



- 1 (a) (i) Explain what is meant by a **Subroutine** and an **Interrupt** as they apply to microprocessor systems.

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.....[2]

- (ii) Explain why Subroutines are useful.

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.....[2]

- (iii) Explain why Interrupts are useful.

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.....[2]

- (b) Describe how a microprocessor responds when it detects an interrupt. Include in your answer a description of the stack and how it is used at the beginning and end of the interrupt.

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.....[5]

- 2 Fig. 2.1 shows a three terminal component often used in control circuits.

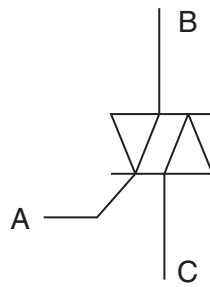


Fig. 2.1

- (a) For the component shown in Fig. 2.1,

- (i) state its name

.....[1]

- (ii) identify the terminals

A =

B =

C =[2]

- (iii) describe how it behaves.

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.....

.....[3]

Fig. 2.2 shows a control circuit for a powerful mains lamp using the component of Fig. 2.1.

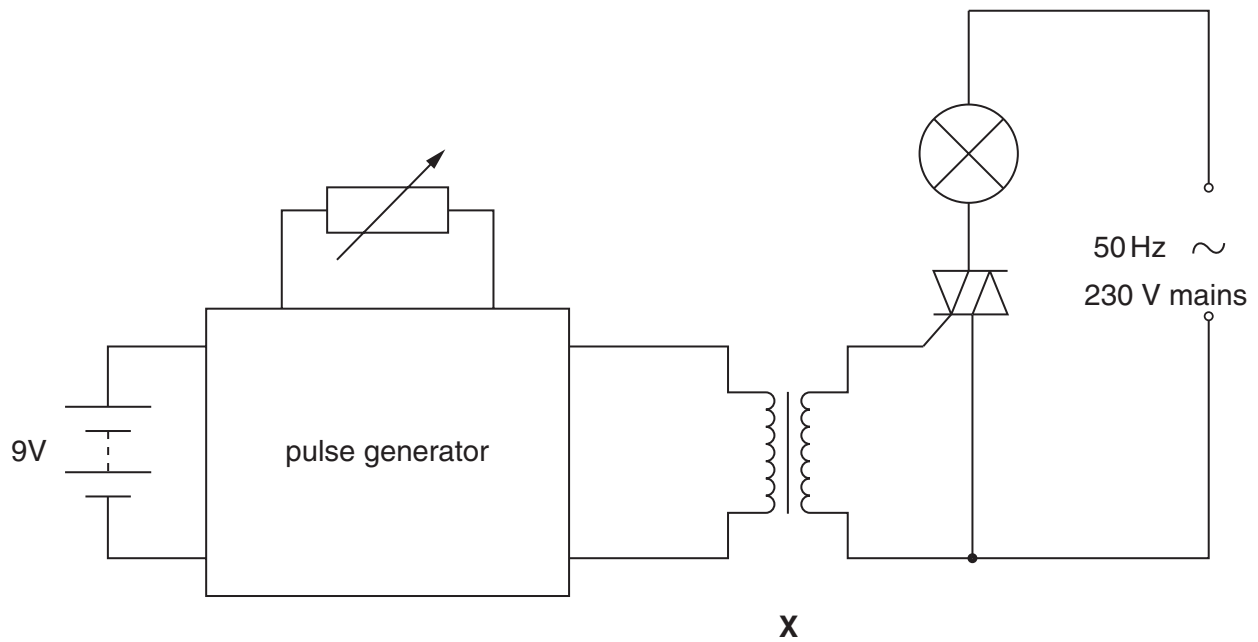


Fig. 2.2

The pulse generator circuit operates from a 9V battery and produces brief voltage pulses at a frequency governed by the resistance of the variable resistor. Fig. 2.3 shows two typical outputs of the generator.

