Scan

000020

University of Colombo, Sri Lanka

University of Colombo School of Computing

Bachelor of Science in Computer Science

Academic Year 2016-2017 — Second Year Examination — Semester II

SCS2106 — Operating Systems I

(2 Hours)

Answer All Questions

Number of Pages = 12 Number of Questions = 4

To be completed by the candidate

Index Number | | | | | | | | |

Important Instructions

- The duration of the paper is **2** Hours.
- The medium of instructions and questions is English.
- This paper has **4** questions on **12** pages.
- Answer **all** the **4** questions.
- **Write your answers on and only on the space provided** on this question paper.
- Do not tear off any part of this answer book. Under no circumstances may this book (or any part of this book), used or unused, be removed from the Examination Hall by a candidate.
- Questions appear on both sides of the paper. If a page is not printed, please inform the supervisor immediately.
- Any electronic device capable of storing and retrieving text, including electronic dictionaries and mobile phones, are **not allowed**.
- Non-programmable Calculators may be used.

To be completed by the examiners

1	
2	
3	
4	
Total	

Index Number | | | | | | | | |

1. (a). Assume that a process transits between the following states: *new*, *ready*, *running*, *waiting* and *terminated*. A process goes through the following state transtions.

$$X \rightarrow Y \rightarrow Z \rightarrow X \rightarrow terminated$$

The states X, Y and Z are different states.

i. What is X?

[2 marks]

ii. What is Y?

[2 marks]

iii. What is Z?

[2 marks]

(b). A function with a single local variable (an integer) is called by the main program. Draw the stack frame depicting the return address and the memory reserved for the local variable.

[2 marks]

Index Number | | | | | | | | |

(c). i. How many X's are printed by the following program?

```
int main()
{
    fork();
    fork();
    fork();
    printf("X\n");
    return 0;
}
```

[4 marks]

ii. What is the output of the following program?

```
int main()
{
      int x;
      x=0;
      if (fork())
         x++;
      if(x==0) fork();
      printf("%d\n",x);
}
```

[5 marks]

Index Number | | | | | | | | |

(d). Consider the following *C* program.

```
int * f(int x)
{
  int p;
  p=x;
  return &p;
}


int * g(int x)
{
  int y;
  y=x;
  return &y;
}

int main()
{

  int *x,*y;
  x=f(1000);
  y=g(250);
  *x=*x+250;
  printf("%d\n", *y);
  return 0;
}
```

i. What is the output of the above program?

[4 marks]

ii. Assume that the line containing the `printf(.)` in `main()` is replaced by the following line.

```
printf("%d\n", (int)y-(int)x);
```

What is the output of the above program under this assumption?

[4 marks]

Index Number | | | | | | | | |

2. (a). The structure of the **Producer** process of the bounded-buffer problem is given below. Assume that the initial value of *empty* is 100.

```
while(TRUE){
 //Produce and item
 wait(empty);
 wait(mutex);
 // Insert item
 signal(mutex);
 signal(X);
}
```

The corresponding **Consumer** process is as follows.

```
while(TRUE){
  wait(full);
  Z;
  // Remove an item
  signal(mutex);
  Y;
}
```

i. What is the initial value of *full*?

[2 marks]

ii. Assume that intially there is only one producer and no consumers. How many items can this producer produce before being blocked waiting for a consumer?

[2 marks]

iii. What is X?

[3 marks]

iv. What is Y?

[3 marks]

v. What is *Z*?

[3 marks]

(b). The **reader** process of the readers-writers problem is given bellow.

```
while(TRUE){
  wait(mutex);
  rc=rc+1;
  if (rc==1)
            wait(wrt);
  signal(mutex);

  //reading is performed

  wait(mutex);
  rc=rc-1;
  if (rc==0)
            signal(wrt);
  P;
  // other work
}
```

The corresponding **writer** process is as follows.

```
while(TRUE){
  //Generate data
  wait(wrt);
  //writing is performed
  Q;
  // other work
}
```

i. What is *P*?

[2 marks]

ii. What is *Q*?

[2 marks]

iii. What is the initial value of rc?

[2 marks]

iv. How many readers can concurrently perform the read operation?

[3 marks]

v. Assume that one writer is performing the writing operation. How many other writers can perform the same operation?

[3 marks]

Index Number | | | | | | | | |

3. (a). A system uses q bits addresses and the memory is byte addressable. The page size used in this system is 2^p bytes and the system uses a single level page table.

i. What is the frame size suitable for this system?

[2 marks]

ii. What is the size of the virtual address space?

[2 marks]

iii. How many pages are there in the virtual address space?

[2 marks]

iv. How many entries should be in the page table?

[2 marks]

v. What is the minimum amount of space required for the page table?

[4 marks]

vi. Assuming C language semantics of the operators / and % when applied to integer operands, write down an expression for the page number that contains the logical address x.

[4 marks]

Index Number | | | | | | | | |

vii. A variable is stored at the offset m in the page l of the logical address space in this system. What is the logical address of that variable?

[4 marks]

(b). Which type of fragmentation problem is solved by paging?

[3 marks]

(c). Name two types of page tables that are suitable for a system with a 64 bit address space.

[2 marks]

Index Number | | | | | | | | |

4. (a). i. Name the four conditions that should hold for a deadlock to occur?

[4 marks]

ii. What is the solution used by modern operating systems (ie: Linux, Mac OS , Windows) to prevent deadlocks?

[2 marks]

(b). Consider a block device which is suggested to be used to store daily backups of other computer hard disks.

i. What is the most suitable block allocation technique for this storage device?

[2 marks]

ii. Give one reason for your choice?

[2 marks]

Index Number | | | | | | | | |

iii. FAT file system is not suitable for a hard disk drive with a capacity of several tera bytes. What is the reason for this?

[4 marks]

(c). Answer the following questions regarding an i-node based file system which contains the file given below.

`/home/ucsc/exam-branch/OS1-results.xls`

i. A process is going to open the file using the absolute path. How many i-nodes does the file system abstraction has to traverse in order to get the second data block of this file?

[2 marks]

Index Number | | | | | | | | |

ii. The process now deletes the above mentioned file. Write down the three actions that should be performed to achieve the delete operation at the i-nodes level.

[6 marks]

iii. A power failure of the hard disk while deleting the above file may put the file system into an inconsistent state. What is the solution used by some file systems (eg: NTFS, ext3, ext4) to overcome from such inconsistencies?

[3 marks]

****