



Wednesday 7 January 2015 – 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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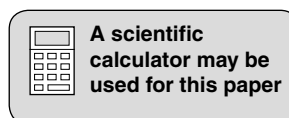
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- 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.

1 State which **two** of the following are input devices:

- DC Motor
- Strain Gauge
- Relay
- Signal Lamp
- Thermistor.

1

2 [2]

2 Explain what is meant by the term 'feed-forward control'.

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

3 Explain what is meant by the term 'data signal transmission'.

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

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

[2]

5 On the graph below, label the diagram to show the -3dB point, the unity gain point and the slope.

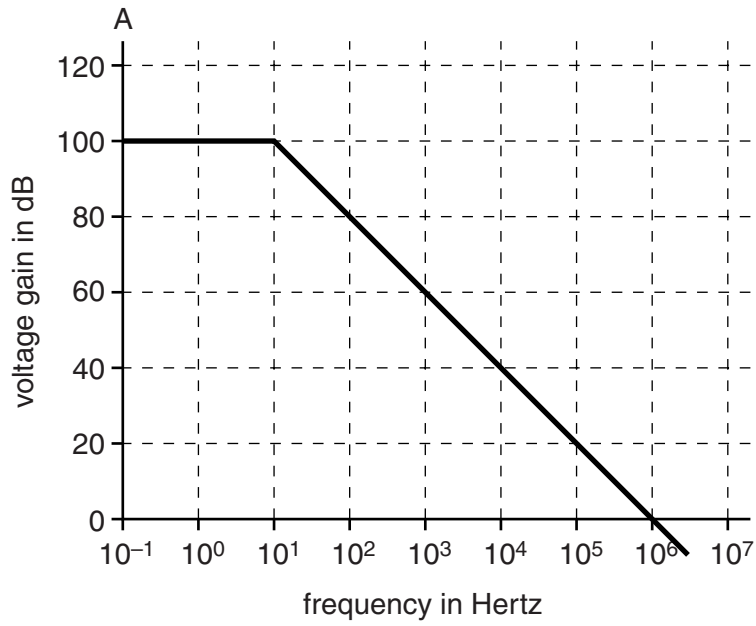


Fig. 1

[3]

6 Name a sensor that can be used to monitor:

(a) pressure in a pressurised pipe, giving a visual display of the pressure

.....

(b) rapidly changing temperature.

.....

[2]

7 Calculate the gain for a non-inverting operational amplifier when the feedback resistor R_f is 470K and the input resistor R_1 is 47K.

.....

.....

..... [2]

8 Complete the table with one of the following terms:

- Proportional control
- Proportional plus integral control
- Proportional plus derivative control
- Derivative control.

Statement	Term
A steady state error will not occur when there is a change to the set value with a control system.	

[1]

9 Give **two** benefits of a specific simulation software package used in engineering.

1

.....

2

.....

[2]

10 Name **two** test instruments that include a visual display unit.

1

2

[2]

[Total: 20]

5
SECTION B

Answer any **four** questions.

1 Fig. 1 shows the block diagram of a control system.



Fig. 1

(a) Explain what is meant by the terms 'Input' and 'Output' in this block diagram.

Input

.....

.....

..... [2]

Output

.....

.....

..... [2]

(b) Explain the function of the processing stage shown in the block diagram.

.....

.....

.....

..... [2]

(c) Describe **two** practical applications of a control system that you have studied.

1

.....

2

.....

[4]

[Total: 10]

Turn over

- 2 (a) An amplifier with a voltage gain of 20000 is used in a negative feedback circuit when the feedback fraction is 0.045. Calculate the overall gain.
If the voltage gain now drops by one-half of its original value because of supply voltage variations, what would be the value of the new voltage gain?

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

- (b) In a positive feedback amplifier the gain is 250. Calculate the overall gain when the feedback fraction is:

(i) 0.002

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

(ii) -0.004

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

- (c) Another amplifier having an open loop gain of 500 has overall negative feedback applied which reduces the overall gain to 125. Calculate the value of the feedback fraction.

