NATIONAL UNIVERSITY OF SINGAPORE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ONLINE EXAMINATION

Matriculation No.:	A0232935A
Module Code:	EE5903
Number of pages in this PDF file (including this cover page and Declaration Form): i.e. 2+no. of answer pages	7

INSTRUCTIONS TO CANDIDATES

1. Follow the instructions for online examination and invigilation.

2. Write your answers on A4 size paper with black or dark blue ink.

3. Write the question number at the top left corner of each page. Start the answer to each question on a new page. Indicate the part, e.g. "(a)", on the left margin.

4. At the end of the exam:
   a) scan or take photographs of your answers (make sure your writing and/or drawings can be seen clearly);
   b) enter your matriculation number, module code and the total number of pages (including the cover and declaration pages, i.e. 2+number of answer pages) on the cover page;
   c) merge the completed cover page, signed declaration form and your answers into a single PDF file named **<matric_no>-<module code>.pdf** (e.g. **A1234567R-EExxxx.pdf**)
   d) open the PDF file to ensure that it has been generated without error and the contents are correct;
   e) upload your PDF file into the stated LumiNUS exam submission folder within the stipulated deadline. Late submissions will not be accepted.

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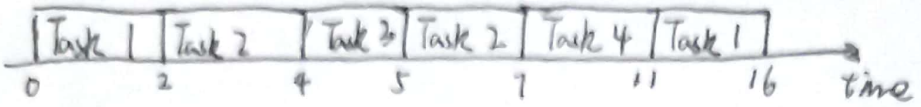
Question	Mark	Remarks
TOTAL		

Q1.

(i) $M = LLM(P_i) = LLM(20, 100, 250) = 500$

(ii)



sequence: Task 3, Task 2, Task 4, Task 1.

(iii) Task 3: waitting time: 0

Task 2: waitting time: 1

(iv) parallel: ~~$R(t) = R^{-\lambda t} = e^{-0.8t}$~~

overall: $R(t) = 1 - [(1-0.8)\cdot(1-0.8)\cdot(1-0.8)] = 0.992$

Assume there are n devices, each realibility is: $r'(t) = 0.8^3$

~~$R'(t) = 0.8^3$~~ $R'(t) = 1 - (1 - r'(t))^n \geq R(t)$

$\Rightarrow n \geq 6.73.$

So, at least 7 devices

(v)

Task ID.	response time	waitting time
1	3	0
2	5	2
3	6	3
4	7	4
5	8	5

~~ave (w) = $\frac{3+6+9+12+15}{5} = 9$~~ average waitting time $= \frac{0+2+3+4+5}{5} = 2.8$

Q. 1

(vi) 3 tasks, LL bound: $3 \times (2^{\frac{1}{3}} - 1) = 0.7798$

$\sum_{i=1}^{3} u_i = \frac{20}{100} + \frac{20}{150} + \frac{90}{200} = 0.85 > LL$ bound.

Not schedulable.

(vii) No, in some algorithm, thread cannot modify context directly.

~~Fe~~ For kernel. Yes.

(viii) ① Mutual exclusion ② Hold & wait ③ No preemption.

Banker's : Hold & wait.
there's no ~~chose~~ circular wait.

(ix) P(0) and P(1) may set "flag = True" at the same time,

the code will ~~stop~~ at "while(flag[1]);"
block

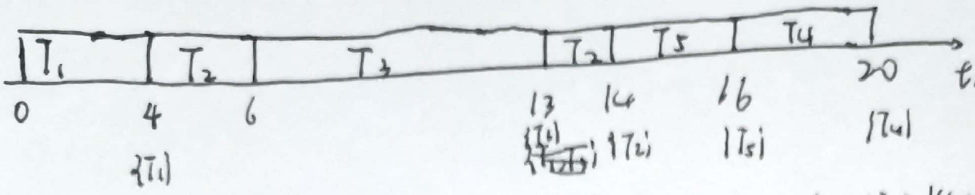
(x) It's an off-line algorithm

Braetley's algorithm.