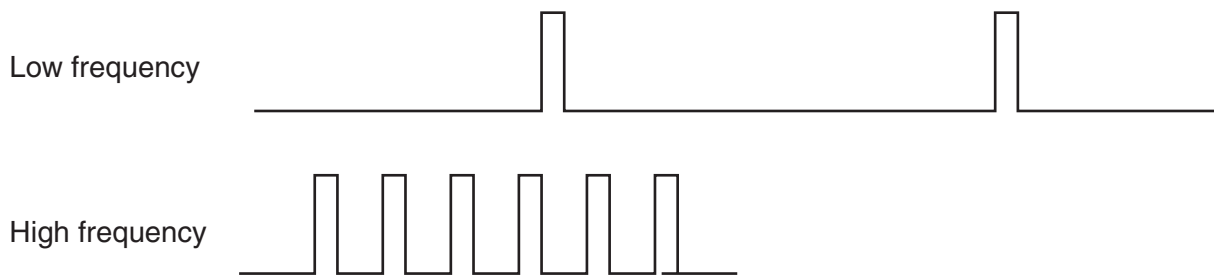


Fig. 2.3

- (b) The component labelled **X** is known as a pulse transformer.
Describe how it behaves and explain why it has been included in the circuit of Fig. 2.2.

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.....[3]

- (c) Fig. 2.4 shows the mains voltage supplied to the lamp circuit and the corresponding pulse generator output.

Draw a sketch graph to show the resulting voltage across the lamp.

[4]

