Solved Exercises 3

1. Solve Problem **7.8** from the textbook.

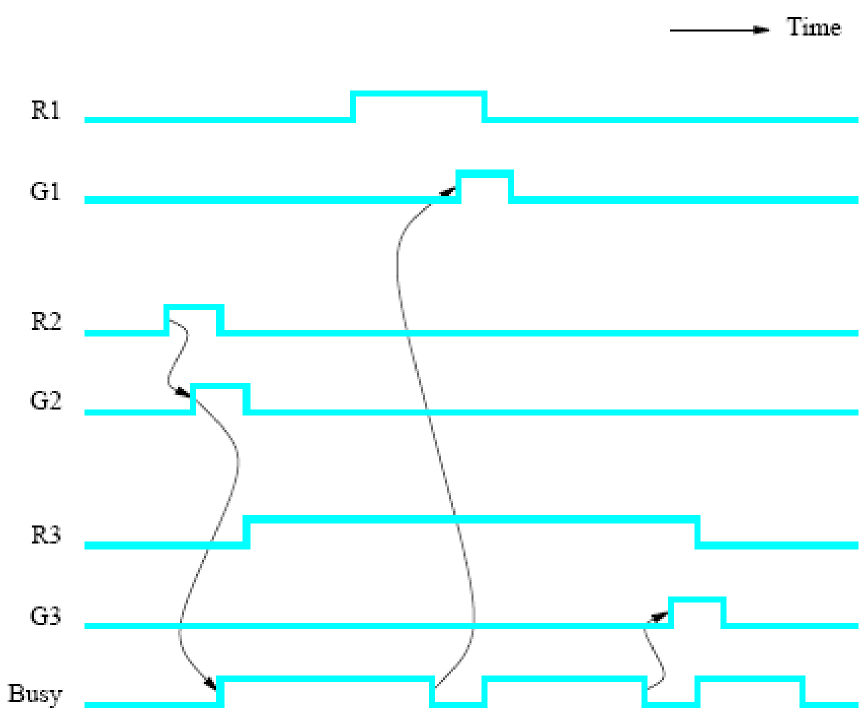
The addressed device sends the requested data at t_2. This is followed by three traversals of the bus to complete the handshake between Master-ready and Slave-ready, each taking one bus driver delay and one propagation delay. The bus cycle ends when the master sees a negated Slave-ready (t_5). Therefore:

$$\text{Minimum bus cycle} = 1 + 2 + 5 + 6 + 0 + 1 + 1.5 + 3(2 + 5) + 1 = 38.5 \text{ ns}$$

$$\text{Maximum bus cycle} = 1 + 2 + 5 + 6 + 25 + 1 + 1.5 + 3(2 + 10) + 1 = 78.5 \text{ ns}$$

Note that an allowance for bus skew is added when the address is transmitted and later when it is removed, because the address must always be correct when Master-ready is asserted. It is also added when the slave places its data on the data lines.

2. Solve Problem **7.10** from the textbook.



3. Solve Problem **7.12** from the textbook.

(*a*) A possible revision to the protocol would work as follows. When the arbiter receives a request from a high-priority device while a lower-priority device is being serviced, it drops the grant. This indicates to the device that is currently using the common resource that it must suspend its operation. It does so at the earliest, but safe opportunity, saving any information that may be needed when it resumes operation later. Then it drops its request. The arbiter can then grant the use of the resource to the higher-priority device. Meanwhile, the lower priority device asserts its request again, so that it can complete its suspended operation when the resource becomes available.

(*b*) A state diagram is given in Figure PS7.3.

