UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAIN EXAMINATION MAY 2011

TITLE OF PAPER:	**INDUSTRIAL ELECTRONICS**
COURSE CODE:	**EIN520**
TIME ALLOWED:	**THREE** HOURS

INSTRUCTIONS:

1. Answer any four (4) 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

A modular transducer outputs 10 to 60 mA current. The manufacturer indicates that the gain is 6 and 100Ω is the maximum allowable floating load. For the current to voltage converter of Figure 1, determine the correct zero and span components to give the output of -10 to 10 V output, using the following steps:

(A) Draw the transfer curve. (7 marks)

(B) Determine the value of the span resistor R_{span}. (9 marks)

(C) Determine the zero offset voltage V_Z and the supply voltage V^+ and V^- . (5 marks)

(D) Determine the value for R_i, and R_f. (4 marks)
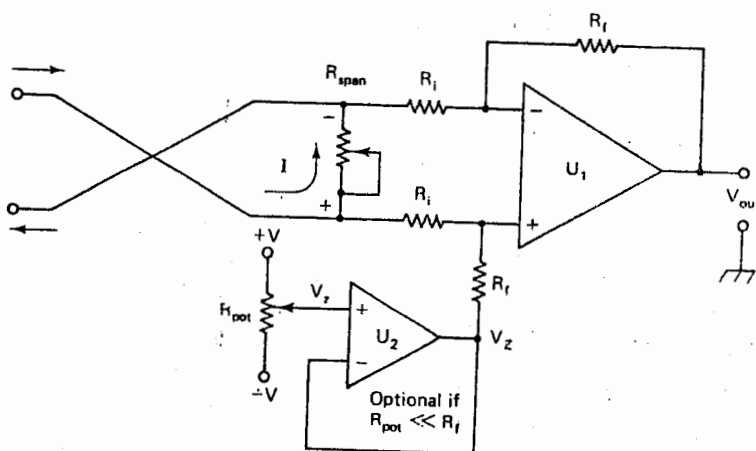
Floating current-to-voltage converter.

Figure 1

Question 2

A reflective optical sensor is used to encode the velocity of a shaft. There are six pieces of reflective tape. They are sized and positioned to produce a 50% duty-cycle wave. The maximum shaft speed is 4000r/min. Design the frequency-to-voltage converter necessary to output 10 V at the maximum shaft speed. Provide filtering adequate to assure no more than 10% ripple at 100r/min. Use the configuration shown in Figure 2 and note that the size of the switched current is $i = \dfrac{2volts}{R_s}$. (25 marks)
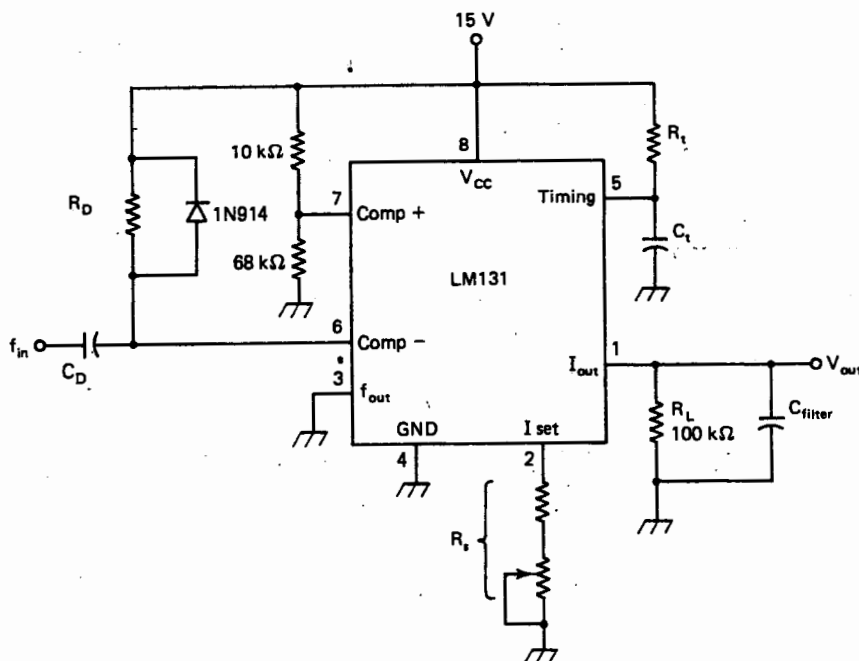
Figure 2

Question 3

Design a telemetry circuit required to transmit temperature readings ranging from -5°C to 110°C.