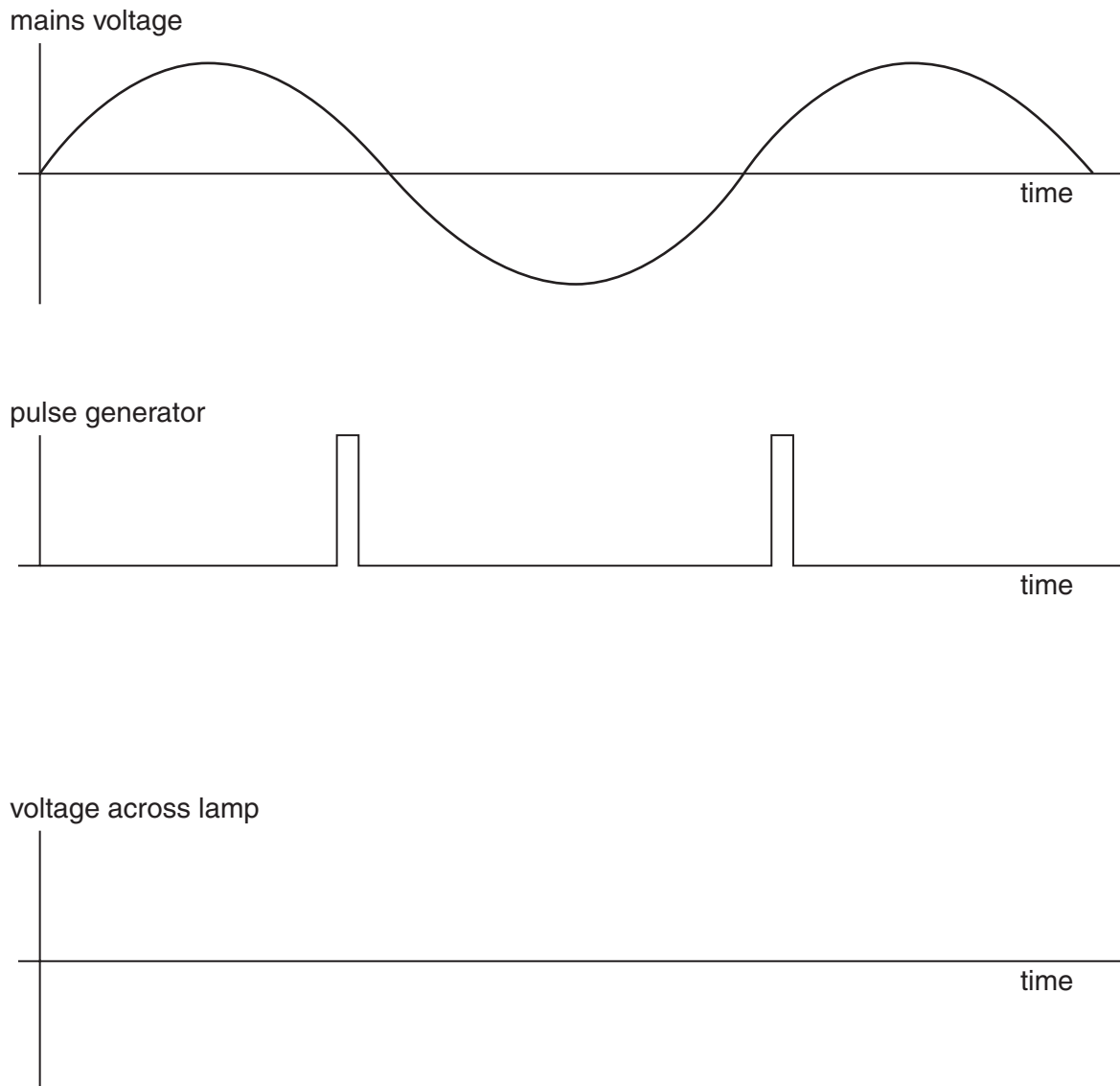


Fig. 2.4

- (d) The mains voltage is 230V r.m.s and the mean power drawn by the lamp is 450W when operated directly across the mains. Calculate,

- (i) the r.m.s current in the lamp

r.m.s current = A [3]

- (ii) the peak current in the lamp.

peak current = A [1]

[Turn over]

- 3 Fig. 3.1 shows part of a circuit diagram to allow the position of a rudder on a boat to be controlled by a motor without oscillations occurring.

master potentiometer

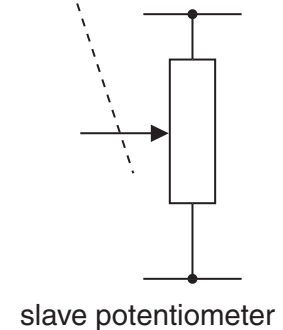
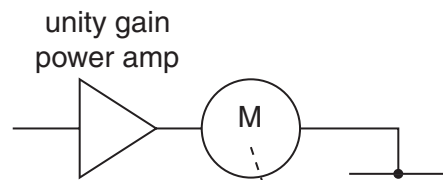
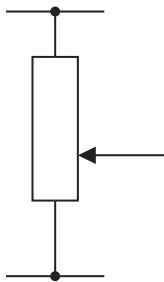


Fig. 3.1

The master potentiometer controls the angular position of the rudder. The motor M which moves the rudder is also mechanically linked to the wiper of a slave potentiometer. When the master wiper is moved, the motor moves both the rudder and slave wiper until the slave wiper position matches that of the master. When the two positions are the same, the motor stops.

- (a) Complete the circuit diagram of Fig. 3.1 of a dc servo control system which will allow the slave wiper to copy accurately the position of the master wiper. You should label the voltage on each rail. [7]

- (b) Explain how your circuit operates and how you prevented oscillations occurring.

.....

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.....[4]

- 4 (a) Explain what is meant by a fetch-execute cycle in the context of microprocessor systems.

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.....[3]

- (b) In the space below, draw a labelled block diagram of a simple microprocessor system.

Your diagram should include

- the clock, CPU, memory and ports
- the connections between blocks
- the names of the connections

[8]

- 5 Fig. 5.1 shows the 8-bit output port of a microprocessor together with four 7-segment LED displays and their corresponding BCD to 7-segment decoder/drivers. W, X, Y and Z are the common cathode terminals of each 7-segment LED.

(a) Explain what is meant by the abbreviation BCD.

.....

