

OCR

Oxford Cambridge and RSA

Tuesday 2 June 2015 – 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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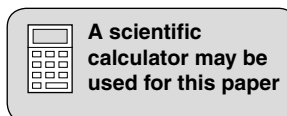
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

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



2
SECTION A

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

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

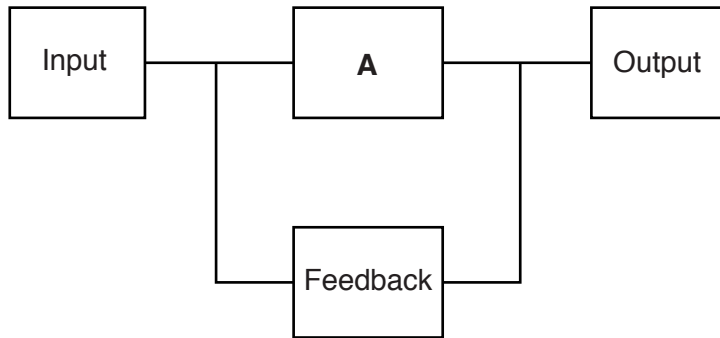


Fig. 1

(a) Draw on Fig. 1 arrowheads (>) to show the direction of flow throughout the system.

..... [1]

(b) State what Block **A** represents in Fig. 1.

..... [1]

2 Name **two** output devices in a control system.

1

2

[2]

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

- Liquid Crystal Display (LCD)
- Pressure sensor
- Signal Lamp
- Keypad
- Solenoid.

1

2

[2]

4 Explain what is meant by the term ‘two-input multiplexer’.

.....
 [2]

5 Complete the sensor column in the table by writing in the correct word from the list below:

- Potentiometer
- Load cell
- Strain Gauge
- Thermistor
- Ammeter.

Situation	Sensor
Monitoring the temperature of a liquid in the range 10°C to 80°C.	
To measure a change in dimension on a crack in a wall	
Measure the weight of a truck on a weighbridge	

[3]

6 A pneumatic cylinder has a piston of cross sectional area 0.004 m². Calculate the force exerted by the out-stroking piston when the working pressure in the cylinder is 2000 kNm⁻².

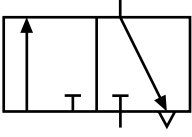
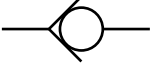
.....

 [2]

7 State the use of the formula $G = A/(1 + \beta A)$.

..... [1]

8 Complete the table by naming each component from its graphical symbol shown.

Graphical symbol	Component
	
	

[2]

9 Draw a basic circuit diagram of an inverting operational amplifier.

[2]

10 Name **two** features of a burglar alarm access keypad.

1

2

[2]

[Total: 20]

5
SECTION B

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

1 (a) Fig. 2 shows a block diagram of a chemical production process.

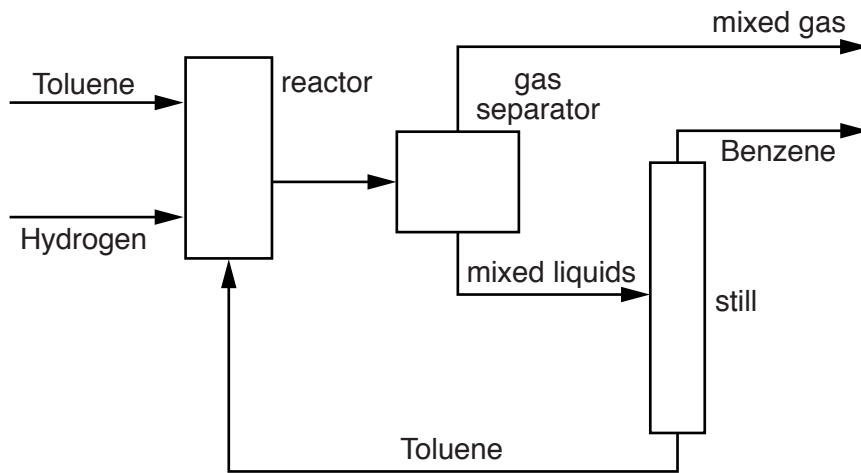


Fig. 2

(i) Name the **two** inputs shown on the block diagram.

- 1
- 2 [2]

(ii) Name **one** chemical output shown on the block diagram.

..... [1]

(iii) Name the chemical recovered through feedback.

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

(b) An amplifier has an overall gain of 10^3 with a feedback fraction of 1×10^{-3} . Calculate the open loop gain when positive feedback is applied.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 10]

2 (a) Explain what is meant by each of the following terms:

(i) Light Sensor.

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

(ii) Signal processor.

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

(iii) Data presentation.

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

(iv) Transducer.

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

[8]

(b) Name a sensor that could be used to monitor:

(i) a rapidly changing temperature

.....

(ii) the pressure in a corrosive fluid environment.

.....

[2]

[Total: 10]

Turn over

3 (a) State **two** differences between a single acting pneumatic cylinder and a double acting pneumatic cylinder.

.....

.....

.....

..... [2]

(b) Fig. 3 shows part of a pneumatic system.

