

Wednesday 15 May 2013 – Morning

**PRINCIPAL LEARNING LEVEL 3
ENGINEERING**

F559/01 Instrumentation and Control Engineering

Candidates answer on the Question Paper.

OCR supplied materials:

None

Other materials required:

- Scientific calculator

Duration: 2 hours



Candidate forename		Candidate surname	
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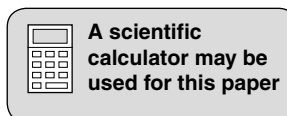
Centre number							Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions in **Section A** and any **four** questions from **Section B**.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.



SECTION A

Answer **all** questions in the spaces provided.

1 Name **two** input devices in a control system.

1

2 [2]

2 Explain what is meant by the term 'closed-loop control'.

.....

.....

..... [2]

3 Draw a labelled diagram of a strain gauge in the space below.

[3]

4 Name one sensor that can be used to monitor fluid pressure.

..... [1]

5 State the formula for overall gain in a system using negative feedback.

..... [1]

6 A pneumatic cylinder with a piston of cross-sectional area 0.005 m^2 and a pressure of 400 kPa on the outstroke.

Calculate the force acting on the piston in the cylinder.

.....

.....

..... [3]

7 Draw the symbol for a double-acting cylinder in the space below.

[2]

8 State **two** practical applications of a Programmable Logic Controller (PLC).

1

2 [2]

9 Explain what is meant by the term 'virtual instrumentation'.

.....

.....

..... [2]

10 Explain why it is necessary to monitor a control system.

.....

.....

.....

..... [2]

[Total: 20]

SECTION B

Answer **four** questions in the spaces provided.

- 1 (a) Explain what is meant by the term 'Block Diagram of a Control System'.

.....
.....
..... [2]

- (b) Draw a block diagram of an open-loop control system.

[2]

(c) Fig. 1 shows the block diagram of a washing machine control system.

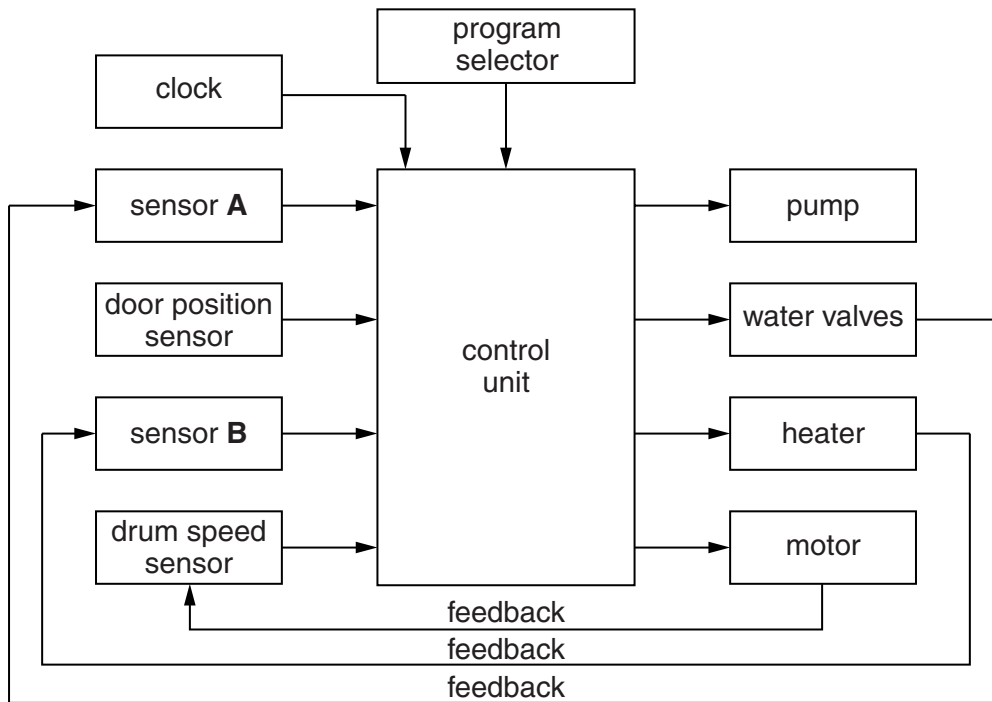


Fig. 1

(i) State what is being measured by sensor A.

Sensor A

(ii) State what is being measured by sensor B.

Sensor B

[2]

(iii) Explain the role sensor A and sensor B plays in the system.

Sensor A

.....

.....

Sensor B

.....

.....

[4]

[Total: 10]

2 (a) Explain what is meant by the term 'negative feedback' in a control circuit.

.....
.....
..... [2]

(b) Give **two** practical applications of the use of a feedback system.

1

2 [2]

(c) An inverting operational amplifier has a gain of 20 and a feedback fraction of $1/20$, which is used to apply negative feedback.

