BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science & Engineering
Student Group : 72 < Earned Credit Hour <= 108, Final Examination (Fall) : Dec 2020

Subject: CSE-307, Operating System

Total: 2.00 hours **Full Marks: 180**
Section A : 1.00 hour **Section A : 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 **(Compulsory)**

a. Why is an operating system needed in a computer? Explain how an operating system works as a resource manager. **4+4=8**

b. Microkernel and Monolithic kernel OS architectures are widely used for building operating systems. Describe the differences between them. Microsoft Windows falls under which OS architecture? Justify your answer. **4+5=9**

c. How do Desktop environment and Shell work with Kernel? In any OS is it possible to change the desktop environment, shell and kernel at your own choice? Explain your answer. **4+5=9**

d. In traditional x86 architectures, Virtual Machine [VM] OS Kernels expect to run in ring 0 privilege level, but in full virtualization, ring 0 is controlled by the host OS; and guest VMs are forced to execute at ring 1 or 3 privilege level. How was this drawback removed in next generations VMs? **10**

Question – 2

a. Suppose that you were designing an advanced computer architecture for a new OS, where multiple new processes were needed to create and terminate during any program execution. Describe with example the principle events those caused the new processes to be created and terminated. **10**

b. Using the process model, it becomes much easier to think about what is going on inside the system. Illustrate with diagram all the possible transitions between states of a process in a process model. **8**

c. While threads are often useful, they also introduce a number of complications into the programming model. Describe all the probable problems those you might encounter while making a multi-threaded program. **10**

d. 'Round-robin' scheduler normally maintains list of all runnable processes, with each process occurring exactly once in the list. What would happen if a process occurred twice in the list? Can you think of any reason for allowing this? **8**

Question – 3

a. Derive a formula which will give optimal page size and with the help of that formula, calculate optimal page size for a 300KB process, where 8 bytes is required for each page entry. **8**

b. A computer has four page frames. The time of Loading, time of last access and the 'R' and 'M' bits of each page are as shown below **8**

(the times are in clock ticks):

Page	Loaded	Last ref	R	M
0	126	280	1	0
1	110	285	0	1
2	140	270	0	0
3	230	265	1	1

i. Which page will NRU replace?
ii. Which page will FIFO replace?
iii. Which page will LRU replace?
iv. Which page will second chance replace?

c. Write down the differences between unconditional security and computational security. Is it possible to build a secure computer system? If so why is it not done?

d. Why are rootkits extremely difficult or almost impossible to detect as opposed to viruses and worms?

Question – 4 Viva Voce (Compulsory)

...cience and Technology

B.Sc. in Computer Science & Engineering

Student Group : 72 < Earned Credit Hour <= 108, Final Examination (Fall) : Dec 2020

Subject: CSE-307, Operating System

Total: 2.00 hours **Full Marks: 180**
Section B : 1.00 hour **Section B : 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. One way to prevent deadlocks is to eliminate the hold and wait condition. In the text it was proposed that before asking for a new resource, a process must first release whatever resources it already holds (assuming that is possible). However, doing so introduces the danger that it may get the new resource but lose some of the existing ones to competing processes. Propose an improvement to this scheme. **06**

b. Considering the following example of a system, If P, request (1,0,2) determine if it can be granted immediately? **15**

*** Value of X = last digit of your roll number
Value of Y = (4th digit of your roll number % 2)
[Hints if roll is 201814052 then, X = 2 and Y will be (4th digit: 8) % 2 = 0]

Process	Allocation	Maximum	Available (work)
	ABC	ABC	ABC
P0	010	753	332
P1	200	322	
P2	3Y2	902	
P3	211	22X	
P4	002	433	

c. Using a resource graph determine whether the following state is dead locked or not: **15**

** A system with eleven processes (A through K)
** Nine resources (R through Z)

1. Process C holds R and wants S.
2. Process B holds nothing but wants T.
3. Process C holds nothing but wants S.
4. Process D holds U and S wants T.
5. Process E holds T and wants V.
6. Process F holds W and wants S.
7. Process G holds V and wants U and W.

** If last digit of your roll number is odd, then proceed this 8,9 & 10 and skip 11, 12 & 13.

8. Process H holds W and wants X.
9. Process J holds X and wants Y.
10. Process K holds Z and wants Y.

** If last digit of your roll number is even, then proceed this 11, 12 & 13 and skip 8, 9 & 10.

11. Process I holds W and wants X and Y.

12. Process J holds Z and wants nothing.
13. Process K holds Y and wants Z.

Question – 6

a. Suppose a disk having 200 cylinders numbered from 0 to 199. The disk head is currently at cylinder X. Queue is 34, 74, 122, 174, 9, 187.

Calculate total cylinder move for the following algorithms: [Answer 2 algorithms. If (X%2 = = 0) then answer a and c otherwise answer b and d.]

i. Shortest Seek Time First
ii. Elevator Algorithm (Go down first)
iii. C-Scan Scheduling Algorithm (Go down first)
iv. C-Look Scheduling Algorithm (Go up first)

*** X will be the last 2 digits of your roll number.

b. The idea of disk read is to read multiple tracks in one continuous operation without losing data. Suppose that a request needs 18 sectors starting at sector 0 on the innermost track. Reading continuously at the same rate, the first 16 sectors takes one disk rotation. A controller with a one-sector buffer will be given a command to read three consecutive sectors. What problems the system will be faced and explain how to solve them.

c. On stable storage, it was shown that the disk can be recovered to a consistent state (a write either completes or does not take place at all) if a CPU crash occurs during a write. Does this property hold if the CPU crashes again during a recovery procedure? Explain your answer.

