Roll Num: Name:

CS3510: Operating Systems I
Finals: Autumn 2020

Instructions for submission:
1. You must submit your final answer copy as pdf.
2. You should avoid submitting scan copies of hand-written notes. Only if you wish to attach any figure, you can attach the scans of the figures in your pdf.
3. Please give justification for all your answers.

1. In a batch operating system, three jobs are submitted for execution. Each job involves an I/O activity, CPU time and another I/O activity of the same time span as the first. Job JOB1 requires a total of 23 ms, with 3 ms CPU time; JOB2 requires a total time of 29 ms with 5 ms CPU time; JOB3 requires a total time of 14 ms with 4 ms CPU time. Illustrate their execution and find CPU utilization for **uniprogramming** and **multiprogramming systems.** Here CPU utilization is defined as ratio Total execution time by CPU execution time. **[9 pts]**

2. Consider a computer system that contains an I/O module controlling a simple keyboard/printer called as Teletype. The following registers are contained in the CPU and connected directly to the system bus:
INPR: Input Register, 8 bits
OUTR: Output Register, 8 bits
FGI: Input Flag, 1 bit
FGO: Output Flag, 1 bit
IEN: Interrupt Enable, 1 bit

Keystroke input from the Teletype and output to the printer are controlled by the I/O module. The Teletype is able to encode an alphanumeric symbol to an 8-bit word and decode an 8-bit word into an alphanumeric symbol. The Input flag is set when an 8-bit word enters the input register from the Teletype. The Output flag is set when a word is printed.

(a) Describe how the CPU, using the first four registers listed in this problem (without using IEN), can achieve I/O with the Teletype. **[3 pts]**
(b) Describe how the function can be performed more efficiently by also employing IEN flag.
[3 pts]

3. Consider a hypothetical 64-bit microprocessor having 64-bit instructions composed of two fields. The first 4 bytes contain the opcode, and the remainder an immediate operand or an operand address. What is the maximum directly addressable memory capacity? **[3 pts]**

4. Figure 3.5 (page 113 of Galvin book) suggests that a process can only be in one event queue at a time.
(a) Is it possible that you would want to allow a process to wait on more than one event at the same time? Provide an example. **[4 pts]**
(b) In that case, how would you modify the queuing structure of the figure to support this new feature? **[3 pts]**

5. An application has 20% of code that is inherently serial. Theoretically, what will its maximum speedup be if it is run on a multicore system with (a) four processors and (b) Eight processors. **[4**

pts]

6. Name an application where thread pooling may be useful and the give the reason for it. **[4 pts]**

7. Is there any circumstance in which an algorithm that performs several independent calculations concurrently (e.g., matrix multiplication) be more efficient if it it did not use threads? **[4 pts]**

8. In this problem you are to compare reading a file using a single-threaded file server and a multi-threaded server. It takes 12 msec to get a request for work, dispatch it, and do the rest of the necessary processing, assuming that the data needed are in the block cache. If a disk operation is needed, as is the case one-third of the time, an additional 75 msec is required, during which time the thread sleeps. How many requests/sec can the server handle if it is (1) single threaded (2) multi-threaded? **[7 pts]**