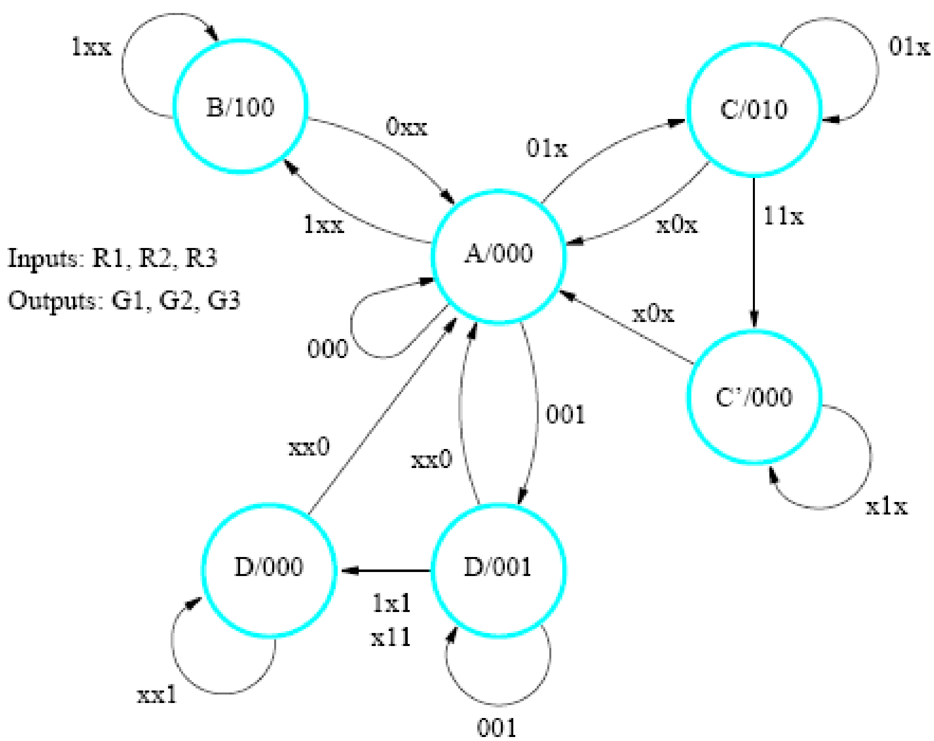
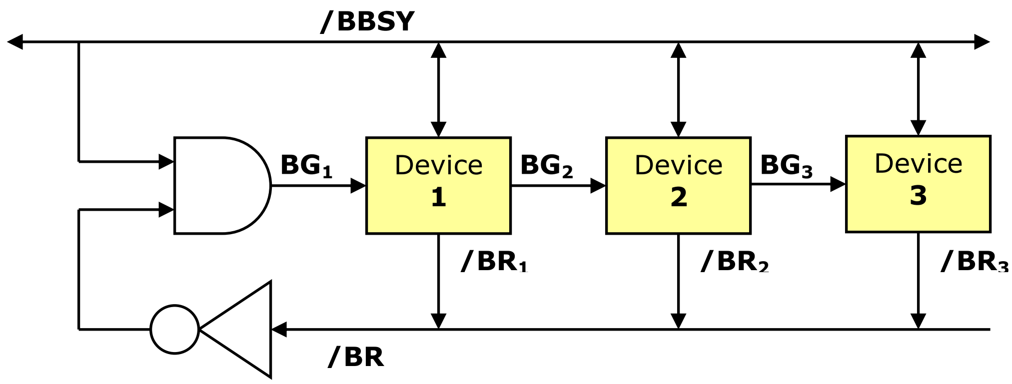
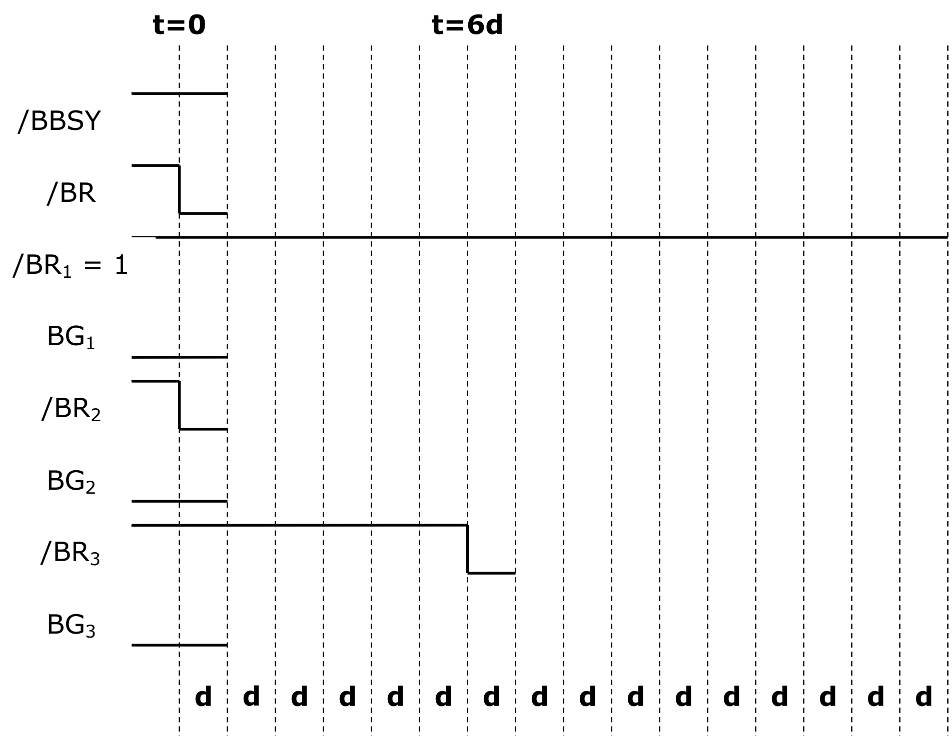