Question – 7

a. Jon's night job at university computing center is to modify some important files along with his thesis paper and lastly change the tapes used for overnight data backups. Backuping take almost 12 hours which makes him sleepy so he decided to parallely modify his thesis work during backup. Is there a problem with this arrangement? Justify your answer.

b. Show step by step implementation of logical dump algorithm for the following graph.

*** Now update the following graph using the following rules,

*** If last digit of roll number is even then, directory 20, 22 & 29 will be marked and file 31 will be marked.

*** If last digit of roll number is odd then, directory 5, 19 & 30 will be marked and file 12 & 25 will be marked.

i. Draw the updated graph.
ii. After drawing updated graph, show step by step work flow of logical dump algorithm.

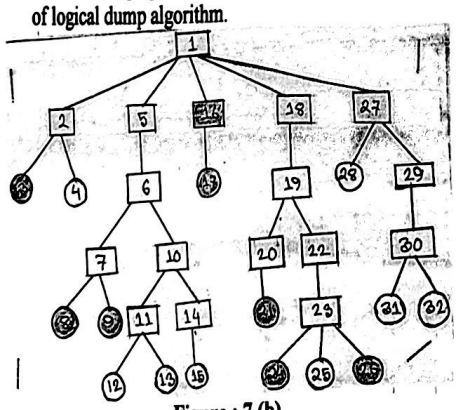

Figure : 7 (b)

c. Two computer science students, A and B are having a discussion about i-nodes. A maintains that memories have gotten so large and so cheap that when a file is opened, it is simpler and faster just to

fetch a new copy of the i-node into the i-node table, rather than search the entire table to see if it is already there. B disagrees. Who is right? Justify your answer.

Question – 8 **Viva Voce (Compulsory)** **18**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Supplementary Examination: July 2019 [Improvement]

Subject: CSE -307: Operating Systems

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. While threads are often useful, they also introduce a number of complications into the programming model. Describe all the probable problems you might encounter while making multi-threaded program. **10**

b. 'Instead of layers, MULTICS OS structure was described as having a series of concentric rings, with the inner ones being more privileged than the other ones'. Describe how the complexity was managed in MULTICS when a procedure in an outer ring wanted to call a procedure in an inner ring. **10**

c. Round-robin scheduler normally maintains a list of all runnable processes, with each process occurring exactly once in the list. What would happen if a process occurred twice in the list? Can you think of any reason for allowing this? **05**

d. Explain mutual exclusion using critical region with examples. **10**

Question – 2

a. Suppose that two processes A and B share a page that is not in memory. If process A faults on the shared page, the page table entry for process A must be updated once the page is read into memory. **07**
   (i) Under what condition should the page table update for process B be delayed even though the handling of process A's page fault will bring the shared page into memory? Explain.
   (ii) What is the potential cost of delaying the page table update?

b. Design a multi-threaded web server which will be able to maintain a collection of heavily used pages in main memory. **06**

c. Two computer students Sadia and Yousuf are having a discussion about i-nodes. Sadia maintains that memories have gotten so large and so cheap that when a file is opened, it is simpler and faster to fetch a new copy of i-node into the i-node table, rather than search the entire table to see if it is already there. Yousuf disagrees. Who is right? **10**

d. Write and explain the Shoshani and Coffman algorithm with example. **12**

Question – 3

a. Derive a formula which will give optimal page size for a 300 KB process (average size) where each page entry requires 8 bytes.

b. A computer has four page frames. The time for last access, and R and M bits for each pages are shown below (the time are in clock ticks):

Page	Loaded	last ref	R	M
0	126	280	1	0
1	110	285	0	1
2	140	270	0	0
3	230	265	1	1

(1) Which page will NRU replace?
(2) Which page will FIFO replace?
(3) Which page will LRU replace?
(4) Which page will second chance replace?

c. Describe the scheduling technique of user level and kernel level threads, while several processes (each has multiple threads) have process and thread level of parallelism.

d. On all current computers, at least part of the interrupt handlers are written in assembly language. Why?

Question – 4

a. 'Reliability is an issue in file system consistency' – Explain the statement.

b. "Abstraction is the key to managing all complexity in OS. Good abstraction turns a nearly impossible task into two manageable ones". Describe with examples these two approaches of operating system to manage the complexity.

c. 'Operating system makes sure that users do not exceed their quotas' – describe typical mechanism of disk quota.

d. Draw the structure of a page table entry and describe all its fields.

SECTION-B

Question – 5

a. Write the advantages and disadvantages of hard links over symbolic links. **08**

b. Consider a swapping system in which memory consists of the following hole sizes in memory in this order: 10 KB, 4 KB, 20 KB, 18 KB, 7 KB, 9 KB, 12 KB. Which hole is taken for successive segment requests of 12 KB, 10 KB, 9 KB for **08**

(1) First fit?
(2) Best fit?
(3) Worst fit?
(4) Next fit?

c. Why is it advantageous for the users for an operating system to dynamically allocate its internal tables? What are the penalties to the operating system for doing so? **07**

d. The codes of a thread may have local variables, global variables and parameters. Local variables and parameters do not cause any trouble, but variables that are global to a thread but not global to the entire program are a problem. How are you going to access those variables which are global to threads but not global to the entire program? **12**

Question –6

a. Contiguous allocation of files leads to disk fragmentation, because some space in the last disk block will be wasted in files whose length is not an integral number of blocks. Is this internal fragmentation or external fragmentation? Make an analogy with an example of each fragmentation type. **10**

b. How does DMA work? Explain DMA configuration with examples of each. When does DMA fetch/steal Data Bus from CPU? **15**

c. A machine is encrypting a plaintext using playfair Cipher algorithm, where the keyword is 'Operating'. What will be the cipher text of the plain text is "Today is Operating system exam"? **10**