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

[Total: 10]

3 Fig. 2 shows a circuit diagram.

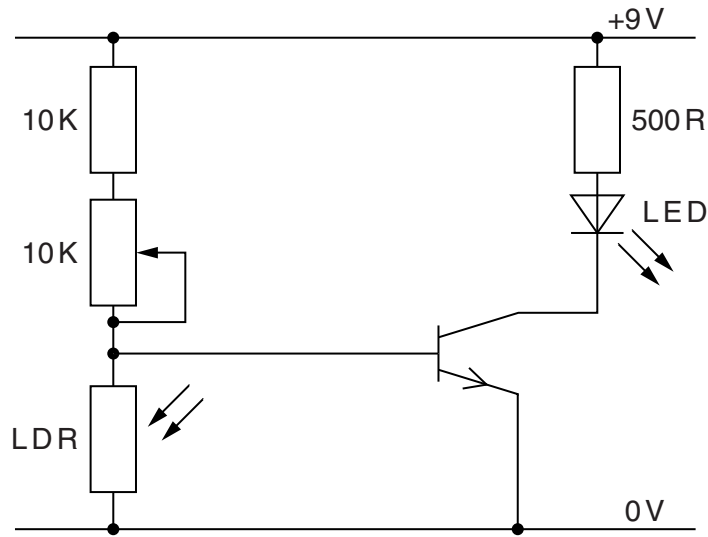


Fig. 2

(a) What do the letters LDR and LED stand for?

LDR

LED

[2]

(b) Describe how the circuit in Fig. 2 works.

.....

 [5]

(c) Explain what happens if the position of the LDR and the 10K resistor/10K potentiometer is reversed.

.....

 [3]

[Total: 10]

Turn over

4 (a) Draw a labelled diagram of an operational amplifier (op amp) showing the inverting input, non-inverting input and output.

[4]

(b) State **two** main properties of an operational amplifier.

1

2

[2]

(c) Give **four** advantages of negative feedback in an operational amplifier.

1

.....

2

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3

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4

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[4]

[Total: 10]

5 (a) Explain what is meant by the term 'Programmable Logic Controller'.

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

(b) Programmable Logic Controllers contain six basic components:

- Central Processing Unit (CPU)
- Rack or mounting
- Input assembly
- Output assembly
- Power supply
- Programming unit.

Explain the function of any **four** of these components in a Programmable Logic Controller.

1

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2

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3

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4

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..... [8]

[Total: 10]

6 (a) Explain what is meant by a 'pneumatic system'.

.....

 [2]

(b) Fig. 3 shows a pneumatic circuit.

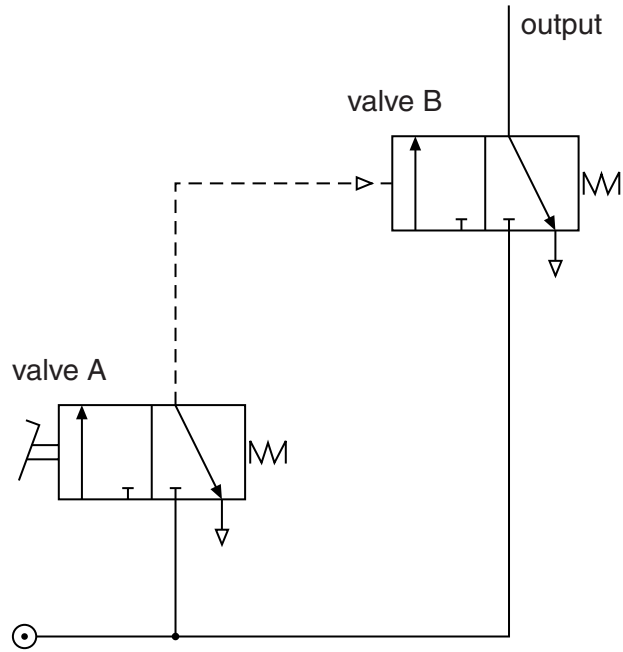


Fig. 3

(i) Name the component that is operating control valve A.

..... [1]

(ii) State the full name of valve B.

..... [1]

(c) Explain the operation of the pneumatic circuit shown in Fig. 3.

.....

 [6]

[Total: 10]

7 (a) Give **two** reasons for using a computer controlled monitoring system rather than people employed to do the same task.

1

.....

2

.....

[2]

(b) Explain how monitoring systems can be used to address the following needs:

- Energy conservation
- Fire detection control
- Quality Control and Assurance
- Security.

Energy conservation

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.....

Fire detection control

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Quality Control and Assurance

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Security

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.....

[8]

[Total: 10]

