UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

MAIN EXAMINATION MAY 2007

TITLE OF PAPER: **INDUSTRIAL ELECTRONICS**

COURSE CODE: **EIN520**

TIME ALLOWED: **THREE** HOURS

INSTRUCTIONS:

1. Answer question **one** (1) and any other three questions.
2. Each question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin.

This paper has 6 pages including this page.

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Question 1

Draw a ladder diagram for a section of a physical layout for bottling systems shown in Figure 1 (A) and Figure 1 (B). The section detects empty bottles and divert the empty bottles before entering the sizing zone. A size detector measures the size of each bottle (king size or small size) and classifies the bottles as king size, medium size or small size. The system then sort bottle according the one of the three classifications.

[25 marks]

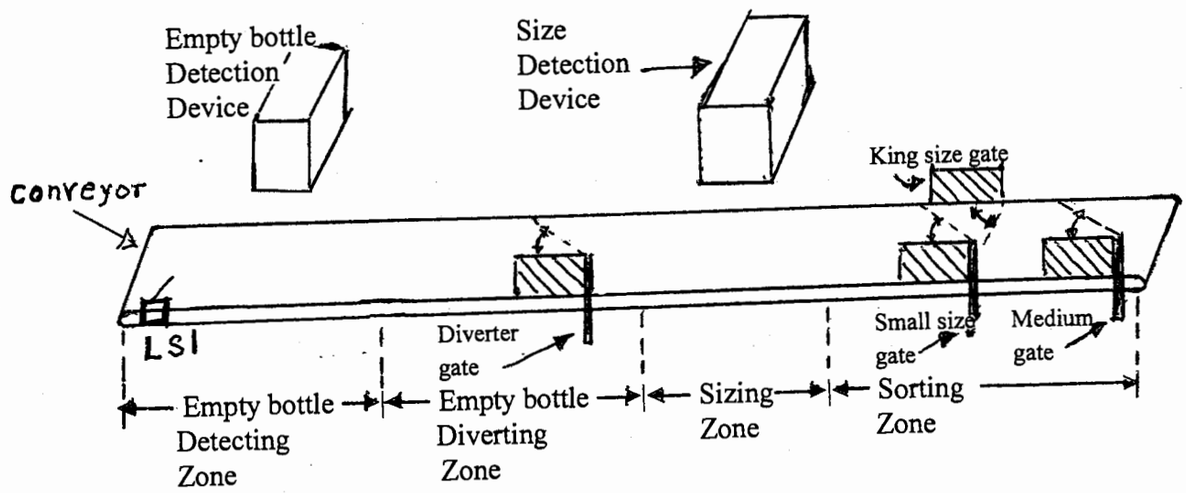

Figure 1 (A)

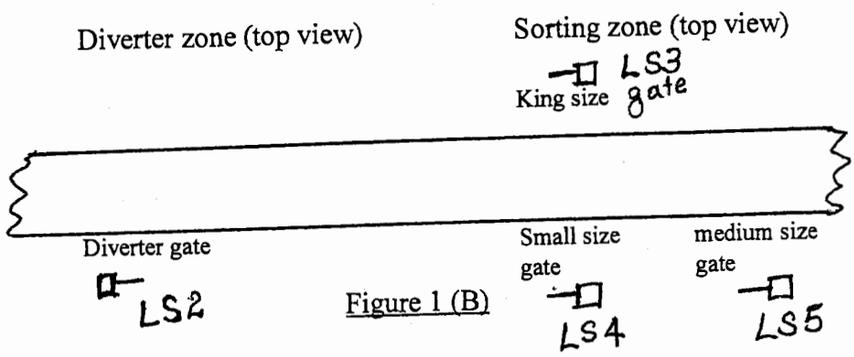

Figure 1 (B)

Note: LS1, LS2, LS3, LS4, and LS5 are limiting switches with cat-whisker extensions.

Question 2

For the LM335 temperature sensor circuit shown in Figure 2, select appropriate values for R_{bias}, R_L, R_{zero}, given that $V_{supply} = \pm 15V$. The temperature range is 20 to 70°C with a nominal value of 40°C. The output of the LM335 is given as $v_z = 2.73V + 10\frac{mV}{^0C}$.

[25 marks]

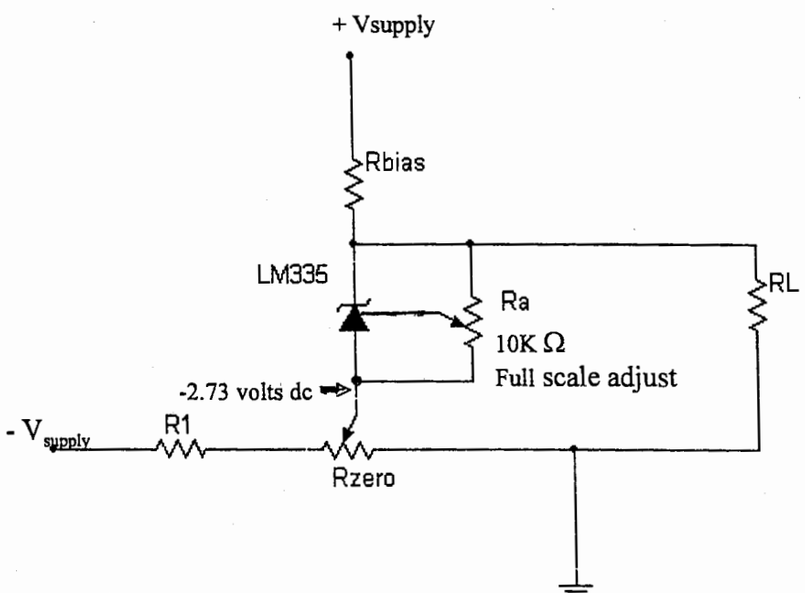

Figure 2

Question 3

A pulse-width modulation control system for a small permanent-magnet motor is shown in Figure 3-A. For this system