Question –7

a. 'An unsafe state is not a deadlock state' – explain this statement using the following table: **07**

Process	Has	Max
A	4	9
B	2	4
C	2	7
Free: 2		

b. What is starvation? Explain starvation with respect to 'Dining Philosophers Problem'. **08**

c. Explain the difference between programmed I/O and Interrupt Driven I/O. **05**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. inComputer Science and Engineering
Supplementary Examination: July 2019

Subject:CSE-307, Operating System

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
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SECTION-A

Question – 1

a. While threads are often useful, they also introduce a number of complications into the programming model. Describe all the probable problems you might encounter while making multi-threaded program. **10**

b. 'Instead of layers, MULTICS OS structure was described as having a series of concentric rings, with the inner ones being more privileged than the other ones'. Describe how the complexity was managed in MULTICS when a procedure in an outer ring wanted to call a procedure in an inner ring. **10**

c. Round-robin scheduler normally maintains a list of all runnable processes, with each process occurring exactly once in the list. What would happen if a process occurred twice in the list? Can you think of any reason for allowing this? **05**

d. Explain mutual exclusion using critical region with examples. **10**

Question – 2

a. Suppose that two processes A and B share a page that is not in memory. If process A faults on the shared page, the page table entry for process A must be updated once the page is read into memory. **07**
   (i) Under what condition should the page table update for process B be delayed even though the handling of process A's page fault will bring the shared page into memory? Explain.
   (ii) What is the potential cost of delaying the page table update?

b. Design a multi-threaded web server which will be able to maintain a collection of heavily used pages in main memory. **06**

c. Two computer students Sadia and Yousuf are having a discussion about i-nodes. Sadia maintains that memories have gotten so large and so cheap that when a file is opened, it is simpler and faster to fetch a new copy of i-node into the i-node table, rather than search the entire table to see if it is already there. Yousuf disagrees. Who is right? **10**

d. Write and explain the Shoshani and Coffman algorithm with example. **12**

Question – 3

a. Derive a formula which will give optimal page size for a 300 KB process (average size) where each page entry requires 8 bytes.

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c. Describe the scheduling technique of user level and kernel level threads, while several processes (each has multiple threads) have process and thread level of parallelism.

d. On all current computers, at least part of the interrupt handlers are written in assembly language. Why?

Question – 4

a. 'Reliability is an issue in file system consistency' – Explain the statement.

b. "Abstraction is the key to managing all complexity in OS. Good abstraction turns a nearly impossible task into two manageable ones". Describe with examples these two approaches of operating system to manage the complexity.

c. 'Operating system makes sure that users do not exceed their quotas' – describe typical mechanism of disk quota.

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SECTION-B

Question – 5

a. Write the advantages and disadvantages of hard links over symbolic links. 08

b. Consider a swapping system in which memory consists of the following hole sizes in memory in this order: 10 KB, 4 KB, 20 KB, 18 KB, 7 KB, 9 KB, 12 KB. Which hole is taken for successive segment requests of 12 KB, 10 KB, 9 KB for 08

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(3) Worst fit?
(4) Next fit?

c. Why is it advantageous for the users for an operating system to dynamically allocate its internal tables? What are the penalties to the operating system for doing so? 07

d. The codes of a thread may have local variables, global variables and parameters. Local variables and parameters do not cause any trouble, but variables that are global to a thread but not global to the entire program are a problem. How are you going to access those variables which are global to threads but not global to the entire program? 12

Question –6

a. Contiguous allocation of files leads to disk fragmentation, because some space in the last disk block will be wasted in files whose length is not an integral number of blocks. Is this internal fragmentation or external fragmentation? Make an analogy with an example of each fragmentation type. 10

b. How does DMA work? Explain DMA configuration with examples of each. When does DMA fetch/steal Data Bus from CPU? 15

c. A machine is encrypting a plaintext using playfair Cipher algorithm, where the keyword is 'Operating'. What will be the cipher text of the plain text is "Today is Operating system exam"? 10

Question –7

a. 'An unsafe state is not a deadlock state' – explain this statement using the following table: 07

Process	Has	Max
A	4	9
B	2	4
C	2	7
Free: 2		

b. What is starvation? Explain starvation with respect to 'Dining Philosophers Problem'. 08

c. Explain the difference between programmed I/O and Interrupt Driven I/O. 05

d. Explain the following:
   (1) FAT
   (2) NTFS
   (3) exFAT
   (4) ext3 and ext4
   (5) VM

e. Round – robin scheduler normally maintains a list of all runnable processes, with each process occurring exactly once in the list. What would happen if a process occurred twice in the list? Can you think of any reason for allowing this?

Question–8

a. Consider a system with three resource types and the vector available initialized to (4, 2, 2). If process P0 asks for (2, 2, 1), it gets them. Then, if P0 asks for (0, 0, 1), it is blocked (resource not available). If P2 now asks for (2, 0, 0), it gets the available one (1, 0, 0) and one that was allocated to P0 (since P0 is blocked). P0's allocation vector goes down to (1, 2, 1) and its need vector goes up to (1, 0, 1).
   (1) Can deadlock occur? If you answer 'yes', give an example. If you answer 'no', specify which necessary condition cannot occur.
   (2) Can indefinite blocking occur? Explain your answer.

b. A computer system has m resources of the same type and n processes share these resources. Prove or disprove the following statement of the system:-
"This system is deadlock free if sum of all maximum needs of processes is less than m+n"

c. Is it possible to build a secure computer system? If so, why is it not done?

d. Write down the differences between unconditional security and computational security.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination:Jan 2019

