

CAMPBELL UNIVERSITY

NORTH CAROLINA, U. S. A.

ACADEMIC YEAR 2015/2016

AUGUST/SEPTEMBER EXAMINATION

COMPUTER SCIENCE BACS2093(B)
OPERATING SYSTEMS

WEDNESDAY, 2 SEPTEMBER 2015

TIME: 2.00 PM – 4.00 PM (2 HOURS)

BACHELOR OF SCIENCE DEGREE

Instructions to Candidates:

Answer ALL questions. All questions carry equal marks.

BACS2093(B) OPERATING SYSTEMS

- Q1. (a) Identify the level (short-term, medium-term, long-term) of scheduler that would make a decision on each of the following situation. Justify your answer.
- (i) Which temporarily suspended process should be activated in order to balance the process mix? (2 marks)
 - (ii) Which ready process should be assigned the CPU when it next becomes available? (2 marks)
 - (iii) Which of a series of waiting batch jobs that have been spooled to disk should next be initiated? (2 marks)
- (b) Discuss why Round-Robin scheduling algorithm is the most suitable for time-sharing systems. (5 marks)
- (c) Non-preemptive scheduling policy functions without external interrupts.
- (i) Explain how the above scheduling policy differs from preemptive scheduling policy. (3 marks)
 - (ii) Analyze the disadvantages of non-preemptive scheduling policy. (3 marks)
- (d) A real-time system has 2 processes, P and Q with 4 and 3 instances respectively. The table below shows the arrival time, execution time and deadline for each instance of the 2 processes. The period for P and Q are 20 and 32 respectively.

Process	Arrival Time (ms)	Execution Time (ms)	Deadline (ms)
P ₁	0	10	20
P ₂	20	10	40
P ₃	40	10	60
P ₄	60	10	80
Q ₁	0	14	32
Q ₂	32	14	64
Q ₃	64	14	96

Illustrate the execution of the processes with Gantt chart based on the following real-time scheduling algorithms:-

- (i) Earliest-Deadline First (EDF) (4 marks)
- (ii) Rate-Monotonic (RM), assuming that the execution time for each instance of process P has changed to 8 milliseconds (ms) and all other details remain the same. (4 marks)

[Total: 25 marks]

BACS2093(B) OPERATING SYSTEMS

Q2. (a) The dual-mode operation forms the basis for I/O protection, memory protection and CPU protection from errant users for the operating system. This can be accomplished by designating some of the machine instructions as privileged instructions.

- (i) Explain how dual-mode operation provides I/O protection, memory protection and CPU protection to ensure the proper execution of the operating system and hardware components, with the use of privileged instructions. (6 marks)
- (ii) Provide and elaborate two examples of privileged instruction for hardware protection. (6 marks)
- (iii) Explain the transition from user to kernel mode with the aid of a diagram. (6 marks)

(b) A system call occurs when a program requests a service from an operating system's kernel. This includes hardware-related services (for example, accessing a hard disk drive), creation and execution of new processes and communication with integral kernel services such as process scheduling. Discuss how multiple system calls are utilized when a program reads a file from a SD card and copies it to a hard drive.

(7 marks)

[Total: 25 marks]

Q3. (a) Suppose a system has 6 processes (Pa, Pb, P1, P2, P3, P4) running in a uniprocessor environment. Each process consists of code as shown in Figure 1. (Note: M and N are semaphore.)

Pa	Pb	P1	P2	P3	P4
M = 0; N = 0;	M = 0; N = 0;	int a;	int b;	int c;	int d;
wait(M); - access disk1 signal(M); wait(N); - access disk2 signal(N);	wait(M); - access disk1 signal(M); wait(N); - access disk2 signal(N);	a = R ₁ + 2; R ₁ = a;	b = R ₁ - 1; R ₁ = b;	c = R ₁ * 9; R ₁ = c;	d = R ₁ / 3; R ₁ = d;

Figure 1

- (i) Briefly explain what will happen to the above processes Pa and Pb. (2 marks)
- (ii) Make changes to the codes in Pa and Pb, so that mutual exclusive access to disk 1 and disk 2 is provided. (2 marks)
- (iii) Add the necessary semaphore operations wait() or signal() or both to synchronize the process P1, P2, P3 and P4, so that P2 will complete first, followed by P4, then P1 and lastly P3. (6 marks)

BACS2093(B) OPERATING SYSTEMS**Q3. (Continued)**

(b) Distinguish the following terms:-

(i) Circular wait and Busy wait (4 marks)

(ii) Safe state and Unsafe state (4 marks)

(c) An operating system contains 3 resource classes; the number of resource units in these classes is 7, 7 and 10 respectively. The current resource allocation state is as shown below:-

Processes	Allocated Resources			Maximum Requirements		
	R1	R2	R3	R1	R2	R3
P1	2	2	3	3	6	8
P2	2	0	3	4	3	3
P3	1	2	4	3	4	4

(i) Based on Banker's algorithm, what is the content of the matrix *Need*? (2 marks)

(ii) Is the system in a safe state? If yes, state the process sequence, otherwise identify the deadlocked processes. Justify your answer by showing the progress of resource availability. (5 marks)

[Total: 25 marks]

Q4. (a) Differentiate between the following terms: -

(i) Parity bit (2 marks)

(ii) Directional bit (2 marks)

(iii) Valid bit (2 marks)

(iv) Invalid bit (2 marks)

(b) Suppose a page size of 300 bytes is used in a demand paging system. A particular process has THREE page frames allocated to it and they are initially empty. Given the following sequence of virtual addresses:

208, 300, 190, 500, 480, 678, 1500, 908, 1200, 400, 206, 800, 300, 1202, 899

(i) Convert the above virtual addresses into a page reference string. (2 marks)

(ii) Prepare a page trace analysis indicating page faults and then compute the numbers of page faults by using Optimal page replacement algorithm. (3 marks)

(iii) State three factors determine the page-fault time. (3 marks)

BACS2093(B) OPERATING SYSTEMS**Q4. (Continued)**

- (c) Consider a demand-paging system where the degree of multiprogramming is currently fixed at four. The system was recently measured to determine utilization of the CPU and the paging disk.

The results are one of the following alternatives.

- CPU utilization 13 percent; disk utilization 97 percent
- CPU utilization 87 percent; disk utilization 3 percent
- CPU utilization 13 percent; disk utilization 3 percent

For each of the cases above, answer the following:-

- (i) Analyse whether thrashing occurs. (3 marks)
- (ii) Can the degree of multiprogramming be increased to increase the CPU utilization? (3 marks)
- (iii) Does paging help? (3 marks)

[Total: 25 marks]