(A) find the period and draw the output from the $555_{(1)}$. [8 marks]

(B) draw the output from the $555_{(2)}$ if the $V_{control}$ is as shown in figure 3-B. [17 marks]

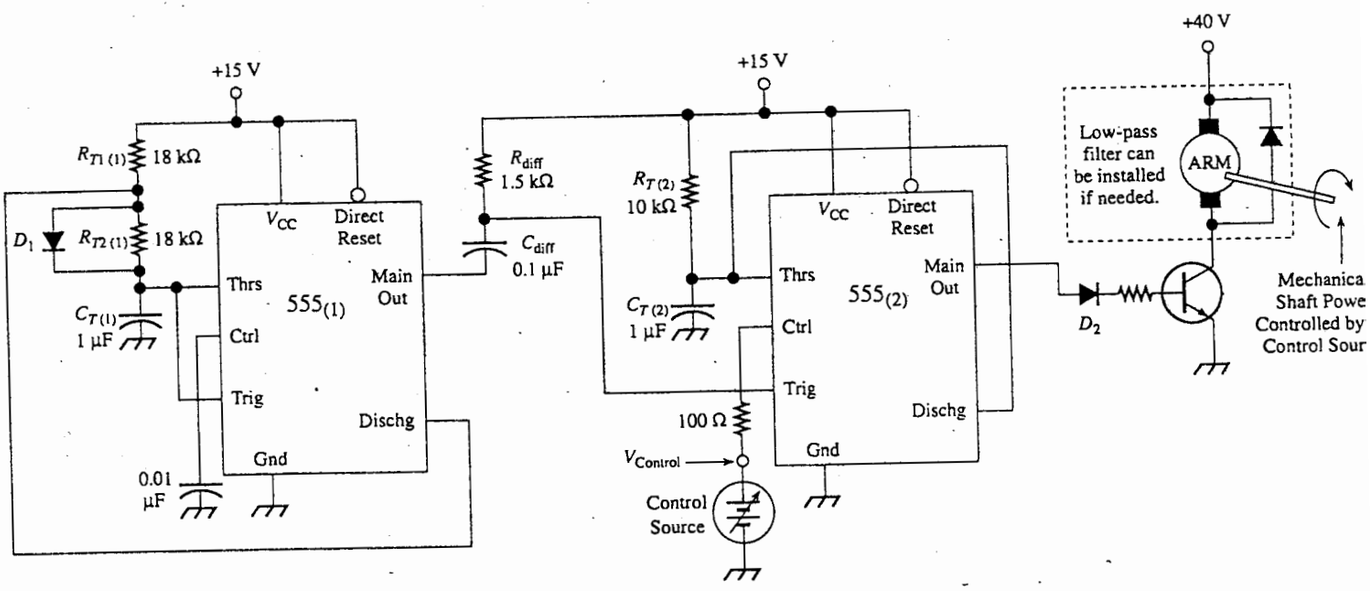

Figure 3-A

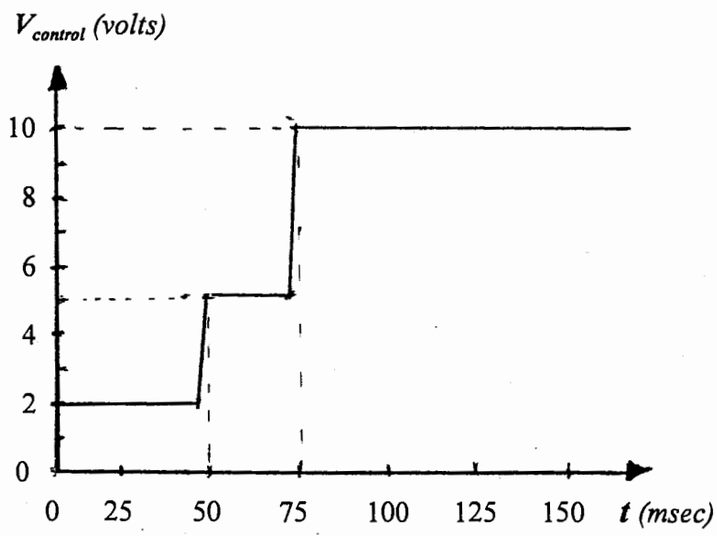

Figure 3-B

Question 4

The op-amp voltage-to-current converter is useful for transmitting a signal voltage to a remote location. Design voltage converters to drive a grounded load to meet the following conditions.

(A) Differential voltage of 4V produces 60mA (5 marks)

(B) Negative voltage of 10V produces 20 mA (5 marks)

(C) Positive voltage of 10V produces 60mA, zero volts input produces 10mA (6 marks)

(D) Input voltage of 10V produces 20mA, input voltage of 0V produces 4mA; use an AD524 instrument amplifier. (6 marks)

(E) What must the maximum power supply voltage be if the maximum current is 60 mA and you are driving a load of 20Ω ?

(3 marks)

Question 5

A) In your own words state two (2) major differences between SCADA and DCS. [10 marks]

B) What is the potential risk of SCADA? [2 marks]

C) State three (3) advantages of relay logic over solid-state logic. [9 marks]

D) What is the major drawback of dedicated automation? [4 marks]