Subject: CSE-307 Operating System

Time: 3.00 hours **Full Marks:210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. "Abstraction is the key to managing all complexities in OS. Good abstraction turns a nearly impossible task into two manageable ones" - Describe with examples these two approaches of operating system to manage all complexities. **10**

b. To a programmer, a system call looks like any other call to a library procedure. Is it important that a programmer knows which library procedures result in system call? Under what circumstances and why? **5**

c. Explain how separation of policy and mechanism aids in building a microkernel-based operating system. **10**

d. "In monolithic operating system, it is possible to have some structure" – briefly explain the concept with figure. **10**

Question – 2

a. Using process model, it becomes much easier to think about what is going on inside the operating system. Illustrate with diagram all the possible transitions between states of a process in a "Process Model". **10**

b. Suppose that, you want to design an advanced computer architecture, where multiple new processes are needed to be created and terminated during any operation. Describe with examples the principle events those may cause the new process to be created and terminated. **10**

c. While threads are often useful, they also introduce a number of complications into the programming model. Describe all the probable problems those you might encounter while making a multithreaded program. **15**

Question – 3

a. Consider the following solution to the mutual exclusion problem involving two processes P_0 and P_1. Assume that the variable 'turn' is initialized to 0. **10**

For P_0:

```
/* Other codes */
while (turn != 0) {} //Do nothing and wait
critical_section();  //
turn = 0
/* Other codes */
```

For P_1:

```
/* Other codes */
while (turn != 1) {} //Do nothing and wait
critical_section();  //
turn = 1
/* Other codes */
```

Determine whether the above solution meets all the required conditions for correct mutual-exclusion or not. If not, give the probable solution.

b. "Round-robin scheduler" normally maintain a list of all runnable processes, with each process occurring exactly once in the list. What would happen if a process occurred twice in the list? Can you think of any reason for allowing this? 10

c. On all current computers, at least part of the interrupt handlers is written in assembly language. Why? 5

d. A real-time system needs to handle two voice calls that each run every 6 mSec and consume 1 mSec of CPU time per burst, plus one video at 25 frames/sec, with each frame requiring 20 mSec of CPU time. Is this system schedulable? Justify. 10

Question – 4

a. Derive a formula which will give optimal page size and with the help of that formula, calculate optimal page size for a 300KB process (average size) where each page entry requires 8 bytes. 10

b. A computer has 32KB physical memeory 4 KB page size and 16 bit virtual memory addresses. Describe with diagram, how the memory management unit (MMU) will map the virtual addresses on to the physical memory addresses. 10

c. Suppose that two processes A and B share a page that is not in memory. If process A faults on the shared page, the page table entry for process A must be updated once the page is read into memory. 7

(i) Under what conditions should the page table update for process B be delayed even though the handling of process A's page fault will bring the shared page into memory? Explain.

(ii) What is the potential cost of delaying the page table update?

d. A computer has four page frames. The time of loading, time of last access and the R and M bits of each page are as shown below. (The times are in clock ticks) 8

Page	Loaded	Last Ref	R	M
0	126	280	1	0
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3	230	265	1	1

1. Which page will NRU replace?
2. Which page will FIFO replace?
3. Which page will LRU replace?
4. Which page will second chance replace?

SECTION-B

Question – 5

a. Making a backup takes a long time and occupies a large amount of space. So, doing it efficiently and conveniently careful backup is important. Keeping this in mind, what are the issues you must consider before designing a file backup system? 10

b. Two Computer Science students Reza and Yousuf are having a discussion about i-nodes. Reza mentions that memories have gotten so large and so cheap that when a file is opened, it is simpler and faster to fetch a new copy of i-node into the i-node table, rather than 10

search the entire table to see if it is already there. Yousuf disagrees. Who is right? Justify your answer.

c. The Linux Kernel does not allow paging out of Kernel memory. What effect does this restriction have on the Kernel design? What are the advantages and disadvantages of this design decision? **15**

Question –6

a. Can a system detect that some of its processes are starving? If your answer is "Yes", explain how it can. If your answer is "no", explain how the system can deal with the starvation problem? **10**

b. A computer has m resources of the same types and n processes share these resources. Prove or disprove the following statement of the system: **10**

"This system is deadlock free if the sum of all maximum needs of process is less than m+n"

c. Explain if the system in the figure below is deadlocked or not. If deadlock, give an execution order of the processes which successfully terminates of all the processes. **15**

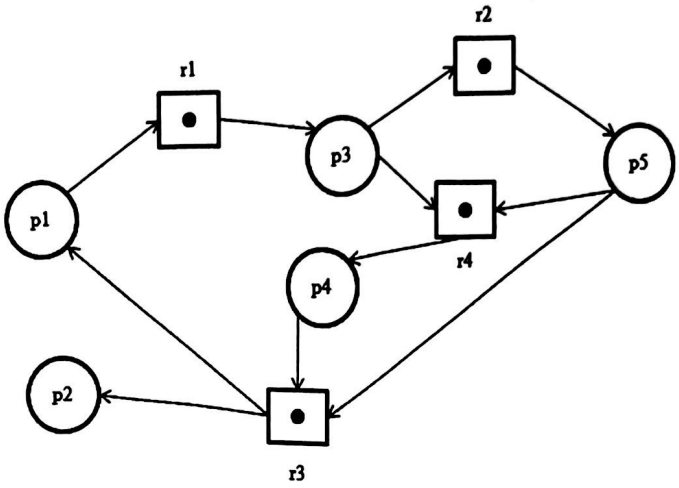

Figure 6c

Question –7

a. How does DMA work? Explain DMA configurations with example of each. When does DMA fetches/steals a cycle of Data Bus from CPU? **15**

b. Disk requests come in to the disk driver for cylinders 10, 22, 20, 2, 40, 6 and 38 in that order. A seek takes 6 mSec per Cylinder moved. How much seek time is needed for **10**

(i) First come first served
(ii) Closest cylinder next
(iii)Elevator algorithm (initially moving upward)

In all cases, the arm is initially at cylinder 20.

c. While running a system, a disk can be recovered to a consistent state (a write either completes or does not take place at all) if a CPU crash occurs during a write. Does this property hold if the CPU crashes again during a recovery procedure? Explain your answer. **10**

Question–8

a. "A central role of operating system is protection – the isolation of potentially misbehaving applications and users, so that they do not corrupt other applications or the operating system itself." Protection is essential to achieve the following goals of operating system: **10**

(1) Reliability
(2) Security
(3) Privacy

(4) Fairness

Identify and describe how these goals operating systems can be achieved for the following task:

(1) An operating system must operate correctly regardless of what an application or user might do.