A block diagram of the circuit is shown in Figure 3 and the following are the specifications

Temperature sensor circuit

The output of the sensor circuit is linear and gives the following readings:

0.8 volts at - 10°C

0.2 volts at 120°C

Signal conditioner

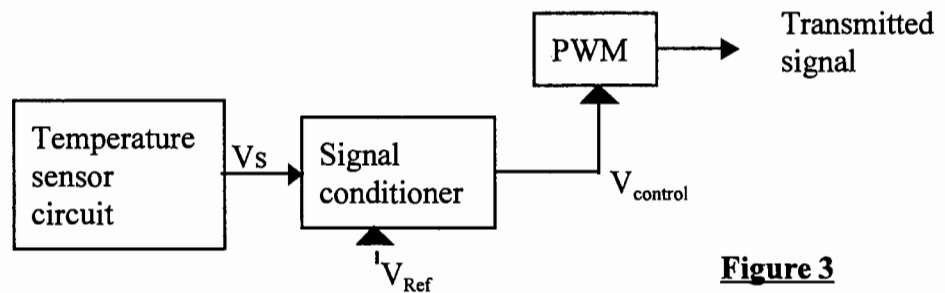The output of the signal conditioner should range from 1 volts to 10 volts.

PWM

The PWM comprises of two 555 timers.

Oscillator: T = 20 msec and 50% duty cycle

Duration of the variable one shot: t_p = 18 msec

(25 marks)

Figure 3

Question 4

Shift registers may be used to keep track of a faulty item moving along a conveyor belt so that when it reaches the appropriate point a reject mechanism is activated to remove it from the conveyor belt. Figure 4 illustrates this arrangement. An Inspector decides if an item is good or faulty. If an item is faulty then the Inspector presses a Reject button while the item is still in zone 1 and marks the item for the benefit of the other workers in zone 2, 3, 4, and 5. Between zone 1 and 2 there is a limit switch (LS). When the part enters zone 6 the shift register signals the diverter to deflect the item if it is faulty. Produce a control circuit of this arrangement and explain the operation of your circuit. Use shift registers.   (25 marks)
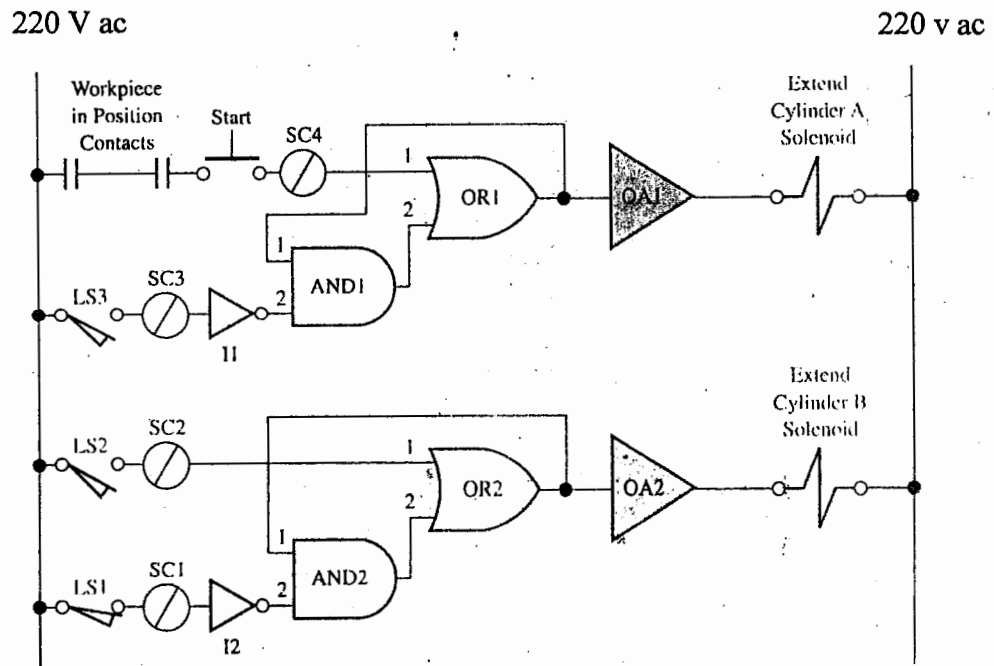

Zones   1 2 3 4 5 6
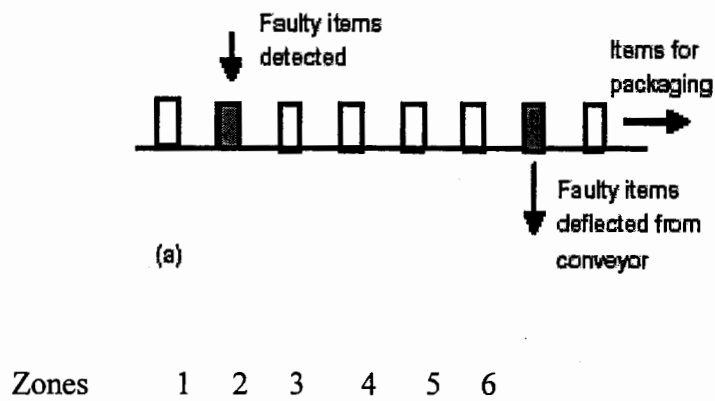
Figure 4

LS makes momentary contact every time an item goes from zone 1 to zone 2 and all items change zones at the same time.

Question 5

Using Allen Bradley PLC 5/12 addressing notation, draw a ladder- logic from the logic circuit of a two-cylinder machine-tool drilling apparatus shown in Figure 5. (25 marks)

Figure 5