

UNIVERSITY OF DUBLIN

TRINITY COLLEGE

Faculty of Engineering and Systems Sciences
Department of Computer Science

BA Mod. (Computer Science)
JS Examination

Trinity Term 2000

3BA3 - Systems Software and Data Communications

Saturday 27th May

RM. 3074

09.30 - 12.30

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Attempt **five** questions, at least two questions from each section.

Use separate answer books for each section

Section A

1. Process Management

- (i) Describe the seven-state process model. Draw a state transition diagram for the model and describe what is the meaning of each state. Describe what kind of events might activate each state transition.
- (ii) Describe the differences between short-term, medium-term and long-term processor scheduling. How does each kind of processor scheduling relate to the process state transition diagram provided in the previous question?
- (iii) The Unix SVR4 operating system has the following states: Kernel Running, User Running, Pre-empted, Zombie, Ready to Run in Memory, Created, Ready to Run Swapped, Asleep in Memory and Asleep Swapped. How do these states relate to the ones of the seven-state process model? What are the reasons for the addition of the extra states?

2. Process Synchronisation and Deadlocks

- (i) Consider the following ways of handling deadlock: (1) banker's algorithm, (2) deadlock detect and kill thread, releasing all resources, (3) reserve all resources in advance, (4) restart thread and release all resources if thread needs to wait, (5) resource ordering and (6) detect deadlock and roll back thread's actions.

(a) One criterion to use in evaluating different approaches to deadlock is as follows: Which permits the greatest concurrency? In other words, which allows the most threads to make progress without waiting when there is no deadlock, where 1 allows the greatest degree of concurrency. Comment on your ordering

(b) Another criterion is efficiency; in other words, which requires the least processor overhead? Rank order the preceding approaches from 1 to 6, with 1 being the most efficient, assuming that deadlock is a very rare event. Comment on your ordering. Does your ordering change if deadlocks occur frequently?

- (ii) Describe the critical section problem. What are necessary requirements for a correct solution to the problem?
- (iii) Show that, in the case of semaphores if the wait and signal operations are not executed atomically then mutual exclusion might be violated.

3. Memory Management

- (i) Give a definition of thrashing and describe what its causes are. How does the system detect thrashing? What can the system do to prevent it?
- (ii) Explain the difference between internal and external fragmentation.
- (iii) We have devised a new page-replacement algorithm that we think may be optimal. In some contorted cases, Belady's anomaly occurs. Is the new algorithm optimal? Explain your answer.

4. File System Management

- (i) Describe alternative methods for free-space management and discuss their respective advantages and disadvantages.
- (ii) Explain the purpose of the file open and file close operations.
- (iii) An important variation on the linked allocation method is the use of a File Allocation Table (FAT). This simple allocation method is used by the MS-DOS and OS/2 operating system. Describe how the method works and its advantages and disadvantages

Section B

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 - (i) Explain, with the aid of diagrams, how the digital binary pattern 0101100100100 is encoded as an analog signal using (a) Amplitude Shift Keying, (b) Frequency Shift Keying, (c) Phase Shift keying.
 - (ii) Describe, in detail, how modem technologies have evolved, and speeds increased, from early V.21 and V.23 models to modern V.90 modems. Then explain how DSL technologies operate and how they achieve higher data rates than existing analog modems.

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 - i) Explain, with the aid of diagrams, how the following flow-control techniques operate: X-On/X-Off, Stop and Wait, Sliding Windows Protocol, Credit-based Flow Control.
 - ii) Show how these flow-control techniques can be extended to include error control functionality. Illustrate your answer using a selection of different ARQ models. Your answer should also explain how typical ARQ error conditions are handled.

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 - i) Explain, in detail, how the FDDI fiber protocol operates. In doing so, explain the role and implementation of the following: a) FDDI Reference Model; b) Cabling; c) Physical layer; d) Frame format; e) MAC protocol. Illustrate your answer with numeric examples and diagrams as appropriate.
 - ii) Describe briefly how, if at all, Wireless CSMA/CD differs from 802.3 CSMA/CD.

8. Answer **each** of the following.
 - i) Describe the purpose of each layer of the OSI Reference model. Briefly compare the TCP/IP Reference Model with the OSI Reference Model.
 - ii) Describe briefly the four basic elements required for communication.
 - iii) Define the terms: bandwidth, capacity, baud and attenuation. Describe how channel bandwidth and data rate are affected by noise.
 - iv) The frame 1101011 is to be transmitted across a network. The frame is to be protected against transmission errors by a Cyclic Redundancy Check (CRC). The generating polynomial is 10011. Compute the Frame Check Sequence (FCS) and, hence, list the transmitted frame. Explain how the receiver detects the presence of an error in the received frame.