

## WEEK 5 - WORKED EXAMPLE

Design a sequential circuit with the following properties.

The next state  $Q'$  is decided by two control inputs  $J$  and  $K$ .

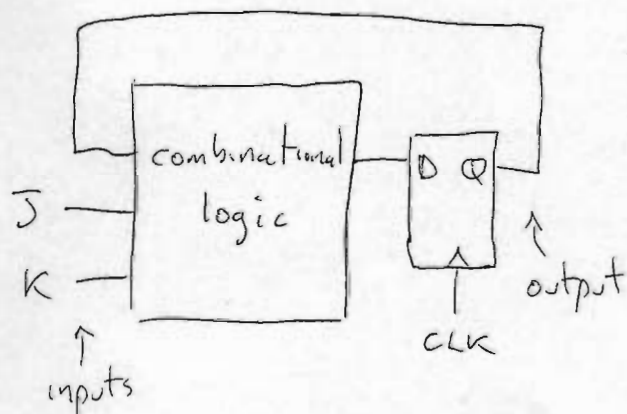
If  $J=K=0$  the output is unchanged. If  $J=K=1$  the output toggles. If  $J=0, K=1$  the output is reset to '0'.

If  $J=1, K=0$  the output is set to '1'.

### ① Construct the characteristic table

The next state of the output will depend not only on  $J$  &  $K$ , but also the present state  $Q$  of the output. Hence,  $Q$  must be fed back to the input combinational logic.

input		present state	next state
$J$	$K$	$Q$	$Q'$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0



### ② Obtain the characteristic equation

Solving gives  $Q' = \bar{J}\bar{K}Q + J\bar{K}\bar{Q} + J\bar{K}Q + JK\bar{Q}$

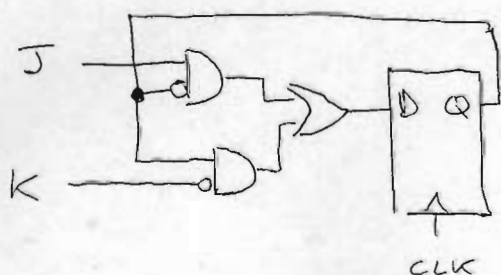
Common factors?

(try to separate  $J$  and  $K$ )  $Q' = J\bar{Q}(\bar{K} + K) + \bar{K}Q(J + \bar{J})$

$$Q' = J\bar{Q} + \bar{K}Q$$

### ③ Draw the circuit

For a D-type flip-flop  $Q' = D$  so the input to  $D$  will be  $J\bar{Q} + \bar{K}Q$  ie a JK flip flop!



$J$	$K$	$Q'$
0	0	$Q$
0	1	0
1	0	1
1	1	$\bar{Q}$