Assignment 3

Question 1

Tasks	Periods	WCET
Task A	10ms	4ms
Task B	39ms	12ms
Task C	1s	98ms

Utilization $= \sum \left(\frac{ExecutionTime}{CycleTime} \right)$

Utilization RMS $= n(2^{\frac{1}{n}} - 1)$

Where n = 3

Utilization $= \frac{4}{10} + \frac{12}{39} + \frac{98}{1000} = 0.80569$

$2(2^{\frac{1}{3}} - 1) = 0.77976$

80.57% > 77.78%

The 3 tasks could possible be given a suitable schedule if the CPU usage is less than 77.78%. The task set is not harmonic, meaning we cannot guarantee a reasonable schedule can be found or not. Our Utilization is also higher than 77.78% meaning we cannot guarantee a suitable schedule

Fix:

A possible approach to fix this, is to make the task set harmonic, meaning all periods are divisible by their smaller and larger periods. We are able to do this by making task B period from 39ms to 40ms, making all periods divisible by the other

1000/10 = 100
40/10 = 4
1000/40 = 25

Here we can see the task set is harmonic, the only condition left to satisfy is keeping the utilization under 1, which ours is .798, therefor we have an optimal task set

Question 2

Task	Period	Execution Time	Priority
Task A	10ms	4ms	3 (highest)
Task B	20ms	5ms	1
Task C	40ms	10ms	2
Idle	Continuous	5ms	--

A.

  i. Utilization $= \sum \left(\frac{ExecutionTime}{CycleTime} \right)$

     Utilization $= \frac{4}{10} + \frac{10}{40} + \frac{5}{20} = 0.9$

ii. No, this is not RMS scheduled. In RMS, priorities are assigned based on the frequency of the tasks. Here task A has the highest frequency, and the highest priority, however Task C has a lower frequency than task B but a higher priority, which does not follow RMS

iii. $R1 = C1 + \left\lceil \frac{R1}{P0} \right\rceil C0$

Task A: 4ms

Task C: $10 + \left\lceil \frac{0}{10} \right\rceil 4 = 10ms$

$10 + \left\lceil \frac{10}{10} \right\rceil + 4 = 14ms$

$10 + \left\lceil \frac{14}{10} \right\rceil 4 = 10 + 2 * 4 = 18ms$

$10 + \left\lceil \frac{18}{10} \right\rceil 4 = 10 + 2 * 4 = 18ms$
unchanged from previous therefor 18ms for this task

Task B: $5 + \left\lceil \frac{0}{10} \right\rceil 4 + \left\lceil \frac{0}{40} \right\rceil 10 = 5ms$

$5 + \left\lceil \frac{5}{10} \right\rceil 4 + \left\lceil \frac{5}{40} \right\rceil 10 = 5 + 1*4 + 1*10 = 19ms$

$5 + \left\lceil \frac{19}{10} \right\rceil 4 + \left\lceil \frac{19}{40} \right\rceil 10 = 5 + 2*4 + 1*10 = 23\ ms$

$5 + \left\lceil \frac{23}{10} \right\rceil 4 + \left\lceil \frac{23}{40} \right\rceil 10 = 5 + 3*4 + 1*10 = 27ms$

$5 + \left\lceil \frac{27}{10} \right\rceil 4 + \left\lceil \frac{27}{40} \right\rceil 10 = 5 + 3*4 + 1*10 = 27ms$
Unchanged from previous therefor 27ms for this task

Total response times for each task in the worst case:
Task A: 4ms
Task C: 18ms
Task B: 27ms

iv. Deadlines comparison:

Task	Deadline	Response Time	Over/Undershot amount
Task A	10ms	4ms	Undershot 6ms
Task C	40ms	18ms	Undershot 22ms
Task B	20ms	27ms	Overshot 7ms

As we can see, Task A and C are meeting, by getting under the deadline time, but task B is overshooting by 7ms

A

4

C — 1

B —

6   7   6   4

2   3

Time(ms)