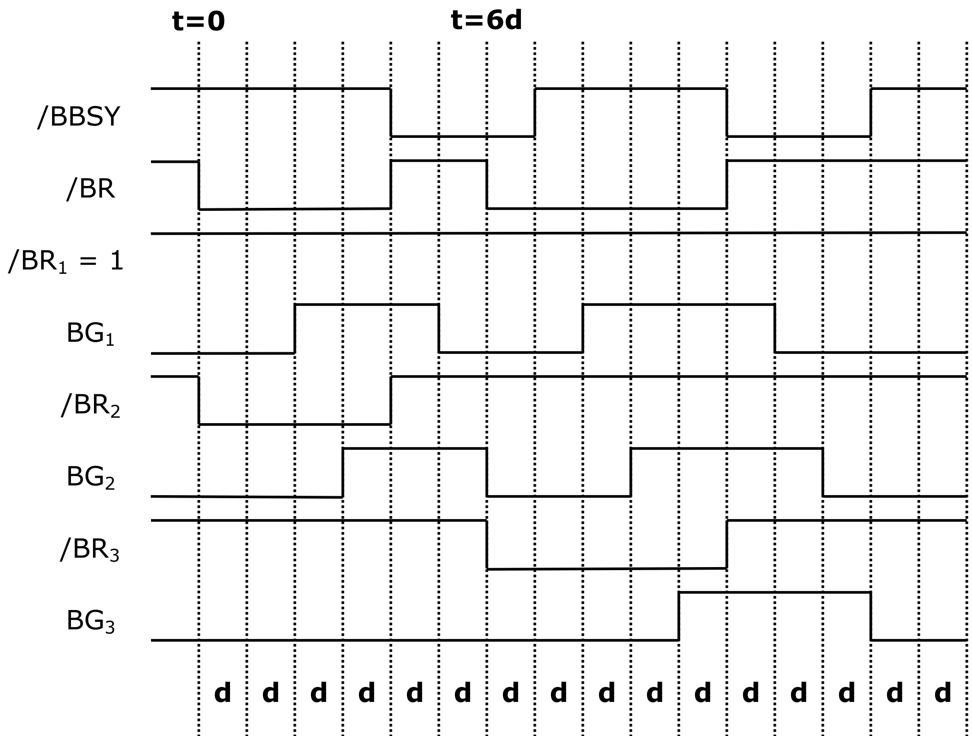
Figure PS7.3 An arbiter that allows preemption.

4. Consider the <u>daisy-chain</u> arbitration scheme shown below. Assume that the input-to-output signal propagation delays are the same and equal to **d** for all three devices, the inverter, and the **AND** gate. Also, assume that device **x** is able to start using the bus (making **/BRx = 1** and **/BBSY = 0**) only when it receives a <u>**0-1** transition</u> on its bus-grant input **BGx** and detects that the bus is not currently busy (i.e., **/BBSY = 1**). Also, assume that device **x** lets the bus-grant propagate through only when it is neither requesting nor using the bus. Finally, assume that any of the three devices will need to use the granted bus for only **3d** time units. Complete the <u>timing diagram</u> below, where <u>Device 2</u> requests the bus at time **t = 0**, and <u>Device 3</u> requests the bus at time **t = 6d**.





Solution is shown on the next page.


t=0
t=6d
/BBSY
/BR
$/BR_1 = 1$
BG_1
$/BR_2$
BG_2
$/BR_3$
BG_3
d d d d d d d d d d d d d d d d