

**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 14 January 2010  
Morning**

**Duration: 2 hours**



Candidate Forename		Candidate Surname	
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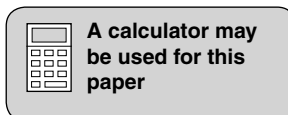
Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions in **Section A** and any **four** questions from **Section B**.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**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 For a system, explain what is meant by the term input.

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

2 Draw a block diagram to represent a system that has feedback.

[2]

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

(i) .....  
(ii) ..... [2]

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

(i) .....  
(ii) ..... [2]

5 Explain what is meant by an operational amplifier controller.

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

6 Explain the difference between an analogue voltmeter and a digital voltmeter.

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

7 Explain how a computer package is used to test a digital instrumentation and control circuit.

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

8 Name **two** devices that measure fluid flow in a control system.

(i) .....  
 (ii) ..... [2]

9 Complete the table below by selecting and writing in, a sensor output for each of the situations below.

Choose from the following list:

**displacement, resistance, inductor, capacitance, voltage.**

Situation	Sensor output
A thermocouple which has an input of a temperature change	
A strain gauge which has an input of a change in length	
A Bourdon gauge which has an input of a pressure change	
A linear variable differential transformer which has an input of a pressure change	

[4]

[Section A Total: 20]

**Section B**

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

- 1 (a) Give **two** practical applications of a (PID) proportional – integral – derivative controller.

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

- (b) Explain, using examples, how PID controllers have had an impact on instrumentation and control systems.

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

- (c) Describe in detail, with the aid of a labelled diagram, how a PID controller could be used in a control system.

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

**[Total: 10]**

2 (a) State **two** practical applications of a LDR (light dependent resistor) in a control circuit.

1 .....

2 ..... [2]

(b) Explain how a light dependent resistor works.

.....

.....

..... [3]

(c) Describe, with the aid of a labelled block diagram **and** a labelled circuit diagram how a light dependent resistor can be used in control applications.

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

3 (a) Give **two** practical applications of circuits that make use of a closed loop system.

1 .....

2 ..... [2]

(b) Explain, with the aid of a labelled diagram the difference between an open loop system and a closed loop system.

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

(c) An amplifier has an overall gain of  $10^3$  with a feedback fraction of  $0.9 \times 10^{-3}$ . Calculate the open loop gain when negative feedback is applied.

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

[Total 10]

4 (a) State **two** advantages of using a wave guide as compared to a two wire type cable.

advantage 1 .....

advantage 2 ..... [2]

(b) Explain, with the aid of a labelled diagram, what is meant by wave guides when related to signals.

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

(c) Describe in detail, with the aid of a labelled diagram, the difference between a transverse electric mode and a transverse magnetic mode of propagation of a signal.

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

[Total: 10]

Turn over

5 (a) Name **two** applications for a control system.

1 .....

2 ..... [2]

(b) Explain what is meant by a control system.

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

..... [3]

(c) Describe, in detail, the control system shown in Fig. 1 which is being used to control the pressure of a fuel supply system.