[2]

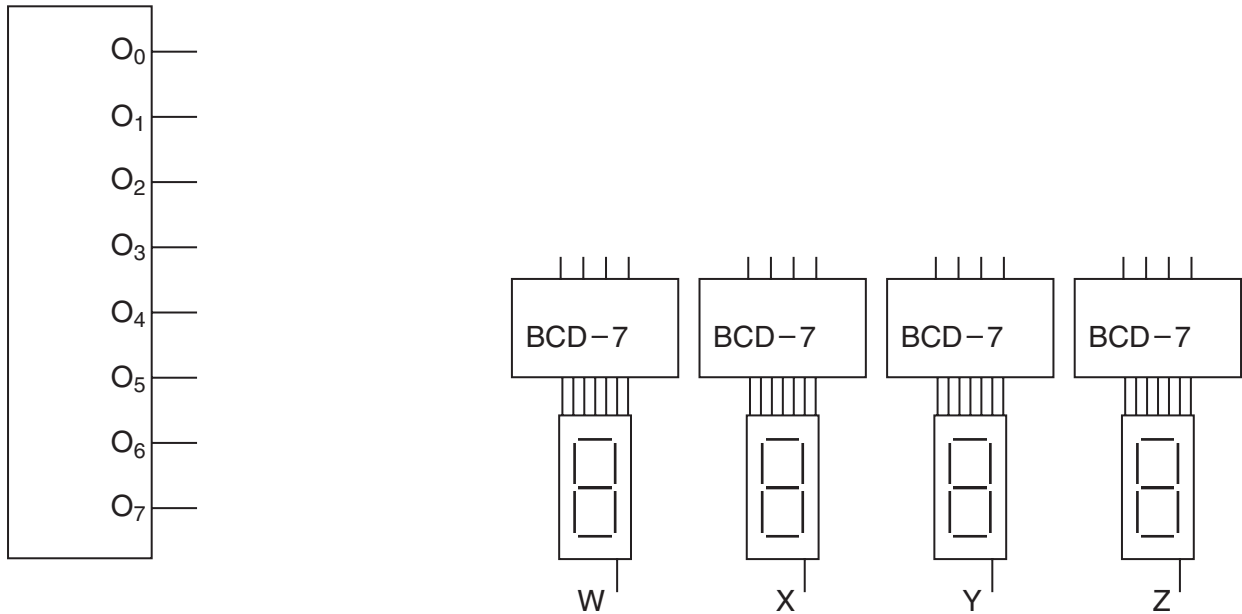


Fig. 5.1

- (b) Draw on Fig. 5.1 to show how the output port can be wired to the 7-segment LEDs so that the microprocessor is able to show a sequence of 4-digit numbers on the LEDs. [4]
- (c) Explain the sequence of output states necessary for the displays to show 1234 apparently all lit up at the same time.

.....

[4]

- 6 Fig. 6.1 shows a microprocessor system designed to operate as an analogue-to-digital converter. Each time the test button T is pushed, the analogue input is to be displayed as a two-digit number on the two 7-segment displays.