4   10   18 20   27   30   40
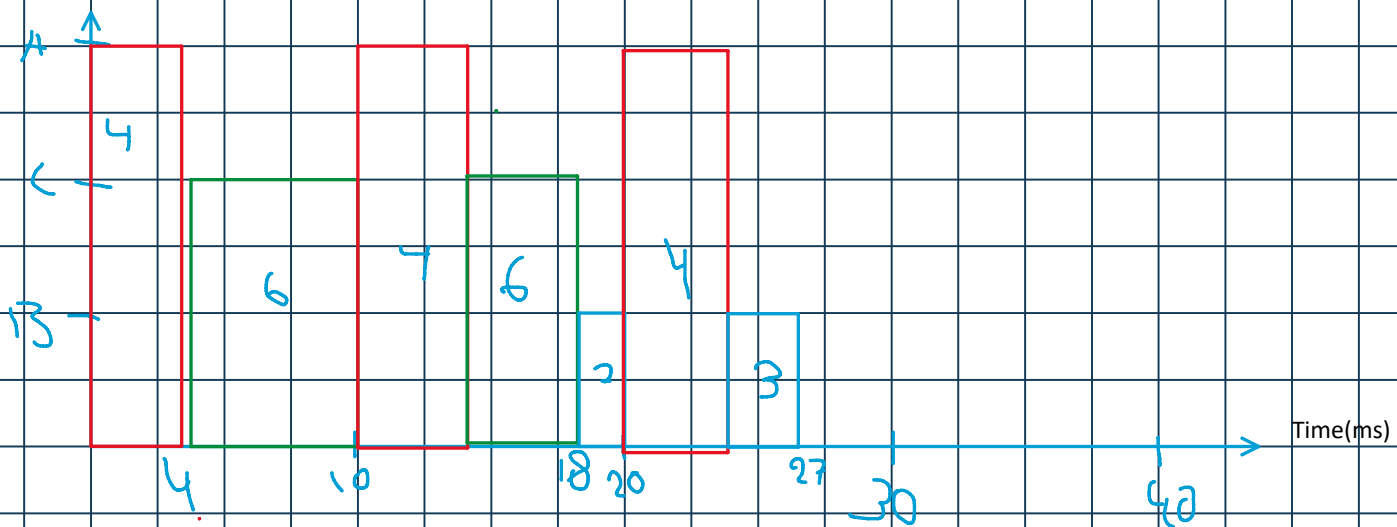
B.

Task	Period	Execution Time	Priority
Task A	10ms	4ms	3 (highest)
Task B	20ms	5ms	2
Task C	40ms	10ms	1
Idle	Continuous	5ms	--

i. System utilization would not change, as we did not change the numbers, just the priorities of them. The system utilization would still be 0.9

ii. $R1 = C1 + \left\lceil \dfrac{R1}{P0} \right\rceil C0$

Task A: 4ms.
Task A would stay unchanged as it has the same priority as before

Task B:

$$5 + \left\lceil \frac{0}{10} \right\rceil 4 = 5 + 0 = 5ms$$

$$5 + \left\lceil \frac{5}{10} \right\rceil 4 = 5 + 1 * 4 = 9ms$$

$$5 + \left\lceil \frac{9}{10} \right\rceil 4 = 5 + 1*4 = 9ms$$

Unchanged from previous therefor 9ms for this task

Task C:

$$10 + \left\lceil \frac{0}{10} \right\rceil 4 + \left\lceil \frac{0}{20} \right\rceil 5 = 10 + 0 + 0 = 10ms$$

$$10 + \left\lceil \frac{10}{10} \right\rceil 4 + \left\lceil \frac{10}{20} \right\rceil 5 = 10 + 4 + 5 = 19\text{ms}$$

$$10 + \left\lceil \frac{19}{10} \right\rceil 4 + \left\lceil \frac{19}{20} \right\rceil 5 = 10 + 2*4 + 1*5 = 23\text{ms}$$

$$10 + \left\lceil \frac{23}{10} \right\rceil 4 + \left\lceil \frac{23}{20} \right\rceil 5 = 10 + 3*4 + 2*5 = 32\text{ms}$$

$$10 + \left\lceil \frac{32}{10} \right\rceil 4 + \left\lceil \frac{32}{20} \right\rceil 5 = 10 + 4*4 + 2*5 = 36\text{ms}$$

$$10 + \left\lceil \frac{36}{10} \right\rceil 4 + \left\lceil \frac{36}{20} \right\rceil 5 = 10 + 4*4 + 2*5 = 36\text{ms}$$

Unchanged from previous therefor 36ms for this task

iii.

Task	Deadline	Response Time	Over/Undershot amount
Task A	10ms	4ms	Undershot 6ms
Task B	20ms	9ms	Undershot 11ms
Task C	40ms	36ms	Undershot 4ms

All tasks beat their deadline time

iv.   priority