UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

COMPUTER SCIENCE THREE

COMPUTER DESIGN

Monday 11 September 2000

9:30 to 11:00

Examiners:

K. Turner (External)

G. Brebner (Chairman)

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

1. (a) What is the principal difference between *synchronous* and *asynchronous* sequential logic circuits? [*3 marks*]

   (b) With reference to the Huffman model for a sequential circuit, explain the advantages of designing sequential circuits to operate synchronously, rather than asynchronously. What are the disadvantages? [*8 marks*]

   (c) Outline the procedure you would use to design an implementation of a Mealy machine defined by a given state diagram, using D-type edge-triggerred flip-flops and a PROM. What features in the state diagram determine the number of flip-flops and the size of PROM required? [*10 marks*]

   (d) What additional design steps would be required if an off-the-shelf EPLD was used instead of a PROM, and what problems might arise? Comment on the potential advantages of using an EPLD instead of a PROM. [*4 marks*]

2. (a) Explain, with logic equations and diagrams as appropriate, the design of

    i. a 32-bit ripple carry adder;

    ii. a 32-bit look-ahead carry adder.

    How do they compare in cost in gates, and in operating speed? [*18 marks*]

   (b) Describe the design of a pipelined adder for floating-point numbers. [*7 marks*]

3. Provide short answers to *three* of the following (all parts carry equal credit):

   (a) Describe the structure of a CPU-memory bus and explain how data transfers across it may be synchronised. How are single-byte reads and writes dealt with in a system with 32-bit wide memory?

   (b) Summarize the differences between *static* and *dynamic* memory devices. State typical uses for each.

   (c) What is a *bus arbiter*, and how would one be used?

   (d) What are the functions of the *data path* and *control section* of a processor, and what sub-units might each be constructed from?

[*25 marks*]