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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: ECX5235/EEX5535 Operating Systems**
Academic Year	: 2017/18
Date	: 30th January 2019
Time	: 1330-1630hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Six (6)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Relevant charts/ codes are provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Question 1 [20 Marks]

Suppose you have been asked to design an Operating System for a personal computer.

i. List and briefly explain the following;

   a) Four (4) factors to consider in Operating System design.

   [04 Marks]

   b) Four (4) basic functions of an Operating System.

   [02 Marks]

ii. State two possible techniques that you can use to request kernel services from a program executing in user mode. Illustrate the operation of each technique.

   [10 Marks]

iii. Discuss how to decide a kernel architecture for an operating system between monolithic and microkernel by considering the following mechanisms to implement.

   a) Inter process communication
   b) I/O communication

   [04 Marks]

Question 2 [20 Marks]

i. Briefly state how a multiprocessor system achieves the following over a single processor system.

   a) Increasing throughput
   b) Increasing reliability
   c) Reducing cost

   [06 Marks]

ii. Let's consider a scenario where multithreading is applied in a web server. Whenever the server receives a request it creates a separate thread to service the request. Server allows all concurrent requests to be serviced in a new thread.

   a) State two (2) possible issues in creating threads in such a system.

   [04 Marks]

   b) Suggest a solution to rectify these issues and state how these issues are rectified.

   [04 Marks]

iii. Consider a multicore system and a multithreaded program written using the many-to-many threading model. Let the number of user-level threads in the program be greater than the number of processing cores in the system. Discuss the performance implications of the following scenarios.

   a) The number of kernel threads allocated to the program is less than the number of processing cores.
   b) The number of kernel threads allocated to the program is equal to the number of processing cores.
   c) The number of kernel threads allocated to the program is greater than the number of processing cores but less than the number of user-level threads.

   [06 Marks]

Question 3 [20 Marks]

i. Let's consider a system with 100 bytes page size. Job 1 is 350 bytes and is being readied for execution. The pages of this job are stored in noncontiguous locations.

   i. State an advantage of allowing the pages to store in noncontiguous locations in this system.

   [03 Marks]

   ii. State if there is internal and/or external fragmentation in this system. Calculate the fragmentation.

   [03 Marks]

ii. State the effect of having the following page sizes in paging scheme.

   i. Page size that is too small

   [03 Marks]

   ii. Page size that is too large

   [03 Marks]

iii. Briefly explain how the page size is determined in paging scheme and state why.

[05 Marks]

iv. Compare virtual memory with paging and segmentation. State at least three (3) points.

[03 Marks]

Question 4 [20 Marks]

i. Discuss one scenario each for where it is appropriate to draw resource allocation graphs and to use banker's algorithm.

[04 Marks]

ii. State how to determine if there is a deadlock in resource allocation graph.

[04 Marks]

iii. Refer the given *Allocation, Max* and *Available matrices* and answer the following questions using the banker's algorithm.

	Allocation	*Max*	*Available*
	A B C D	*A B C D*	*A B C D*
P_0	2 0 0 1	4 2 1 2	3 3 2 1
P_1	3 1 2 1	5 2 5 2	
P_2	2 1 0 3	2 3 1 6	
P_3	1 3 1 2	1 4 2 4	
P_4	1 4 3 2	3 6 6 5	

iv. Illustrate that the system is in a safe state by demonstrating an order in which the processes may complete. Show the steps. Write the safety sequence.

[08 Marks]

v. If a request from process P1 arrives for (1, 1, 0, 1), can the request be granted immediately? Justify your answer.

[04 Marks]

Question 5 [20 Marks]

Consider the following set of processes, with the arrival time and the length of the CPU burst time given in seconds.

Process	Arrival Time (hh:mm:ss)	CPU Burst Time (s)
P_0	00:00:00	1
P_1	00:00:00	2
P_2	00:00:01	1
P_3	00:00:02	3
P_4	00:00:10	2
P_5	00:00:11	4
P_6	00:00:13	5

i. Draw four (4) Gantt charts that illustrate the execution of these processes using First Come First Served(FCFS), Shortest Job First(SJF), Shortest Remaining Time First(SRTF) and Round Robin(RR) algorithms. Choose proper quantum size for RR scheduling and clearly state the reasons to select the quantum size. State assumptions clearly if any.

[10 Marks]

ii. At each scheduling method calculate;
   a) the average turnaround time
   b) the average waiting time
   c) throughput

[06 Marks]

iii. "In non-preemptive scheduling the scheduling decisions are taken place only when the processes switch from running to waiting state and when the processes get terminated". Do you agree with this statement? Justify your answer.