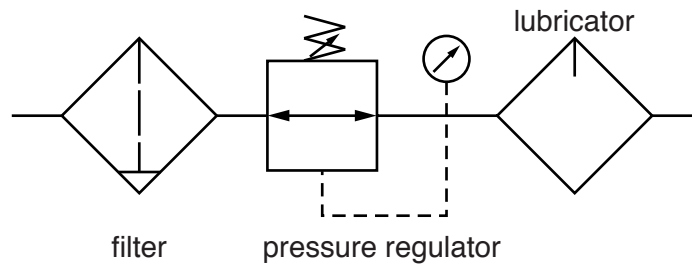


Fig. 3

Explain the function of each part.

Filter

.....

.....

.....

Pressure regulator

.....

.....

.....

Lubricator

.....

.....

.....

[6]

(c) Fig. 4 shows a 5/2 control valve.

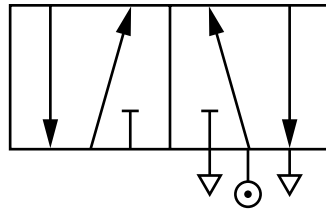


Fig. 4

- (i) '5' indicates the number of
- (ii) '2' indicates the number of

[2]

[Total: 10]

- 4 (a) Complete the right hand column of the table below, by matching a device from the following list to each function:

Orifice Plate
 Operational Amplifier
 Photoelectric Sensor
 Pneumatic ram
 Programmable Logic Controller
 Thermistor.

Function	Device
Comparing the speed of a direct current motor with desired speed.	
Measuring the temperature of car engine coolant.	
Controlling the rate at which liquid passes through a pipe.	
Controlling the upward or downward movement of a robotic arm.	
Identifying faulty components moving along a conveyor belt.	

[5]

(b) In control systems there are several types of PID controllers.
Describe how each type of control listed reacts to error changes.

Proportional mode
.....
..... [1]

Proportional plus derivative mode
.....
..... [2]

Proportional plus integral mode
.....
..... [2]

[Total: 10]

- 5 (a) Describe how the resistance of a negative temperature coefficient (NTC) thermistor will change due to variation in temperature.

.....

.....

.....

..... [2]

- (b) Fig. 5 shows a partly completed circuit diagram.

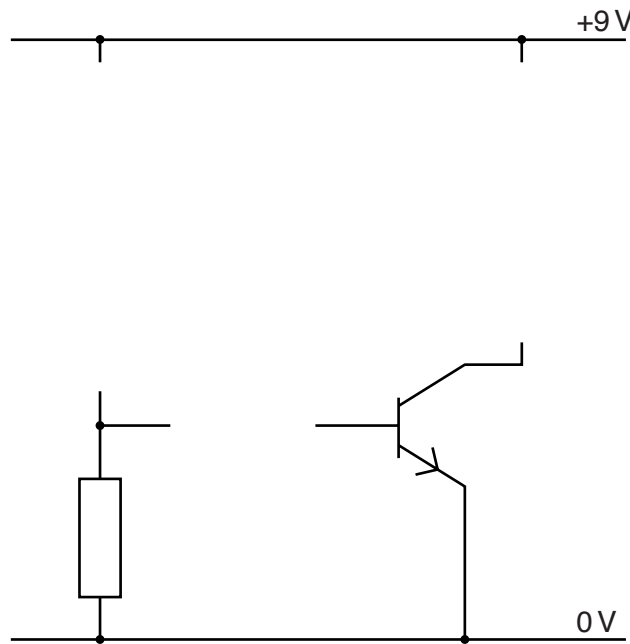


Fig. 5

- (i) Complete the circuit diagram so that a thermistor will turn on a signal lamp under warm or hot conditions.

Use the graphical symbols provided in the table below:

Component	Symbol
Signal lamp	
Base resistor	
Thermistor	

[3]

(ii) Describe how the circuit works.

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

6 (a) Explain what is meant by the term 'servo-mechanism'.

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

(b) State **one** practical application for each of the following types of control system.

Servo control

Temperature control

Positional control [3]

(c) Describe with the aid of a labelled diagram any **one** of the following control systems that you have used during the course of your studies.

Servo control
Temperature control
Positional control

.....
.....
.....
.....
.....
.....
..... [5]

[Total: 10]

7 (a) Explain why it is necessary to have alarm systems inside and outside a workshop building.

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

(b) State **three** features that you would expect to find on a system that is monitoring a factory production line.

1
2
3 [3]

(c) Other than an alarm system, name **two** other industrial applications that use a monitoring system.

1
2 [2]

(d) Explain what type of embedded system is used in a digital camera.

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

[Total: 10]

8 (a) Name **four** instruments that can be used in a virtual situation to test electronic circuits.

- 1
- 2
- 3
- 4

[4]

(b) A simulation software package uses instruments to take measurements.

(i) Fig. 6 shows a single resistor.

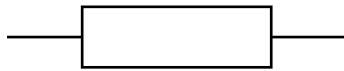


Fig. 6

Using the resistor in Fig. 6 draw a labelled circuit diagram to show how the resistance of the resistor can be measured using one instrument. [2]

(ii) Fig. 7 shows the same single resistor.

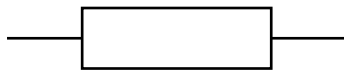


Fig. 7

Using the resistor in Fig. 7 draw another labelled circuit diagram to show how the resistance of the resistor can be measured but this time use a power supply and any other suitable instruments. [4]

[Total: 10]

END OF QUESTION PAPER

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