CSSE 332 – Operating Systems
Rose-Hulman Institute of Technology
Computer Science and Software Engineering Department

Exam 1 – Paper Part

Name:______________________________________ Section:______ CM:_________

This exam consists of two parts. The first part is to be done on paper without using your computer. The second part of the exam is to be done on your computer. You have the full lab period (a total of three periods) to complete the entire exam.

Instructions: The paper part of the exam is closed book, open notes limited to one double-sided sheet of hand written notes, but **no computer or electronic devices**. Write all of your answers in the spaces provided.

When you complete the paper part of the exam, turn it in to an exam proctor. You may then begin using your computer. **Use of your computer before turning in the paper part of the exam will be considered academic dishonesty.**

To allow sufficient time to work on the computer part of the exam, we suggest using no more than 50 minutes for the paper part.

Please begin by putting your name on the first page and your initials on every page of the exam. We encourage you to skim the entire exam before answering any questions and show all your work to receive partial credit.

Problem	Points available	Your Points
1	10	
2	8	
3	10	
4	12	
C	60	
Total	100	

Problem 1 (10 points) Assume that a particular operating system uses the five-state process model discussed in class and consider the sequence of events given below. Note: processes aren't the only thing that can be running on the CPU.

Time t_0

i. Process P1 is created, admitted and dispatched.

ii. Process P2 is created and admitted.

iii. Process P3 is created and admitted.

iv. Process P4 is created and admitted.

v. Process P5 is created and admitted.

vi. The running process times out.

vii. The process at the head of the ready queue is dispatched.

viii. The running process issues a disk I/O request.

ix. The process at the head of the ready queue is dispatched.

x. The running process issues a network I/O request.

xi. The process at the head of the ready queue is dispatched.

Time t_1

xii. An interrupt is received and processed in response to completion of the disk I/O request.

xiii. The running process is terminated and released.

Time t_2

(a) (6 points) Draw a figure that depicts the state of each process in the system at time t_1.

(b) (2 points) What exactly is executing at time t_2? Hint: be thoughtful about your answer. Question 1c depends on this.

(c) (2 points) Which process is at the head of the ready queue at time t_2?

Problem 2 (8 points) Consider the following code.

```
#include <stdio.h>
#include<stdlib.h>

void f(int x, int d, int* q, int* r);

int main(int argc, char *argv[]){

  int a, b;
  int *e, *p;

  e = &b;
  p = &a;

  f(17, 5, p, e);

  printf(”The value of a after invoking f is %d.\n”, a);

  printf(”The value of b after invoking f is %d.\n”, b);

  return 0;
}

void f(int x, int d, int* q, int* r){

  *q = x / d;
  *r = x % d;

}
```

Draw the box and pointer diagram at the follow points:

(a) Just before line 11 executes.

(b) Just after line 12 executes.

(c) Just before line 25 executes.

(d) Just after line 26 executes.

Problem 3 (10 points)

Fill in the Gantt charts, using the given scheduling policy and the table below. If a new process is admitted at the same time that an existing process is preempted, the new process enters the ready queue first.

Note that all processes will not finish in the given slots! Just fill up the 13 slots provided and move to the next question.

Note: processes are always enqueued at the tail of the ready queue and dequeued from the head of the queue.

Process	Arrival Time	Service Time
A	0	2
B	1	5
C	2	1
D	4	7

	0	1	2	3	4	5	6	7	8	9	10	11	12
FCFS													
RR, q = 2													

Problem 4 (12 points)

(a) (3 points) Recall that the process control block is used to store key information about a process. List 5 items that are stored in the process control block.

(b) (3 points) Consider `fork()`, which two items in the process control block are shared between the parent and child processes?

(c) (3 points) Threads of the same process share everything they can. Which two items in the process control block are not shared between threads of the same process?

(d) (3 points) Recall the process image or memory layout discussed in class. Draw the process image. Be sure to include and show the location of *code*, *global variables*, *heap*, *stack* and *the operating system.*