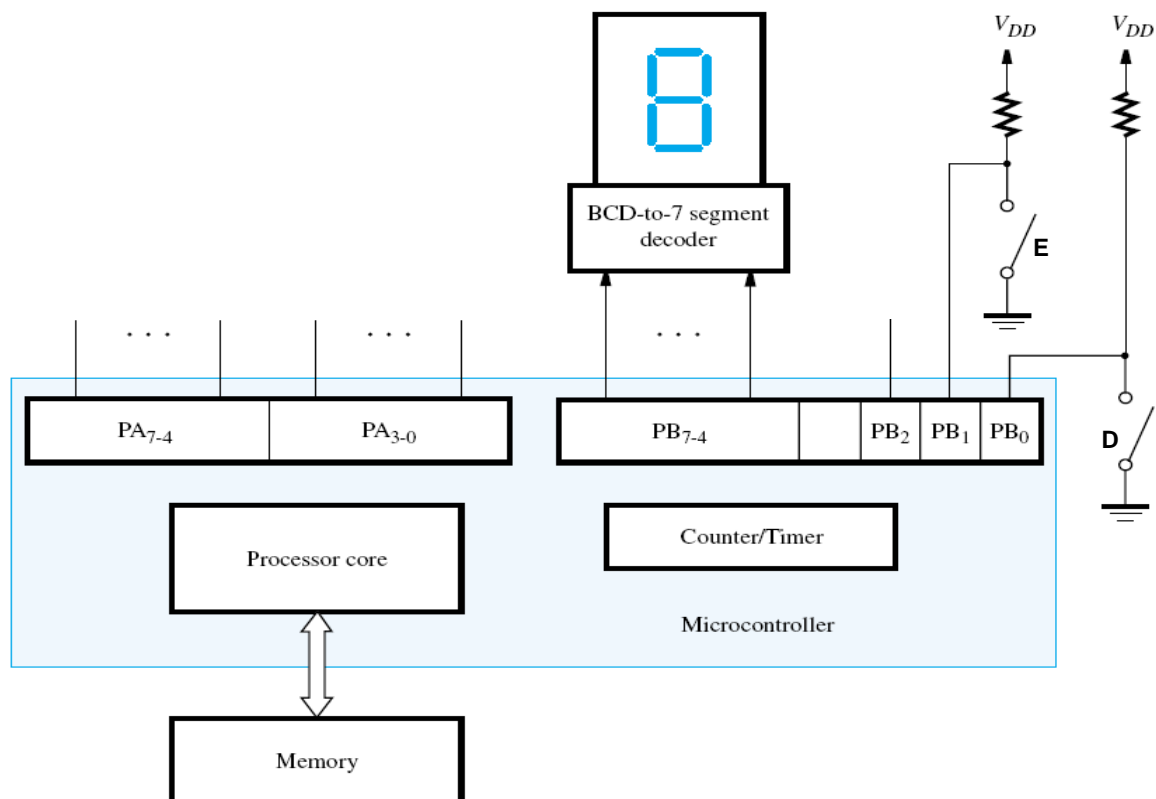
**NOTE:** Late submissions will **NOT** be accepted. Please put your solutions in the CENG 355 **drop-box** (ELW, second floor) – they will be collected at **13:00**.

1. [10 points] The textbook's microcontroller below is responsible for 2 tasks: (1) conditionally incrementing the displayed digit every second, and (2) keeping track of the **E** and **D** switches: pressing **E** enables the process of incrementing the digit every second, while pressing **D** disables that process. Write the corresponding C program, assuming that the first task is the ISR whose address is stored at location **0x20**, and the second task is the main program. Assume that bit **PSR[6]** is the processor's interrupt-enable bit, and **Port B** is always ready to receive data from the processor. Initially, the 7-segment display shows digit **0**, and it is not being incremented.

- *Main Program*: If **D** has been pressed, the digit is not allowed to increment every second (until **E** is pressed). If **E** has been pressed, the digit is allowed to increment every second (until **D** is pressed).

- *ISR*: The 100-MHz Counter/Timer must be configured to generate interrupts every second. The displayed digit must be incremented, provided that **E** was pressed last (i.e., the process of incrementing the digit is enabled). If **D** was pressed last, the displayed digit is unchanged (i.e., the process of incrementing the digit is disabled).

**Note:** Incrementing **9** gives **0**.



2. [10 points] Recall the ISR example shown on **Slide 50** of the “**I/O**” lecture notes, where the ISR reads data from **RBUF** and writes it to **Port A**. Modify it, so that **Port A** is written only when it is ready. Your C code must do the following:

- Check if **Port A** is ready. If it is ready, transfer the data from **RBUF** to **Port A**.
- If **Port A** is not ready, keep polling its appropriate status bit – once it becomes ready, transfer the data from **RBUF** to **Port A**. If after 0.001 seconds **Port A** is still not ready, return from the ISR without writing to **Port A**. Use the Counter/Timer to measure the time. Your solution should take into account that the main program also uses the Counter/Timer.

3. [5 points] The example shown on **Slide 68** of the “**I/O**” lecture notes assumes that the tasks are assigned *Rate Monotonic* (**RM**) priorities. Show the task schedule using Earliest Deadline First (**EDF**) priority assignment.