OCR
RECOGNISING ACHIEVEMENT

PRINCIPAL LEARNING
LEVEL 3

ENGINEERING

Instrumentation and Control Engineering

F559

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
- Scientific calculator

Thursday 13 January 2011
Morning

Duration: 2 hours

OCE/27632

F559

Candidate forename		Candidate surname	

Centre number						Candidate number				

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. Pencil may be used for graphs and diagrams only.
- 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).
- Answer **all** the questions in **Section A** and any **four** questions from **Section B**.
- 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.

A scientific calculator may be used for this paper

Section A

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

1 The block diagram in Fig. 1 shows the layout of a central heating system.

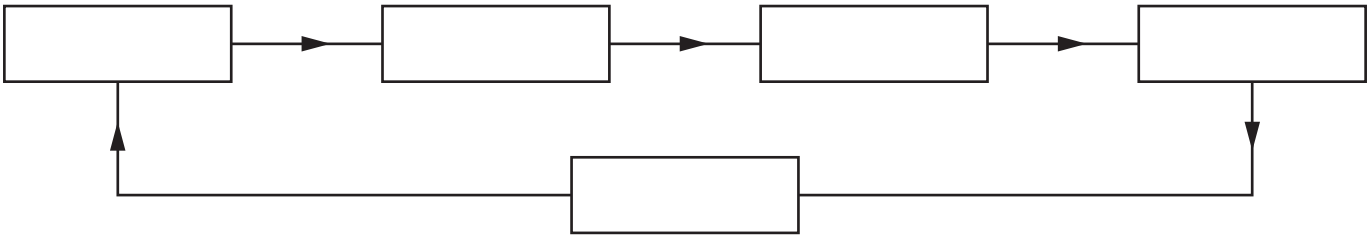

Fig. 1

Complete the block diagram by filling in the empty boxes using the items listed below.

Feedback
Control unit
Temperature sensor
Boiler and radiator pump
Boiler switch

[5]

2 Name **two** types of system that use feedback control other than a central heating system.

(i) .....

(ii) .....

[2]

3 State which **two** of the following are passive transducers.

Thermistor
Thermocouple
Solar cell
Strain gauge.

(i) .....

(ii) .....

[2]

4 Name **one** input device and **one** output device used in a control system.

Input device .....

Output device ..... **[2]**

5 Explain what is meant by the term 'instrument display'.

.....

.....

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

6 State **two** difficulties encountered when transmitting signals using wires when the frequency of the system increases above 2500 MHz.

(i) .....

(ii) .....

[2]

7 Explain what is meant by the term 'virtual test equipment'.

.....

.....

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

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

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

9 Explain why it is beneficial to have a video camera in a system capable of monitoring illegal activity.

.....

.....

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

[Section A Total: 20]

Section B

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

1 **(a)** State the function of a strain gauge and give one reason for measuring strain.

.....

.....

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

(b) State **three** practical applications where a strain gauge is used.

1 .....

2 .....

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

(c) Describe in detail, with the aid of a labelled diagram, how a strain gauge circuit is used in a control system.

.....

.....

.....

.....

.....

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

[Total: 10]

2 **(a)** **(i)** State which type of control system is required to maintain a room at a constant temperature.

.....

(ii) Name an input device used to sense temperature in a control system.

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

(b) Explain why it is important to monitor and control the temperature of a room.

.....

.....

.....

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

Fig. 2 shows a diagram of a control system.