(2) A smart-phone operating system must ensure, a third party app must not access users contact list without the users consent.

b. Why are rootkits extremely difficult or almost impossible to detect as opposed to viruses and worms? **10**

c. Name a few characteristics that a good biometric indicator must have for it, to be useful as a login authenticator. **5**

d. Explain with diagram how "jailing" works for a reliable software for keeping out of malware. **10**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering, Term Final (Fall) Examination 2021: Jan-Feb 2022

Student Group: 72 < Earned Credit Hours ≤ 108

Subject: CSE–307, Operating System

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Find the output for the following code snippet. Also, draw the process tree diagram for the same. **15**

```
int main(){
  for (int i = 0; i <2; i+=2){
        int var = fork();
        if (var!=0) {
              var = fork();
              printf ("%d ", i);
              i--;
        }
        else i++;
        printf ("\n ");
  }
  printf ("\nExiting..");
  return 0;
}
```

b. The memory holds several processes and holds in the manner as depicted in the following table: **9**

Process A	Hole 1	Process B	Process C	Hole 2	Process D	Hole 3
16 units	22 units	64 units	48 units	36 units	16 units	15 units

Now, solve for allocating memory for Process E (6 units), Process F (8 units), and Process G (20 units) sequentially using:
(i) First Fit
(ii) Best Fit
(iii) Worst Fit

c. A virtual memory is addressed using 24 bits and the corresponding physical memory is 2 MB. The virtual memory stores 1024 pages. Calculate the following: **6**
(i) Identify the size of each page frame.
(ii) Calculate the number of page frames in the physical memory.
(iii) Find the number of required bits to refer to the physical page frames and the virtual pages.

Question 2

a. Assume, there are currently four pages – A, B, C & D, in the physical memory; each having a 6-bit counter which is initialized to a binary number that contains alternating 0's and 1's, starting with a zero (0) at MSB. The reference history of these pages in the last 4 clock ticks can be found as follows:

Tick 1: A
Tick 2: A, B
Tick 3: A, C, D
Tick 4: B, C, A, D

In other words, the reference history of page A is 1,1,1,1. Now, if a new page E is required to be loaded by replacing one of these pages, how will "Aging" select it? Demonstrate all the necessary steps in your calculation.

Counters are expensive, which is a drawback of this algorithm. Perhaps, reducing the counters' length (for example, using 2-bit counters instead of 6 bit counters) could save some cost. However, argue on the issue that might arise if each page had maintained a 2-bit counter instead.

b. Suppose, there can be a maximum of three page frames in physical memory. Illustrate which pages reside in physical memory after each memory reference for the following sequential memory accesses:
(page no) 2, 1, 2, 3, 4, 2, 5, 2, 3, 5, 1
You must use the matrix representation of the LRU page replacement algorithm and demonstrate step-by-step calculations. Also, identify and mention whenever a page fault occurs.

c. "Preemptive SJF always provides optimal turnaround time" – do you agree? Defend your answer with an example scenario.

Question 3

a. You are required to implement a scheduling algorithm for a highly responsive server-client system, where each client process has equal priority. However, you are requested to consider the process with higher duration, in case of any tie-breaker only. It has also been reported to you that all the client processes are I/O bound processes, and the system works best when the client processes get scheduled for 4-6 (continuous) time units each time under different scenarios (i.e., time slots can be minimum 4 and maximum 6 time units depending on scenarios). Now, consider the following client processes with arrival time and burst time:

Process	*Arrival Time*	*Burst Time*
P1	0	8
P2	2	5
P3	3	3
P4	0	9
P5	7	1
P6	16	3

Considering the above scenario, which scheduling algorithm would you choose to implement? Support your answer along with necessary assumptions and required for your chosen algorithm.

Sketch the Gantt chart and calculate the average turnaround time using your scheduling algorithm.

b. Consider the following code snippet for a philosopher, i, from the dining-philosopher problem: 10

```
Void put_forks (i)
{  down(&mutex);
   state[i] = THINKING;
   test(LEFT);
   test(RIGHT);
   up(&mutex);
}
```

Explain the purpose of mutex, test(LEFT), and test(RIGHT) in this code.

Question 4

a. Suppose, process X and process Y share two resources – R1 and R2, where only one instance of each resource is available. Process X needs resource R2 from instruction#100 to instruction#200. Process Y needs resource R1 from instruction#200 to instruction#300. Process Y needs resource R2 from instruction#150 to instruction#250. Process X needs R1 from instruction#50 to instruction#150. Is there any unsafe state? If yes, show it on a graph, where the axes represent the instruction# of the processes (X and Y). Also, you must mark the region where the deadlock would occur (if any). 8+4

Discuss what would happen if there were two (2) instances of R1 and three (3) instances of R2 available.

b. Consider a system with five processes P0 through P4, and three resources – A, B, C. Resources A has 10 instances, B has 5 instances, and C has 7 instances in total. Suppose at time t, the following snapshot of the overall process-resource system has been taken: 12