Q.2

(i)

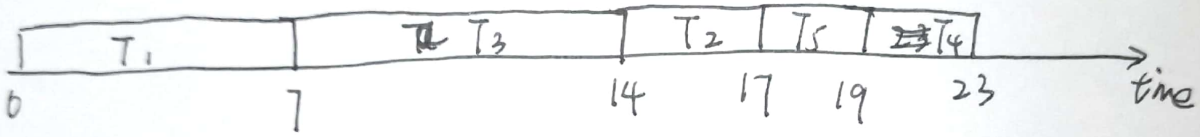
(a)



~~average waiting time = $\frac{\sum (\text{wait time})}{5} = \frac{4+13+14+16+20}{5} = 13.4$~~

average waiting time = $\frac{0+11+0+5+2}{5} = 3.6$s

(b)



average waiting time = $\frac{0+14+0+5+8}{5} = 5.4$s.

although we only add e_i from 4→7, the average waiting time is not increase $\frac{7-4}{5} = 0.6$s. rather than $5.4-3.6 = 1.8$s

(ii) EDF.

$T_i = LCM(P_i)$.

Q.3

(i) $T_1 = (10, 20)$, $T_2 = (20, 60)$, $T_3 = (30, 180)$

(execution time, periodic).

$$U = \sum_{i=1}^{3} \frac{e_i}{p_i} = \frac{10}{20} + \frac{20}{60} + \frac{30}{180} = 1.$$

(ii) Bound1: $\sum_{i=1}^{3} u_i = \frac{5}{10} + \frac{12}{60} + \frac{20}{100} = 0.9 < 1$ ✓

LL bound: $3 \times (2^{\frac{1}{3}} - 1) = 0.7798 > \sum_{i=1}^{3} u_i$ ×.

so RMA and DMA no feasible.

~~for DMA: we use $p_1 \leq d_1$.~~

(iii) select period of the T3..

assign $p_3 = 300$., the DMA is schedulable.

$$\sum_{i=1}^{3} u_i = \frac{5}{10} + \frac{12}{60} + \frac{20}{300} = 0.767 < 0.7798.$$

Q.5

(i) $\text{Success} = \Pr(5 \text{ success}) + \Pr(4 \text{ success}, 1 \text{ fail})$

~~$= \binom{5}{1} 0.995^5 (1-0.995)^{5-1} + t$~~

$= 0.995^5 + \binom{5}{4} \cdot 0.995^4 (1-0.995)$

$= 0.999975$

(ii) $\lambda = 0.002$

$f(t) = \lambda \cdot e^{-\lambda t}$.

~~$R(t) = 1 - F(t) =$~~

$R_1(t) = \int_t^\infty f(t) = e^{-\lambda t} = e^{-0.002t}$, because there are 2 CPUs.

$R(t) = 1 - (1-R_1(t)) \cdot (1-R_1(t)) = 2e^{-\lambda t} - e^{-2\lambda t}$

where $t = 200$, $\lambda = 0.002$ $\Rightarrow$ ~~$R(t) = 0.67$~~.

$R(t) = 0.8913$.

(iii) $R(t) = \int_t^\infty f(t) = \int_t^\infty 0.2 e^{-0.2t} = e^{-0.2t}$

$\lambda(t) = -\dfrac{dR(t)}{d(t)} \cdot \dfrac{1}{R(t)} = 0.2 e^{-0.2t} \cdot \dfrac{1}{e^{-0.2t}} = 0.2$

Exam Declaration Form

Please read sections A, B and C below. Sign and submit this declaration form together with your answers.

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3) Any student who is alleged to have committed or attempted to commit, or caused or attempted to cause any other person to commit any of the following offences, may be subject to disciplinary proceedings:
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Signature: 刘伟豪. Date: 27th Apr 2022

Matric. No.: A0232935J