Final exam Embedded Systems Integration 2 May 2020 (3 hours)

Please provide detailed solution as much as possible to receive full credit.

1. Write an ARM assembly code to compute integer divider / remainder. You have to provide quotient (R0) and integer remainder (R1) of the number R2 and R3. Mathematically, it is R2/R3. The output will be kept in R0 for the quotient and R1 for the integer remainder. You cannot use MUL (multiply), DIV (divide), REM (remainder) instruction. E.g., if R2= 5, R3= 3, the output will be R0 = 1 and R1 = 2. Please optimize your code to use as less number of instructions as possible. (20 points)

2. Optimize dynamic code size (the number of dynamic instruction) for the following ARM code as much as possible. (20 points)

MOV R10, #2000 MOV R0, #1 MOV R5, #0 MOV R6, #0 Loop: CMP R0, #1000 BGE END LDR R1, [R10,#0] ADD R10, R10, 4 ADD R5, R5, 1 MOV R2, #4 MOV R7, #10 MUL R3, R0, R2 ADD R3, R3, #4 LDR R4, [R10, R3] ADD R6, R6, R4 ADD R0, R0, #1 **B** Loop END: MOV R10, #2000 CMP R5, R7 BLT Loop END1: STR R5, [R10,#0] STR R6, [R10,#0]

3) a)

Given the two-integer variable a and b, write a Python program to find the greatest common divider (GCD) e.g, GCD of a=8 and b=12 is 4. (10 points)

b)

Assuming all task comes in the ascending order (T1 comes first and T8 comes last) before time 0. Please calculate the waiting time for FIFO scheduling, SJF scheduling, and round robin using time slice of 5 seconds (only for round robin). Note that for FIFO and SJF scheduling, once the task is scheduled, it has to be executed until completion. Please provide details calculation and justify which is the best methods (10 points)

Task	T1	T2	Т3	T4	Т5	T6	Τ7	T8
Run time	15	10	15	1	5	3	2	4

4) a) Assuming all task comes in the ascending order (T1 comes first and T8 comes last) before time 0. Please calculate the waiting time for Earliest Deadline First scheduling (no preemption). Please provide details calculation and justify which is the best methods (10 points)

Task	T1	T2	Т3	T4	Т5	T6	Τ7	Τ8
Run time	18	12	15	1	12	3	5	4
Deadline	30	15	50	31	70	60	55	35

b) Can this process be scheduled in 20 milliseconds (assume the unit in the graph is in 1 millisecond? Please provide detailed calculation to receive full credit (10 points)



Task	P1	P2	P3	P4	P5	P6
Deadline	4	5	8	11	16	20

5) You have been asked to design the prototype system of automatic face door control system in which you have to acquire face information gathered from a computer through RS232 communication. There are 5 people registered including "A001", "A002", "B001", "B002", "B003". If any of these 5 people come in you will open the door by sending "0" signal to turn off magnetic switch via GPIO Port 17 (BCM). Otherwise, the door should not be open by sending "1" signal constantly. Note that you don't have to do any face recognition system, just read information from RS232 communication (20 points)