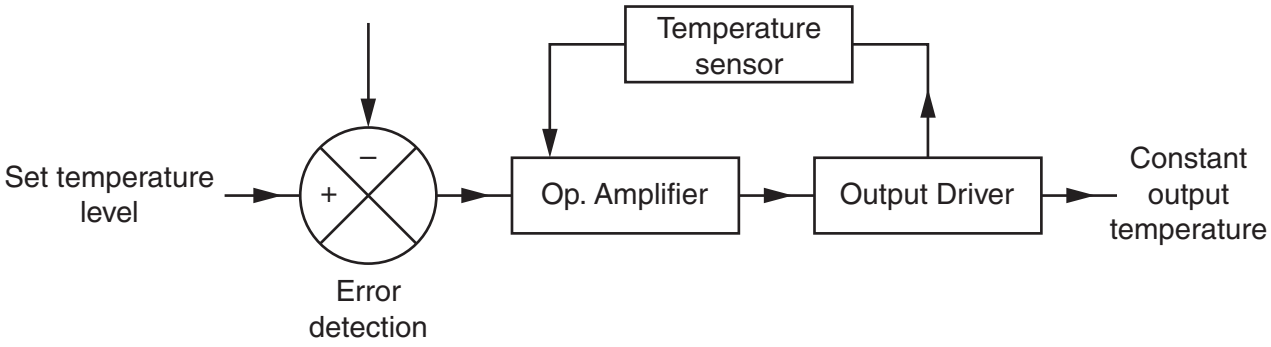

Fig. 2

(c) Describe in detail, how the system in Fig. 2 can be used to control the temperature of a room.

.....

.....

.....

.....

.....

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

[Total: 10]

3 **(a)** Give the meaning of the term 'closed loop' control.

.....

.....

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

(b) Explain, using an example, the advantages of a closed loop control system over an open loop control system.

.....

.....

.....

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

(c) Describe in detail, with the aid of a labelled block diagram, how a mechanical closed loop system can be used to maintain the level of water in a storage tank.

.....

.....

.....

.....

.....

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

[Total: 10]

4 **(a)** Draw, in the space provided, the symbol for the following pneumatic components:

(i) a single acting spring return cylinder.

[1]

(ii) a double acting cylinder.

[1]

(b) Explain how a single acting cylinder is used in a pneumatic control system.

.....

.....

.....

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

(c) Describe in detail, with the aid of a labelled diagram, how a double-acting cylinder can be used with a five-port valve.

.....

.....

.....

.....

.....

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

[Total: 10]

5 **(a)** Give **two** practical applications where a pressure gauge is used.

1 .....

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

(b) Explain the difference between absolute pressure and gauge pressure.

.....

.....

.....

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

(c) Describe in detail, with the aid of a diagram, the construction and action of a bellows pressure gauge. Show how a change in pressure is converted into an analogue electrical signal.

.....

.....

.....

.....

.....

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

[Total: 10]

6 **(a)** Draw a labelled circuit diagram of an ideal operational amplifier.

[2]

(b) Name **three** characteristics of an ideal operational amplifier.

1 .....

2 .....

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

(c) **(i)** An amplifier with a voltage gain of 20000 is used in a negative feedback circuit with a feedback fraction of 0.02.
Calculate, correct to two decimal places, the overall gain.

.....

.....

.....

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

(ii) An amplifier having an open loop gain of 600 has overall negative feedback applied which reduces the overall gain to 100.
Calculate the value of the feedback fraction.

.....

.....

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

[Total: 10]

7 **(a)** Draw a block diagram for an analogue-to-digital (A to D) converter. Show on your block diagram a typical input and output signal.

[2]

(b) Explain why it is better to use an R-2R ladder DA converter as compared to a binary-weighted DA converter.

.....

.....

.....

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

(c) Describe in detail, with the aid of a circuit diagram, the principle of operation of an R-2R ladder DA converter.

.....

.....

.....

.....

.....

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

[Total: 10]

8 **(a)** Give **two** practical applications for a liquid crystal display (LCD).

1 .....

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

(b) Explain the advantages of using liquid crystal displays over other types of display.

.....

.....

.....

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

(c) Explain in detail, with the aid of diagrams, the difference between a transmissive mode LCD and a reflective mode LCD.

.....

.....

.....

.....

.....

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

[Total: 10]

[Section B Total: 40]

PLEASE DO NOT WRITE ON THIS PAGE