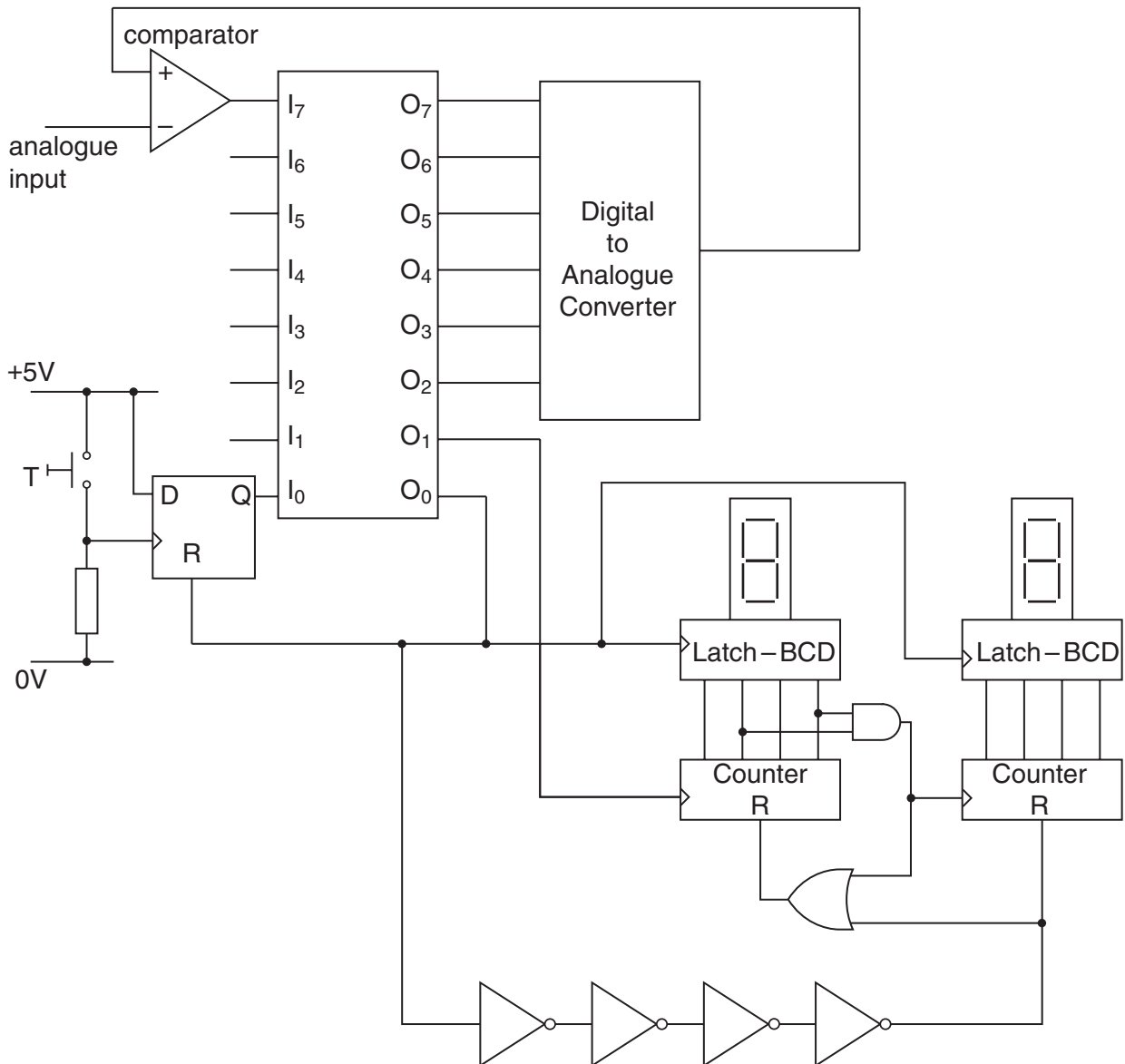


Fig. 6.1

- (a) The circuit of Fig. 6.1 uses a D-type flip-flop. Describe the behaviour of a D-type flip-flop.

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.....

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.....[3]

- (b) The circuit of Fig. 6.1 also uses a chain of four inverters. Explain their purpose.

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.....[2]

- (c) The first part of the program to make the microprocessor operate in the required manner is shown below. Using the instruction set provided, explain the function of each section of program and its effect on the circuit of Fig. 6.1. One line has been completed for you.

Address	Contents	Explanation
00	3E 00	.....
02	32 FF	.....
04	6F	.....
05	3A EF	.....
07	E6 01	.....
09	CA 05	.....
0B	7D	.....
0C	C6 06	.....
0E	32 FF	.....
10	D6 02	.....
12	32 FF	.....
14	6F	.....
15	3A EF	.....
17	E6 80	.....
19	C2 40	<i>go to address 40 if comparator output is logic 1</i>
1B	C3 0B	.....

[12]

- (d) The final part of the program is missing. Write out the necessary program and explain the function of each part.

Address	Contents	Explanation
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[5]

- (e) Calculate the maximum number which can be displayed on the two 7-segment displays during the running of the program.

maximum number =[2]

- (f) Explain how the circuit of Fig. 6.1 operates as a result of the microprocessor program.

[3]

Quality of written communication [3]

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