Calculate the closed-loop gain for this amplifier.

.....
.....
.....
.....
..... [2]

(d) In a different operational amplifier with a constant input, the input falls from 40V to 20V when negative feedback is applied.

Calculate the feedback fraction in this system.

.....
.....
.....
.....
..... [4]

[Total: 10]

3 (a) Explain what is meant by the term 'signal transmission'.

.....
.....
..... [2]

(b) Give **two** practical applications of the use of a multiplexer.

1
2 [2]

(c) Describe, in detail, with the aid of a labelled diagram, the use of a multiplexer in a control system.

.....
.....
.....
..... [6]

[Total: 10]

4 (a) Explain what is meant by an analogue signal.

.....
..... [2]

(b) Give **two** practical applications of a Digital to Analogue converter.

1
2 [2]

(c) Describe, in detail, with the aid of a labelled diagram, the operation of a Digital to Analogue converter.

.....
.....
.....
.....
.....
.....
.....
..... [6]

[Total: 10]

5 (a) Explain what is meant by the term 'signal' used in a control system.

.....
.....
..... [2]

(b) State the form of input and output signal for an electronic amplifier.

Input

Output [2]

(c) Explain the effects on the transfer of signals over long distances when using wire cabling.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [6]

[Total: 10]

6 (a) Explain what is meant by the term 'pneumatic ram'.

.....
.....
..... [2]

(b) Give **two** practical applications of a pneumatic ram.

1
2 [2]

(c) Describe, in detail, with the aid of a labelled diagram, how a lever set/reset 5-port valve can be used to control a double-acting cylinder.

.....
.....
.....
.....
.....
..... [6]

[Total: 10]

7 (a) Explain what is meant by the term 'production line monitoring'.

.....
.....
..... [2]

(b) State **two** practical applications that use a monitored control system other than production line monitoring.

1
2 [2]

(c) Explain, in detail, the function of an embedded control system used in domestic white goods e.g. washing machine.

.....
.....
.....
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.....
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.....
.....
..... [6]

[Total: 10]

8 (a) Give **two** reasons for using simulation software to construct a circuit.

1

2

[2]

(b) State the purpose of using a virtual Cathode Ray Oscilloscope (CRO) for testing a simulated circuit.

.....

..... [2]

(c) Fig. 2 shows a virtual Oscilloscope being used in a simulated situation.

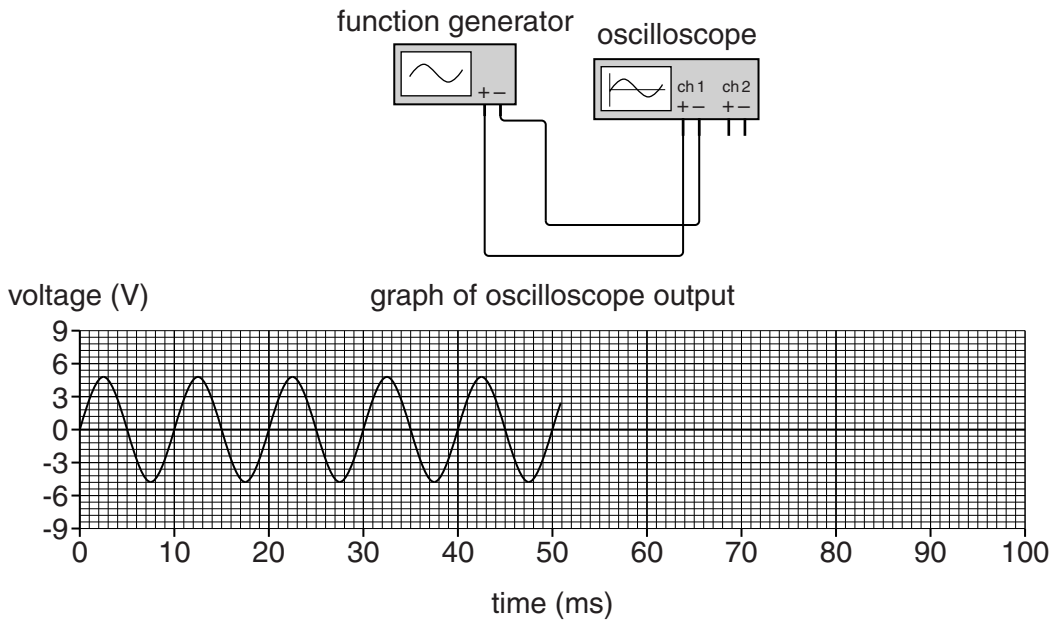


Fig. 2

Describe what happens to the signal when the following controls are adjusted: [6]

Time base

.....

.....

.....

Frequency (X control)

.....

.....

.....

Amplitude (Y control)

.....

.....

.....

[Total: 10]

END OF QUESTION PAPER

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