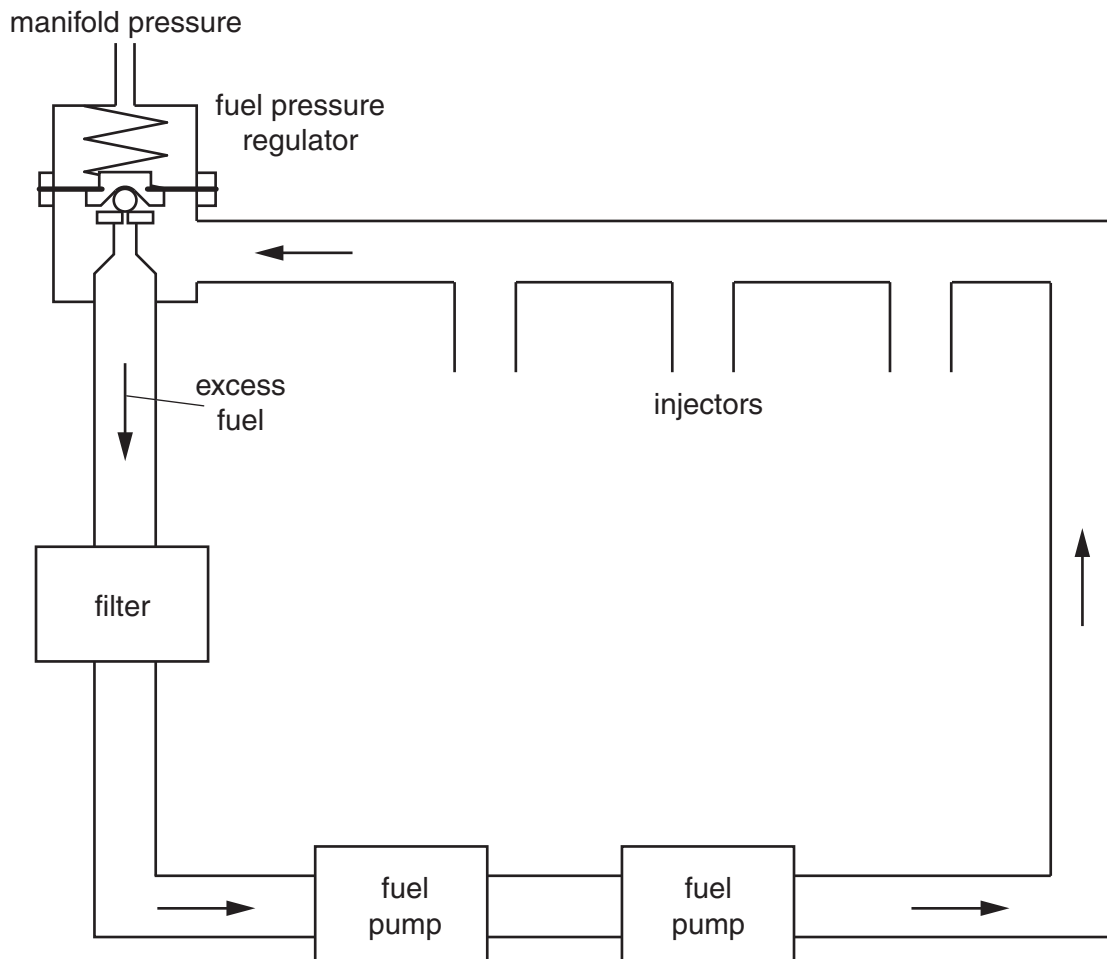


Fig. 1



.....

.....

.....

.....

.....

.....

..... [5]

**[Total: 10]**

6 (a) Name **two** types of display unit other than a seven-segment display.

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

(b) Explain, using **two** examples, the advantages of a seven-segment display.

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

(c) Describe in detail, with the aid of a labelled diagram, the principle of operation of a seven segment display.

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

[Total: 10]

7 (a) State **two** practical applications that use a pneumatic cylinder as a linear actuator.

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

(b) A pneumatic cylinder has an internal diameter of 60mm and a pressure difference of 500kPa.  
Calculate the force acting on the cylinder using the formula  $\text{Force} = \text{Pressure} \times \text{Area}$ .

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

(c) Describe in detail, with the aid of a labelled diagram, how a push-button operated 3-port valve can be used to control a single acting cylinder.

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

[Total: 10]

8 (a) State **two** practical applications that use a monitored control system.

1 .....

2 ..... [2]

(b) Explain why it is often necessary to monitor a control system.

.....

.....

.....

.....

..... [3]

(c) Describe in detail, with the aid of a labelled block diagram, the monitoring control system for an engineering production line of your choice.

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

[Section B Total: 40]

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