Bachelor of Information Technology
3rd Year, 1st Semester Supplementary Examination, 2017
Subject: Operating Systems

Time - Three Hours | Full Marks – 100

Answer question number 1 and any 5 (five) from the rest.

1. 10x2=20

a) At a particular instant the value of a semaphore is '–n'. What does it mean?

b) Consider a program P that consists of two source modules M_1 and M_2 contained in two different files. If M_1 contains a reference to a function defined in M_2, when the reference will be resolved?

c) Distinguish between logical and physical address.

d) Explain the difference between *Internal* and *External fragmentation?*

e) Find the factor(s) to determine the minimum number of frames must be allocated to a running process in a virtual memory environment.

f) What are live locks?

g) A virtual address *"a"* in a paging system is equivalent to a pair (p,w), in which p is a page number and w is a byte number within the page. Let z be the number of bytes in a page. Find algebraic equations that show p and w as a function of z and a

h) What is the reason of improving system performance with the increase in cache?

i) How can the hold-and-wait condition prevented?

j) What are steps performed by an operating system to create a new process?

2. [5+4+7]

a) Suppose that we have a multi-programmed computer in which each job has identical characteristics. In one computation period, for a job, half the time is spent in I/O and the other half in processor activity. Each job runs for a total of N periods. Assume that a simple round-robin scheduling is used, and that I/O operations can overlap with processor operations, compute processor utilization and turnaround time for two and four simultaneous jobs.

b) Distinguish between *multiprogramming* and *multi-tasking* environment.

c) With a neat diagram explain the page mapping technique used in virtual memory.

3. [4+4+4+4]

a) Consider a system consisting of four processes and a single resource. The current state of the claim and allocation matrices is C = (3 2 9 7) A = (1 1 3 2). What is the minimum number of units of the resource to be available for this state to be safe?

b) In a system, n threads T_1, T_2, T_3...T_n want to execute within a critical section in the order T_1, T_2, T_3...T_n. How many semaphores will be required to achieve this ordering, and what should be their initial values? Sketch the code for the n threads.

c) Explain the term *locality of reference.* Illustrate an example of locality of reference.

d) Describe the difference between *short-term* and *long-term* scheduler.

4. [4+3+4+5]

a) Three processes share four resource units that can be reserved and released only one at a time. Each process needs a maximum of two units. Can deadlock occur?

b) Can a system detect that some of its processes are starving? If yes, explain how it can. If no, explain how the system can deal with the starvation problem.

c) Consider a system consisting of m resources of the same type, being shared by n processes. Resources can be requested and released by processes only one at a time. The maximum need of each process is between 1 and m resources. Suppose S is the sum of all maximum needs. What is the maximum value of S for which the system is guaranteed to be deadlock free? Prove.

d) Write the solution to the bounded buffer producer-consumer problem using conditional critical region construct. Sate the assumptions, you made clearly.

5. [4+6+6]

a) What are the necessary and sufficient conditions must hold for a deadlock to occur?

b) Write the deadlock detection algorithm where resource type may consist of multiple instances.

c) Apply the above deadlock detection algorithm to the following data and show the result.

Available = (2 1 0 0)

$$\text{Request} = \begin{vmatrix} 2 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 2 & 1 & 0 & 0 \end{vmatrix} \qquad \text{Allocation} = \begin{vmatrix} 0 & 0 & 1 & 0 \\ 2 & 0 & 0 & 1 \\ 0 & 1 & 2 & 0 \end{vmatrix}$$

6. [2+5+5+4]

a) Describe the notion of *atomic instruction.*

b) Write a solution to the Dinning-Philosopher problem which avoids deadlock.

c) A process references five pages A, B, C, D and E in the following order:

A, B, C, D, A, B, E, A, B, C, D, E

Find the number of page transfer during this sequence of references stating with empty main memory with three frames and assume that replace algorithm is first-in-first-out.

d) Consider a system with two-level paging scheme in which a regular memory access takes 150 nanoseconds, and servicing a page fault takes 8 milliseconds. An average instruction takes 100 nanoseconds of CPU time and two memory accesses. The TLB hit ratio is 90% and page fault rate is one in every 10,000 instructions. What is the average instruction execution time?

7. Write short notes on 4 X 4

a) Inverted Page table

b) Exteral fragmentation

c) FAT

d) PCB