Department of Electrical Engineering, IIT Delhi

EEL602 Operating Systems: Major Examination

(Closed books/Closed Notes) Time: 1 hour Maximum Marks: 25

"Thou shalt not covet thy neighbour's answers"

Do not bank on this!

(a) What is the role of the CPU scheduler, in the Banker's Algorithm?

(b) For n process and m resource types, show that the safety algorithm has time complexity $\mathcal{O}(mn^2)$.

(c) In the Banker's Algorithm for deadlock avoidance, what is the significance of an out-of-turn request?

(d) The Banker's Algorithm for deadlock avoidance concludes whether the system is in a safe state or not, whereas that for deadlock detection concludes whether the system is in a deadlock, or not. Comment.

(2+2+2+2 marks)

2 **Filling too many pages will cause a page fault!** Consider a system with a 32-bit address bus, 512 MB main memory for paging (not for the OS, or the page table itself), and a page size of 4 KB.

(a) What is the role of the dirty bit, and the valid/invalid bit?

(b) What will be the size of the page table, in case a single level page table is needed, and it is to be all stored in the memory? Now, consider a two level page table, where this page table itself is to be paged. For the paging of the page table, each page is to have 1 K entries, and the main memory is to store only 4 of these. Given a memory request for a 32-bit address, explain how the page tables at the two levels, will be used. *(2+4 marks)*

3 **Paging for your attention!**

(a) Why are base-limit register pairs needed in an OS when this information about memory protection and usage is already there in the Process Control Block for each process?

(b) How many base-limit register pairs should be there in a single core single processor computer, and why?

(c) Virtual Memory is mainly an OS activity (software-driven). There is one important instance where hardware interaction is needed, and is available for modern processors. Explain.

(d) What is the basic property of page replacement algorithms such as OPTIMIN and LRU, which enables them to be free from suffering Belady's anomaly? Do not simply state the name.

(e) Virtual memory as a consequence involves, *swapping*, where blocks of memory are transferred between the main memory, and the hard disk. Windows uses a swap file, and Linux prefers a separate swap partition (though historically, it has also been able to handle swap files). Give one advantage each, of the two different methodologies.

(f) Why is the OS kernel (by definition), never paged?

(g) What is paged segmentation? *(1+2+1+2+2+2+1 marks)*