Processes	Allocation			Maximum needed		
	A	B	C	A	B	C
P0	0	1	0	7	5	3
P1	2	0	0	3	2	2
P2	3	0	2	9	0	2
P3	2	1	1	2	2	2
P4	0	0	2	4	3	3

Find if the state at time t is 'safe' using Banker's algorithm. Demonstrate necessary calculations in each step.

c. State the two modes of CPU operation. Explain why a CPU requires two modes of operation instead of one. 6

SECTION-B

Question 5 (Compulsory)

a. Sketch the layout of file system. Explain MBR and super block. 2+6 =8

b. Assume, Dhrubo has a 12MB solid-state drive in his pc. There is currently only one partition and no file in the SSD. The advertised block size of the SSD is 1MB (1024 KB). Blocks 0, 2, 5, 7 and 9 have already been allocated to different file. Now, Dhrubo wants to create 4 12

files in the only partition of the SSD. File name A (size 3.6 MB), B (1.0 MB), C (0.9 MB) and D (0.6 MB). How will the file system (installed on his SSD) allocate hard disks blocks to the above files if it uses the following allocation schemes? Considering the printer size negligible (where applicable), produce the file allocation schemes using illustrative figure

1) Contiguous allocation
2) Linked-list allocation
3) Linked-list allocation using a FAT in memory.

c. Compare between User level and Kernel level threading. Demonstrate the hybrid implementation of both of them using a figure.

Question 6

a. Suppose that a disk drive has 1000 cylinders, numbered 0 to 999. The head pointer is currently at cylinder 60. The queue of pending requests is as follows:
200, 78, 500, 320, 740, 45, 930, 20, 880, 690, 890
starting from the current head pointer, calculate the total and average seek time (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms. Also, sketch the head movement diagram for calculating the distance

1) SSTF
2) C-scan
3) Scan

b. Consider the instruction "count = read(fd, buffer, n bytes)", where "read" is an example of a system call. Illustrate with a diagram the steps of making a system call for "read".

c. Explain why "count!= n bytes" always.

Question 7

a. Which one do you prefer to use for implementing a web-server: Multi-process or Multi-thread? Defend your answer by proposing an appropriate algorithm for the server process to handle client processes.

b. Define the following with a central figure of process life cycle:

1) Long Term Scheduler
2) Short Term Scheduler
3) Middle Term Scheduler
4) Backing Store

c. Illustrate generic security and protection steps in OS using necessary figure.

d. Explain masquerading and session hijacking with appropriate figure.

Question 8

a. Consider a system executing four processes – A, B, C, and D. A has two instructions – A_1 and A_2, B has two instructions – B1 and B2, C has only one instruction are inside a loop in their respective processes. For example, consider process A:

```
while (TRUE)
{A1;
A2;}
```

Now design an algorithm to maintain synchronization (using semaphores) among these processes as follows:

$$A1 \rightarrow B1 \rightarrow D1 \rightarrow C1 \rightarrow A2 \rightarrow D1$$

Note that, $A1 \rightarrow B1$ means that instruction $B1$ must not be executed before instruction $A1$.

b. Code for "Peterson Solution" can be depicted as follows, and consider the given scenario: 10

```
#define FALSE 0
#define TRUE  1
#define N     2                    /* number of processes */

int turn;                          /* whose turn is it? */
int interested[N];                 /* all values initially 0 (FALSE) */

void enter_region(int process);    /* process is 0 or 1 */
{
    int other;                     /* number of the other process */

    other = 1 - process;           /* the opposite of process */
    interested[process] = TRUE;    /* show that you are interested */
    turn = process;                /* set flag */
    while (turn == process && interested[other] == TRUE) /* null statement */;
}

void leave_region(int process)     /* process: who is leaving */
{
    interested[process] = FALSE;   /* indicate departure from critical region */
}
```

In the given code, a process calls the enter-region function with its process id before entering the critical region and calls the leave-region function after exiting the critical region. Assume, process 0 calls the enter-region function first. After executing the 4th line in the enter-region function (turn = process), a context switch occurs giving CPU to process 1 and process 1 calls the enter-region function immediately. In case of process 1, after executing the 4th time in the enter-region function (turn = process), again a context switch occurs giving the CPU to process 0.

Considering the above scenario, will Peterson Solution be able to handle any race condition properly? Defend your answer by explaining what happens next with process 0 and process 1.

c. One of the solution requirement for the avoiding race condition states that – "No process running outside its critical region may block another process". Identify and explain how this requirement might be violated in the following code regarding the "Strict Alteration" approach involving 2 processes – A (figure a) and B (figure b): 8

```
while (TRUE) {
    while (turn != 0)      /* loop */;
    critical_region();
    turn = 1;
    noncritical_region();
}
```

(a)

```
while (TRUE) {
    while (turn != 1)      /* loop */;
    critical_region();
    turn = 0;
    noncritical_region();
}
```

(b)

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group: 72< Earned Credit Hour <= 108, Spring Final Examination: June 2019

Subject: CSE-307, Operating System

Time: 3.00 hours **Full Marks: 180**

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SECTION-A

Question – 1

a. "In monolithic operating system, it is possible to have some structure" –briefly explain the concept with figures. **08**

b. Analyze the design issues of memory management related to "static relocation". Does the design contain any constraint? If so, illustrate how the constraint is being solved. **08**

c. Can a measure of whether a process is likely to be CPU bound or I/O bound be determined by analyzing source code? How can this be determined run time? **06**

d. One of the uses of virtualization is to run two or more operating systems at the same time. Describe with figure 3rd generation silicon based hypervisor which will allow you to achieve this virtualization. **08**

Question – 2

a. Describe how resource management of operating systems include multiplexing (sharing) resources. **08**

b. Write down the advantages of ring mechanism over layering scheme in layer system OS structure. **06**

c. Explain a type of OS which is characterized by having time as a key parameter. **08**

d. System calls are performed in a series of steps. Draw the figure and explain all steps in making the system call **08**

n = Write (fd, buffer, nbyte)

in C or C++ compiler. Note: fd, buffer and nbyte stand for their usual meaning.

