UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1998

BEng Honours Degree in Computing Part III
MEng Honours Degrees in Computing Part IV
MSc Degree in Computing Science
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 3.34 / 4.34

MICROCONTROLLERS AND COMPUTER INTERFACING
Thursday, April 30th 1998, 10.00 - 12.00

Answer THREE questions

1   This question deals with enhancing a typical 16 bit microprocessor with software and hardware to provide analog input and output. The microprocessor currently has no input or output interfaces other than those used for keyboards, screens, disks etc. It makes no distinction between memory and other I/O interfaces and has an asynchronous system bus (16 bits for data).

a   What is the *minimum* hardware required to add analog input and output capabilities to this microprocessor?

b   Fully describe any software that is required to support this additional hardware.

c   What constraints (both hardware and software) will restrict the maximum frequency of analog signal that can be successfully digitised? What constraints (both hardware and software) will determine the maximum accuracy of the digitisation?

d   If a 1KHz signal is to be digitised what is the minimum aperture time that will ensure 8 bits of accuracy? What is the minimum sample time that will ensure no aliases are generated?

The four parts carry, respectively, 25%, 25%, 30%, 20% of the marks.

2 a   Describe the three phases of signal conditioning.

b   The response of a transducer is often non-linear. This can be corrected in either software or analog hardware.

   i)   Outline a suitable analog circuit that performs linearisation. What are the limitations of this type of circuit?

   ii) Outline a suitable program that would perform linearisation. What advantages are there to the software solution over the hardware one?

c   What is the Current Transfer Ratio (CTR) in the context of Opto-Couplers? What advantages and disadvantages are there between a high CTR and a low CTR?

The three parts carry, respectively, 30%, 50%, 20% of the marks.

3 a   What are the 8 Vital Parameters of an input transducer? Give a brief, one line, explanation of each parameter.

b   Strain gauges rely on the changes in length of a resister to measure pressure.

   i)   What is the relationship between length and resistance?

   ii) Give two reasons for using a bridge circuit when using strain gauges.

c i)   Describe a motor drive circuit suitable for use with a Bifilar 4 Pole Stepper motor.

   ii) What advantage does a grey coding of the stepper inputs have over a simple binary coding?

The three parts carry, respectively, 30%, 20%, 50% of the marks.

4   A simple drive circuit that has active high and active low outputs can be constructed from an N type FET and a P type FET.

a i)   Describe the operation of such a line driver and contrast it to a system that has an active low driver only.

   ii) Why can such a circuit not be used to drive a bus?

b   Operational amplifiers can be used as voltage multipliers or current to voltage converters. Draw an appropriate circuit diagram for each and state the relationship between the input current or voltage and the output voltage.

c   I have noticed that a single pole, two way switch demonstrates bounce in one direction but not the other.

   i)   Why is this so?

   ii) How can this bounce be overcome in hardware?

   iii) How can the bounce be overcome in software?

The three parts carry, respectively, 40%, 30%, 30% of the marks.

Paper Ends