ECE 1175 - Homework 4 Solutions

Question 1

```
NN = 2 * N;
for (i = 0; i < NN; i+=2) {
    a[i] = b[i] * c[i];
    a[i + 1] = b[i + 1] * c[i + 1];
    m[j] = m[j] + 5;
    m[j + 1] = m[j + 1] + 5;
}
```

Question 2

a	#	#	#	#	#
b	#	#	#	#	
c		#	#		
p				#	
w	#	#	#		
x		#	#	#	
y			#	#	#
z					#

No. of needed registers = 6 without rescheduling.

One possible solution:

x = a - c;

p = b - x;

w = a + b;

y = c * w;

z = a + y;

a	#	#	#	#	#
b		#	#		
c	#	#	#	#	
p		#			
w			#	#	
x	#	#			
y				#	#
z					#

No. of needed registers = 5 after rescheduling.

Question 3

1) $P_{\mathrm{TR}} = 500\ \mathrm{mW} > P_{\mathrm{run}} = 400\ \mathrm{mW}$

$$T_{\mathrm{TR}} = T_{\mathrm{on,off}} + T_{\mathrm{off,on}} = 160\ \mathrm{ms} + 90\ \mathrm{us}$$

$$T_{\mathrm{BE}} = T_{\mathrm{TR}} + T_{\mathrm{TR}}(P_{\mathrm{TR}} - P_{\mathrm{run}})/(P_{\mathrm{run}} - P_{\mathrm{sleep}}) = 200.03\ \mathrm{ms}$$

2) $T_{\mathrm{idle}} = 2\ \mathrm{s}$

$$E_s(T_{\mathrm{idle}}) = (T_{\mathrm{idle}} - T_{\mathrm{TR}})(P_{\mathrm{run}} - P_{\mathrm{sleep}}) + T_{\mathrm{TR}}(P_{\mathrm{run}} - P_{\mathrm{TR}}) = 0.72\ \mathrm{J}$$

Question 4

$\lambda = 1/2.5 = 0.4,\ f_T(t) = \lambda e^{-\lambda t}$

$$\begin{aligned}
\mathrm{Safety} &= \Pr(T_{\mathrm{idle}} > T_{\mathrm{TO}} + T_{\mathrm{BE}} \mid T_{\mathrm{idle}} > T_{\mathrm{TO}}) \\
&= \Pr(T_{\mathrm{idle}} > 2 \mid T_{\mathrm{idle}} > 1) \\
&= \frac{\int_2^\infty f_T(t)\mathrm{d}t}{\int_1^\infty f_T(t)\mathrm{d}t} \\
&= e^{-0.4} \\
&\approx 0.6703
\end{aligned}$$

$$\mathrm{Efficiency} = \Pr(T_{\mathrm{idle}} < T_{\mathrm{BE}} \mid T_{\mathrm{idle}} < T_{\mathrm{O}}) = 1$$