Question – 3

a. Write down the differences between Process and Program. **06**

b. Suppose that while a process 'PID-3' is running, a disk interrupt happens. What does the lowest level of an operating system do when this interrupt occur? **08**

c. Consider the following solution to the mutual – exclusion problem involving processes P_0 and P_1. Assume that the variable turn is initialized to 0. Process P_0's code is: 08

```
/* Other code */
while (turn != 0) {} /* Do nothing and wait */
Critical Section(); /* ... ... ... */
turn = 0;
/* Other code */
```

Process P_1's code is:

```
/* Other code */
while (turn != 1) {} /* Do nothing and wait */
Critical Section(); /* ... ... ... */
turn = 1;
/* Other code */
```

Determine if the solution meets all the required conditions for a correct mutual – exclusion solution or not.

d. Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 10, 6, 2, 4 and 8 minutes. Their (externally determined) priorities are 3, 5, 2, 1 and 4, respectively with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time. Ignore process switching overhead. All jobs are CPU bound. 0

(a) Round Robin
(b) Priority
(c) First Come First Served (run in order of 10, 6, 2, 4 and 8 minutes)
(d) Shortest job first

Question – 4

a. Suppose that you are running an operating system which manages program address space by paging. While PID 5 is running a page fault occur. Describe the events for handling the page fault. 0

b. A computer has 32 KB Physical memory where frame size is 4K, and 16 bit virtual address. Describe with figure how the Memory Management Unit will map the above virtual addresses on the physical memory addresses. 0

c. Briefly explain the segmentation hardware mechanism with the help of STBR and STLR. 0

d. A small computer has four page frames. At the first clock tick, the R bits are 0110 (Page 0 and 3 are 0, the rest are 1). At the subsequent clock tick, the values are 1001, 1100, 1101, 0010, 1010, 0100, and 0011. 0

(1) If the aging algorithm is used with an 8-bit counter, give the value of the four counters after the last tick.
(2) Decide which page frame will be evicted if page fault occur at last tick.

SECTION-B

Question – 5

a. Describe journaling file systems. Why is idempotent needed for making the journaling workable? **08**

b. A system has 'P' processes, each needing a maximum of 'm' resources and a total 'r' resources available. What condition must hold to make the system dead lock free? Explain your answer. **08**

c. Disk request come into the disk driver for cylinders 10, 22, 20, 2, 40, 6 and 38, in that order. A seek takes 6 msec per cylinder. How much seek time is needed for: **06**

(1) First come, first served.
(2) Closest cylinder next.
(3) Elevator algorithm (initially moving upward)

In all cases, the arm is initially at cylinder 20.

d. What is rootkit? Suppose you are working with malware. Could your machine infected with a rootkit be restored to a good health by simply rolling back the Software state to a Previously stored system restore point? Justify your answer. **08**

Question –6

a. In many UNIX systems, the i-node are kept at the start of the disk. An alternative design is to allocate an i-node, when a file is created and put the i-node at the start of the first block of the file. Discuss the pros and cons of this alternative. **08**

b. What would happen if the bitmap or free list containing the information about free disk blocks was completely lost due to a crash? Is there any way to recover from this disaster, or is it bye-bye disk? Discuss your answer for UNIX and the FAT–16 file system separately. **08**

c. Write down the differences between Physical and Logical file dumping? **06**

d. While manufacturing defects introduce bad sectors in the Disk. If the defect is very small, say only a few bits, what are the general approaches to deal with these bad blocks or sectors? **08**

Question –7

a. Define cylinder skew. If a disk has double interleaving, does it also need cylinder skew in order to avoid missing data when making a track-to-track seek? Discuss your answer. **06**

b. A system has 5 processes P1 through P5 and 4 resource types R1 through R4. There are 2 units of each resource type. **08**
Given that:
P1 holds 1 unit of R1 and requests 1 unit of R4.
P2 holds 1 unit of R3 and requests 1 unit of R2.
P3 holds 1 unit of R2 and requests 1 unit of R3.
P4 requests 1 unit of R4.
P5 holds 1 unit of R_3 and 1 unit of $R_2$and request 1 unit of R_3.

Show the resource graph for this state of the system. Is the system in deadlock, and if so which process are involved? Show each step.

c. How can deadlock be prevented? Describe all the approaches. 08

d. A system has four processes and five allocable resources. The current allocation and maximum needs are as follows: 08

Name of Process	Allocated	Maximum	Available
Process A	10211	11214	0021X
Process B	20210	22210	
Process C	11010	21310	
Process D	11110	11221	

What is the smallest value of X for which this is a safe state?

