UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1996

MEng Honours Degrees in Computing Part IV
MSc Degree in Foundations of Advanced Information Technology
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Diploma of Membership of Imperial College
Associateship of the City and Guilds of London Institute

PAPER 4.31

ADVANCED COMPUTER ARCHITECTURES

Wednesday, May 15th 1996, 10.00 - 12.00

Answer THREE questions

For admin. only: paper contains
4 questions
2 pages (excluding cover page)

1a In the context of a block-structured language, define the meaning of *Display*. Describe *three* distinct methods by which both current display and displays relating to previously called procedures can be represented, and quote in each case one system which uses the method.

b Compare the three methods of representing display with respect to:

i) the use of current display to access outer block variables

ii) the cost of altering display when a procedure is called and when a procedure returns control to the caller.

iii) the contribution to system reliability.

Part b carries 65% of total marks.

2a A certain task consists of two modules, a producer which generates transactions and a consumer which processes these transactions. Define the ***domains*** within which these two modules are executed, observing the principle of least privilege, as they would be represented in

i) a Capability System

ii) an Access Control System

b How could ***recovery blocks*** be organised to enable detection and correction of processing errors occurring during the execution of this task

i) if the modules were executed serially, the consumer being a procedure called by the producer and returning control to the producer after handling the transaction

ii) if the modules were asynchronous processes communicating via a message-passing system. Control is returned to the producer after acceptance of a request, and a reply to the producer is generated by the consumer after handling the transaction.

Part b carries 60% of total marks.

3a Describe the principal components of a Backward Error Recovery system designed to detect and correct faults generated at either hardware or software levels. Outline briefly a method by which the extent of additional data required to support backward error recovery could be minimised.

b Outline in any suitable form the nature these components would take in order to implement a reliable module which performs the matrix operation

$$X: = X + Y * Z$$

where X, Y, Z are matrices of size L * N, L * M, M * N respectively, the elements being of type REAL.

Provide some indication of the cost, in terms of processing time and storage, of making provision for reliable operation assuming use of a minimised *recovery cache*, and compare this with the cost using *check-pointing* and the cost using an *audit-trail.*

4a In a computer system which supports a segmented virtual store, suppose that,when an instruction is fetched from store prior to execution, one bit is faulty.

Describe how this error could be detected and corrected at the time that the instruction is read from slave store or main store.

b If the error is not detected at the time of fetching from store, describe how the error might be detected and corrected if the erroneous bit affected

i) the specification of the virtual store address of an operand

ii) the function code of the instruction

Part b carries 70% of total marks.

End of Paper