

**Wednesday 9 January 2013 – Afternoon**

**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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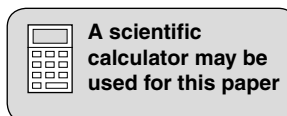
Centre number							Candidate number				
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**INSTRUCTIONS TO CANDIDATES**

- 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 **12** pages. Any blank pages are indicated.



**SECTION A**

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

1 Draw a block diagram of a system showing the input, control, output and feedback.

[4]

2 State the formula for overall gain in a system using positive feedback.

..... [1]

3 Explain what is meant by the term 'open loop control'.

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

4 Name **two** sensors that can be used to monitor fluid pressure.

1 .....  
2 ..... [2]

5 Explain what is meant by the term 'actuator'.

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

6 State **three** characteristics of an ideal operational amplifier.

1 .....  
2 .....  
3 ..... [3]

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

[2]

8 State **two** practical applications that use a servo control system.

1 .....

2 ..... [2]

9 State the type of signal processing element that could be used to:

(a) transform an input of an analogue voltage into a digital signal

..... [1]

(b) select one of a number of analogue signals for further processing

..... [1]

[Total: 20]

**SECTION B**

Answer any **four** questions in the space provided.

1 (a) State **two** practical applications of a Light Dependant Resistor (LDR).

1 .....

2 ..... [2]

(b) Describe what happens to the resistance of an LDR if the level of the light falling on it increases.

.....

..... [2]

(c) Describe in detail, with the aid of a labelled circuit diagram, how an LDR can be used to operate a control circuit.

.....

.....

.....

.....

.....

.....

..... [6]

**[Total: 10]**



3 (a) Give the meaning of the term 'feedback' in a control system.

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

(b) Draw the circuit diagram for an inverting operational amplifier in the space below.

[2]

(c) In a positive feedback amplifier the gain is 100.

Calculate the overall gain when the feedback fraction is:

(i)  $1/200$

.....  
.....  
..... [3]

(ii)  $-1/200$

.....  
.....  
.....  
..... [3]

[Total: 10]

4 (a) Explain the purpose of a 'monitoring system'.

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

(b) Give **two** practical applications where you would find a monitoring system.

1 .....

2 ..... [2]

(c) The following are examples of monitoring equipment for a domestic property or small business:

- |                                      |                         |
|--------------------------------------|-------------------------|
| <b>Detectors</b>                     | <b>Panic button</b>     |
| <b>Remote keypad</b>                 | <b>Bell-box</b>         |
| <b>Speaker/microphone</b>            | <b>Frequency filter</b> |
| <b>Central alarm-management unit</b> |                         |

Choose **three** of these examples and explain in detail, how they are used in a monitoring system.

Example 1 .....

.....  
.....  
.....

Example 2 .....

.....  
.....  
.....

Example 3 .....

.....  
.....  
.....

[6]

[Total: 10]

5 (a) Explain what is meant by the term 'signal conditioning'.

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

The block diagram in Fig. 2 shows a control system.

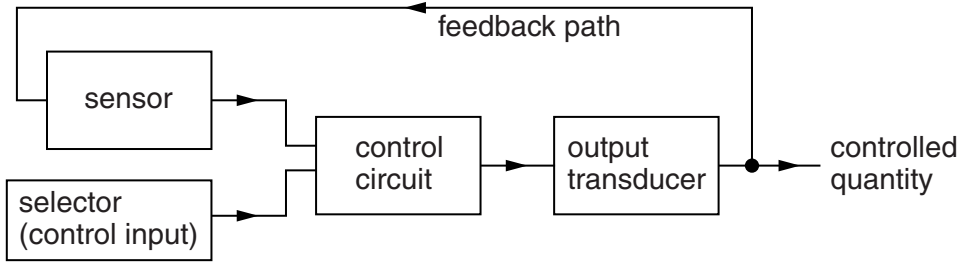


Fig. 2

(b) Describe the purpose of the feedback path.

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

(c) Explain, in detail, the function of the:

- (i) selector .....
- .....
- .....
- (ii) control circuit .....
- .....
- .....
- (iii) output transducer .....
- .....
- .....

[6]

[Total: 10]



6 (a) Explain what is meant by the term 'proportional integral derivative mode (PID) controller'.

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

(b) Give **two** practical applications of a PID controller.

1 .....

2 ..... [2]

(c) Describe in detail, the manner in which PID's have had an impact on instrumentation and control systems.

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

[Total: 10]

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

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

(b) Name **two** types of sensing element other than a piezo-electric crystal.

1 .....  
2 ..... [2]

(c) Describe in detail, with the aid of a labelled diagram, the action of a piezo-electric ultrasonic wave detector.

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

[Total: 10]

8 (a) Explain what is meant by the term 'simulation software'.

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

(b) Give **two** benefits of using simulation software.

1 .....

2 ..... [2]

(c) Fig. 3 shows a multi-meter being used to measure voltage across a motor.

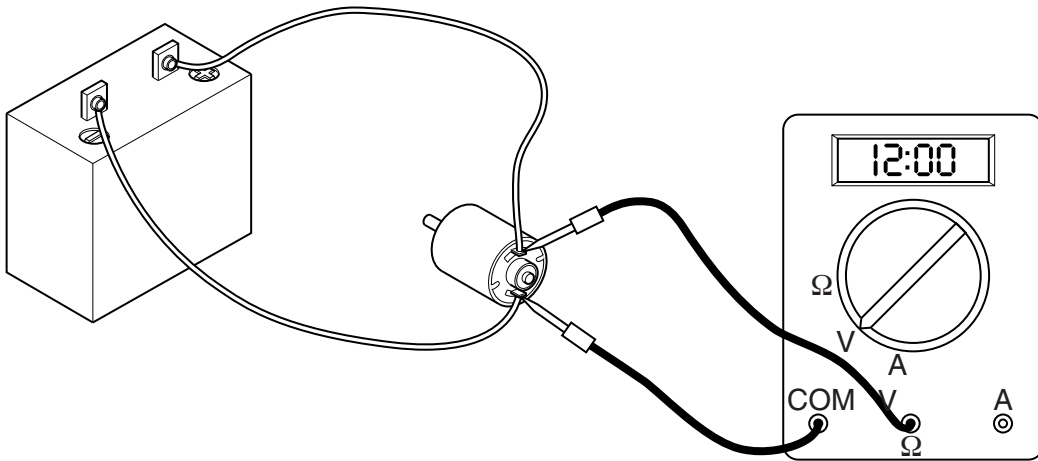


Fig. 3

(i) The next test is to measure current.

State **three** changes needed to enable the multi-meter to measure current in the motor.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Describe why these changes are necessary.

.....

.....

.....

..... [3]

[Total: 10]

**END OF QUESTION PAPER**



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