Question–8

a. Suppose you are working in a software company. In a program, an Account object holds balance, a Customer object holds name and address, an Account Openings object holds opening data, etc. As a security advisor what type of access control and protection domain will you suggest for the program? Discuss in brief. 0

b. Explain with diagram how code signing works for a reliable software for keeping out of malware. 0

c. Avoiding viruses in the first place is a lot easier than trying to track them down once they have infected a computer. Keeping this in mind briefly discuss various virus avoidance methods adopted by individual users and industries. 0

d. To verify that an applet has been signed by a trusted vendor, the applet vendor may include a certificate signed by a trusted third party that contains its public key. However, to read the certificate, the user needs the trusted third party's public key. This could be provided by a trusted fourth party, but then the user needs the public key. It appears that there is no way to bootstrap the verification system, yet existing browsers use it. How could it work? Explain your answer. 0

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science & Engineering
Short Term Final Examination (Improvement): Jan 2020

Subject: CSE 307, Operating System

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

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SECTION-A

Question – 1

a. "An operating system may be termed as Resource Manager"- briefly discuss the concept with example. **5**

b. System calls in OS are performed in a series of steps. Draw the figure and explain all steps in making the system call n= write (fd, buffer,nbyte) in C and C++ compiler, where fd, buffer and nbyte stand for their usual meanings. **10**

c. Explain how separation of policy and mechanism aids in building microkernel-based operating systems. **10**

d. "Instead of layers, MULTICS OS structure was described as having a series of concentric rings, with the inner ones being more privileged than the outer ones." Describe how the complexity was managed in MULTICS when a procedure in an outer ring wanted to call a procedure in an inner ring. **5**

Question – 2

a. On all current computers, at least parts of the interrupt handlers are written in assembly language. Why? **5**

b. Consider the following solution to the mutual exclusion problem involving two processes P_0 and P_1. Assume that the variable 'turn' is initialized to 0. For process P_0, the code is: **10**

```
/* other code */
while (turn !=0) { } /* Do nothing and wait */
critical section /*.....* /
turn =0;

/* other code */
```

For process P_1, the code is :

```
/* other code */
while (turn !=1) { } / * Do nothing and wait */
critical section /*.....* /
turn=1;
/* other code */
```

Determine if the solution meets all the required condition for a correct mutual exclusion or not.

c. Suppose that you were to design an advanced computer architecture where multiple new processes were needed to create and terminate during any operation. Describe with example the principle events those caused the new processes to be created and terminated.

d. A real-time system needs to handle two voice calls that each run every 6msec and consume 1 msec of CPU time per burst, plus one video at 25 frames/sec, with each frame requiring 20 msec of CPU time. Is this system schedulable?

Question – 3

a. A computer has 32 KB physical memory and 16 bit virtual addresses. Describe with diagram how the memory management unit (MMU) will map the above virtual addresses on to the physical memory addresses. 1

b. Explain in detail what happens when there is a page fault in memory. 1

c. A computer has four page frames. The time of loading the time of last access and R and M bits of each page are shown below (the times are in clock ticks): 1

Page	Loaded	Last ref	R	M
0	126	280	1	0
1	110	285	0	1
2	140	270	0	0
3	230	265	1	1

I. Which page will NRU replace?
II. Which page will FIFO replace?
III. Which page will LRU replace?
IV. Which page will second chance replace?

Question – 4

a. Describe the scheduling technique of user level and Kernel level threads, while several processes (each has multiple threads) have process and thread level of parallelisms. 10

b. Discuss the process and hole management technique in memory related to Linked List. Why is it more convenient to have the memory address list as a double linked list rather than a single linked list? 10

c. In traditional X86 architecture, virtual machine (VM) OS Kernels expect to run privileged code in ring 0 but in full virtualization, ring 0 is controlled by the host OS, and VMs are forced to execute at ring 1 or 3. How was this drawback removed in the next generations VMs? 10

SECTION-B

Question – 5

a. Contiguous allocation of files leads to disk fragmentation because some space in the last disk block will be wasted in files whose length is not an integral number of blocks. Is this integral fragmentation or external fragmentation? Make an analogy with an example of each fragmentation types. **10**

b. Two computer science students Anik and Nazia are having a discussion about i-nodes. Anik maintains that memories have gotten so large and so cheap that when a file is opened, it is simpler and faster to fetch a new copy of i-node into the i-node table rather than search the entire table to see if it is already there. Nazia disagree. Who is right? Explain your answer. **10**

c. "Operating system makes sure that users do not exceed their quotas"—describe typical mechanism of disk quota. **10**

Question – 6

a. How does DMA work? Explain DMA configurations with example of each. When does DMA fetches/steals Data Bus from CPU? **15**

b. Disk requests come in to the disk driver for cylinders to 10, 22, 20, 2, 40, 6 and 38 in that order. A seek takes 6 msec per cylinders moved. How much seek time needed for:

I. First come first served (FCFS)
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In all cases, the arm is initially at cylinder 20.

c. Explain the difference between programmed I/O and Interrupt Driven I/O. **6**

Question – 7

a. Consider the following example of a system. A, B, C are the resources and P_0, P_1, P_2, P_3, P_4 are the processes. If process P_1 request (1, 0, 2), determine if it can be granted immediately? Also mention the safe sequence. **15**

Process	Allocation	Maximum	Available(work)
	A B C	A B C	A B C
P_0	0 1 0	7 5 3	3 3 2
P_1	2 0 0	3 2 2	
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b. A computer system has 'm' resources of the same types and 'n' processes shares these resources. Prove or disprove the following statement of the system: **10**

"This system is deadlock free if sum of all maximum needs of

processes is less than m+n".

c. What is starvation? Explain starvation with respect to "Dining Philosophers Problem."

Question – 8

a. Is it possible to build a secure computer system? If so, why is it not done?

b. Write down the differences between unconditional security and conditional security.

c. Explain with diagram how "Jailing" works for a reliable software for keeping out of malware. 1

d. A machine is encrypting the plaintext using "Playfair Cipher" algorithm, where keyword is "Operating". What will be the Cipher test if the plaintext is "Today is Operating System exam"? 1

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Question – 8

a. Is it possible to build a secure computer system? If so, why is it not done? 3

b. Write down the differences between unconditional security and conditional security. 3

c. Explain with diagram how "Jailing" works for a reliable software for keeping out of malware. 10

d. A machine is encrypting the plaintext using "Playfair Cipher" algorithm, where keyword is "Operating". What will be the Cipher test if the plaintext is "Today is Operating System exam"? 10