Roll Number:_____

Thapar Institute of Engineering & Technology
Department of Computer Science and Engineering
END SEMESTER EXAMINATION

B. E. (2nd Yr. COE/COEMBA)
27th January, 2021
Wednesday, Time From – 11:00 AM To 1:00 PM
Time: 2 Hours, Max Marks: 50

Course Code: UCS303
Course Name: Operating Systems
Name of Faculty: Dr. Jhilik Bhattacharya, Dr. Vinay Arora, Dr. Raman Kumar Goyal, Mr. Abhishek Jain

Out of 07 questions student needs to attempt 05 full questions only, attempting sub-part(s) of a question a single place and in serial order. Combining the sub-part(s) of different questions will not be considered as one full question. Assume any missing data.

Q.1 a) On a Windows operating system, consider a process of VLC media player with 4 logical pages, which are numbered from 0 to 3. The page table of the process consists of the following logical page number to physical frame number mappings as: (0, 11), (1, 35), (2, 3), (3, 1). The process runs on a system with 16 bit virtual addresses and a page size of 256 bytes. Taking the system as 1-byte addressable, you have been given that this process accesses virtual address 772. Compute the page number and offset corresponding to this virtual address (consider all numbers given here in decimal).

b) In a system, a process will be having 6 physical pages, which are numbered 0 to 5. The access order of the pages of the process is as follows: 1, 5, 0, 1, 0, 2, 3, 3, 0, 2, 1, 3, 0, 2, 4, 5, 3, 2. Considering the holding capacity of the RAM as 3 out of these 6 pages at a time, and taking RAM initially as empty, with no other process executing on the system; With a suitable illustration, comment on the count of page faults generated using LRU.

Q.2 a) With a suitable illustration, explain three multi-threading models that we use in operating systems. Also, comment on the line "*in each program we must be having at-least one thread at user level*"

b) As tabulated below, in a system, there are four processes in the RAM i.e., P1, P2, P3, and P4, which arrive at time t=0 sec. Due to some memory error, the largest process gets swapped to the disk at time t=10 sec. Consider the disk transfer rate of 01 Megabyte/Second, allied latency time of 5 milliseconds, and process context switch time (both ways) as 500 milliseconds; Draw the GANTT chart for the scenario taking RR quantum as 2.

Process	Size (kilo bytes)	CPU Burst Time
P1	100	3 sec
P2	50	2 sec
P3	30	2 sec
P4	80	5 sec

Note: i) When a process is terminated/exit consider half context switch time, ii) It will be assumed that the error gets resolved, when the erratic/halted process gets reloaded in the memory. This reloaded process continues from where it left off. No other processes can run during this time. Also, assume that context saving/loading of the error process is not required again.

Q.3 a) Consider a 64-bit system running an OS that uses hierarchical page tables to manage the virtual memory. Assume that the logical and physical pages are of size 4 KB and each page table entry is of 4 bytes in size. Using a suitable diagram for hierarchy, comment on the maximum number of levels that can be crafted for the said scenario.

b) Consider a software named Xoro of size 10MB, which comprises 3 segments, namely, DataBase (DB), SourceFile (SF), and LibraryFile (LF); that further take 40, 20 and 40 percent of total software size respectively. While software execution, the SF is required all the time, with either DB or LF. The OS here, uses dynamic loading concept, with a TLB hardware of 8K entries. Each frame number entry of the TLB is 3-bytes in length. The page size is 2KB (with 1 byte addressable). Access of each entry from TLB takes 0.5 milliseconds. Consider time to access main memory as 20% more as compared to TLB access time. Considering the 25% occupancy of the total TLB entries by the software Xoro at any time. Compute the following:

i) Size of Physical Address Space
ii) Size of Logical Address Space for Xoro
iii)What minimal percent of the main memory does Xoro needs to occupy for ensuring its execution? Make an assumption that each segment can either be loaded completely or not at all
iv) Time to access SF+DB from main memory (all the entries needed by Xoro are always present in the page table and page table is available in the RAM)

Q.4 a) Following code snippet is the first known software solution to the critical-section problem for two processes. The two processes, Pi and Pj, share the following variables: (5)

```
boolean flag[2] ;   /* initially false */
int turn;
do {
   flag[i] = TRUE;

   while (flag[j]) {
      if (turn == j) {
         flag[i] = FALSE;
         while (turn == j)
            ; // do nothing
         flag[i] = TRUE;
      }
   }
   // critical section
   turn = j;
   flag[i] = FALSE;

   // reminder section
} while (TRUE)
```

The structure of process Pi (i == 0 or 1) is shown above; the other process is Pj (j == 1 or 0). Prove that the algorithm satisfies all three requirements for the critical-section problem

b) With a suitable example, explain Semaphores and its types that one can deploy in an Operating System to avoid the concern of Critical section. (5)

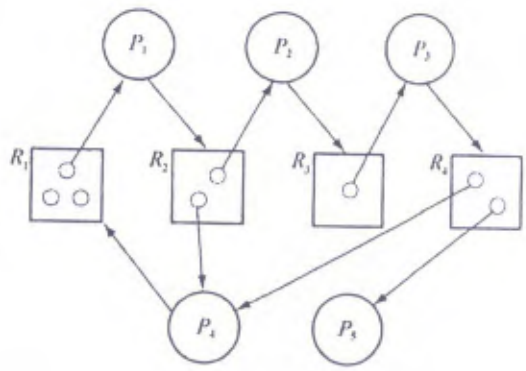
Q.5 a) Consider fork () as system call of LINUX/UNIX operating system. Draw the Tree type structure illustrating the execution of the multiple fork calls given in the code snippet below; and comment on the number of times "Good Morning" and "Good Evening" will get printed. (5)

```
#include <assume all required header files here>
void main ()
{ if (fork() || fork() && fork() ||fork()) { printf ("\t Good Morning \n");} printf ("\t Good Evening \n"); }
```

b) Assume a system has 4 files F1, F2, F3, F4 and 4 domain D1, D2, D3, D4; Where, F1 is owned by D2; F2, F3 is owned by D1 and F4 is owned by D4. Owners have read, write and execute permission but can only copy read and write permissions. D1 can modify any right of D3. D2 has all accesses that D4 has. Draw the access matrix and answer the following questions. (5)
i) Can D2 write on F4 by any way?
ii) Can D1 read F1 by any way through D4?

Q.6 a) List the four levels at which the measures are needed to be applied to protect a system. Give one difference between Masquerading and Session Hijacking. (5)

b) For the resource allocation graph (RAG) shown here; Firstly, convert it to the matrix representation (*i.e.*, Allocation, Request and Available). Execute the deadlock detection algorithm and comment on the scenario of deadlock in the system; and if there is a deadlock, which processes are involved? (assuming/taking request edge depicting single instance request only) (5)



Q.7 Consider a system with a single CPU core and three processes A, B, C. Process A arrives at t = 0, and runs on the CPU for 10 time units before it finishes. Process B arrives at t = 6, and requires an initial CPU time of 3 units, after which it blocks to perform I/O for 3 time units. After returning from I/O wait, it executes for a further 5 units before terminating. Process C arrives at t = 8, and runs for 2 units of time on the CPU before terminating. Compute the average waiting time taking First Come First Serve CPU scheduling algorithm, and average turnaround time considering non-preemptive Shortest Job First scheduling algorithm. (10)