

**Computer Science
Comprehensive Examination
Formal Languages
Fall 2002**

1) (25 points)

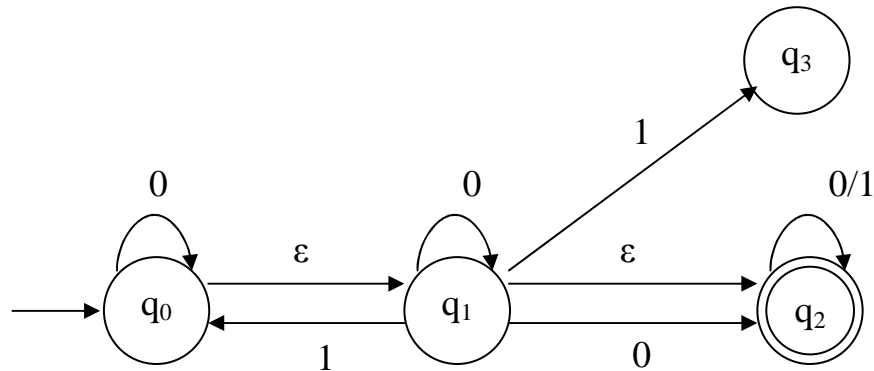
(a) Give a definition for *regular language*.

(b) Give a definition for *context-free language*.

(c) Give a definition for *recursive language*.

(d) Give a definition for *recursively enumerable language*.

2) (25 points) Convert the following NFA *with* epsilon transitions to an equivalent NFA *without* epsilon transitions. Note that for this question you should use one of the standard techniques for eliminating epsilon transitions. However, you are only required to show the final resulting NFA.



3) (25 points) Give a context-free grammar for each of the following languages.

(a) $\{0^i 1^j 0^i \mid i, j \geq 0\}$

(b) $\{0^i 1^j 0^k \mid i, k \geq 0, j \geq 1\}$

40) (25 points)

a) Give a block diagram showing that the recursive languages are closed with respect to set difference. In other words, if L_1 and L_2 are recursive languages, then so is $L_1 - L_2$. Be sure to explain your block diagram.

b) Could your block diagram from part (a) be used to show that the recursively enumerable languages are closed with respect to set difference (yes or no)? If so, then explain why, and if not then explain why not.