[04 Marks]

Question 6 [20 Marks] File Management

i. Illustrate the following using suitable diagrams.
   a) Network Attached Storage(NAS)
   b) Storage Area Network(SAN)

[08 Marks]

ii. Consider a disk queue with requests for I/O to blocks on cylinders in the order of 98, 183, 37, 122, 14, 124, 65, 67. If the disk head is initially at cylinder 53, draw a diagram to illustrate the head movements to cylinders if the following disk scheduling algorithms were used.
   a) First Come First Served(FCFS)
   b) Shortest Seek Time First(SSTF)
   c) SCAN/Elevator

[12 Marks]

Question 7 [20 Marks] Protection and Security

i. Briefly explain the following methods attempted by attackers to breach security.

a) Masquerading
b) Man-in-the-middle
c) Session hijacking
d) Replay attack

[12 Marks]

ii. Medium size office network is shown in figure 1 below. The network consists of a central office with several LAN segments, a branch office with a single LAN segment and a dedicated link connectivity from the central office to an ISP.

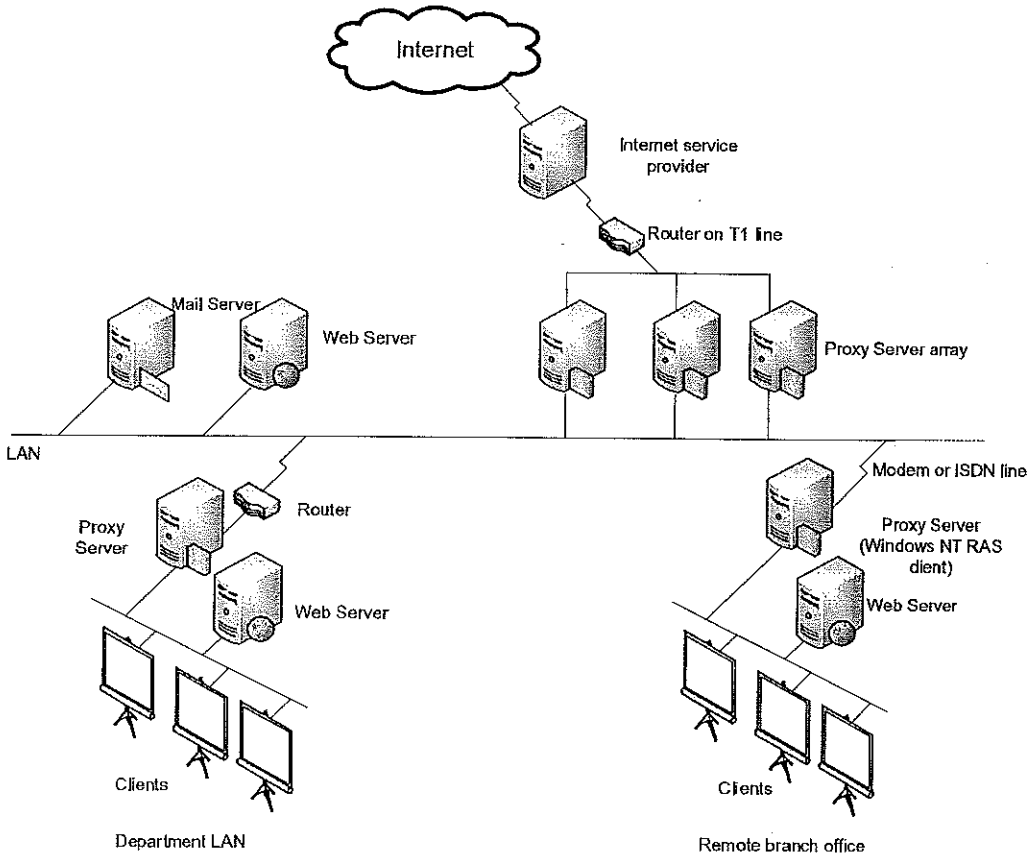

Figure 1 : Office network

Briefly explain one (1) security measure that can be taken under the following four (4) levels in the office.

a) Physical
b) Human
c) Operating System
d) Network

[08 Marks]

Question 8 [20 Marks] Types of OS

i. Fill in the blanks in the given sentences using suitable word/s.
(Write the answer in the given answer book with the question numbers.)

a) When a job requests a printer to output a line, that line is copied into a system buffer and is written to the disk. When the job is completed, the output is printed. This form of processing is called _____.

b) If CPU utilization is too low, the operating system increases _____ _____by introducing a new process to the system.

c) _____ is a condition in which no work is getting done in the system, because the processes are spending all their time paging.

d) After setting up buffers, pointers, and counters for the I/O device, the device controller transfers an entire block of data directly to or from its own buffer storage to memory, with no intervention by the CPU in _____.

e) A _____, *S* is an integer variable that, apart from initialization, is accessed only through two standard atomic operations: wait () and signal ().

[10 Marks]

ii. Briefly explain the operation of the C statements given in the following lines;
   a) line 1
   b) line 8
   c) line 13
   d) line 14
   e) line 18

```
1  #include <sys/types.h>
2  #include <stdio.h>
3  #include <unistd.h>
4  int main()
5  {
6  pid_t pid;
7
8  pid = fork();
9  if (pid < 0) {
10 fprintf(stderr, "Fork Failed");
11 return 1;
12 }
13 else if (pid == 0) {
14 execlp("/bin/ls","ls",NULL);
15 }
16 else {
17
18 wait(NULL);
19 printf("Child Complete");
20 }
21 return 0;
22 }
```

[10 Marks]