1999 Paper 11 Question 6

Operating System Foundations

Producer and consumer processes interact via an N-slot cyclic buffer. Semaphores are defined and initialised as follows:

$$\begin{aligned} lock &: semaphore &:= 1 \\ spaces &: semaphore &:= N \\ items &: semaphore &:= 0 \end{aligned}$$

For the following programs indicate where mutual exclusion and condition synchronisation are being attempted and explain how the system may fail.

producer code	consumer code
produce item	WAIT (*lock*)
WAIT (*lock*)	WAIT (*items*)
WAIT (*spaces*)	remove item
insert item	SIGNAL (*spaces*)
SIGNAL (*items*)	SIGNAL (*lock*)
SIGNAL (*lock*)	consume item

[8 marks]

Write a monitor to manage the N-slot buffer. Discuss why the problems you pointed out in the previous part do not arise in the monitor implementation. [12 marks]