PROGRAM	: BACHELOR ENGINEERING TECHNOLOGY *ELECTRICAL ENGINEERING*
SUBJECT	: **MECHATRONICS & CONTROL B2**
CODE	: **MCCELB2**
DATE	: END YEAR EXAMINATION NOVEMBER 2019
DURATION	: 09:00- 12:00
WEIGHT	: 40:60
TOTAL MARKS	: 100

UNIVERSITY OF JOHANNESBURG

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NUMBER OF PAGES	: 4 PAGES AND 1 ANNEXURES	

INSTRUCTIONS

1. 100 MARKS = 100%. TOTAL MARKS AVAILABLE = 100
2. ATTEMPT ALL QUESTIONS.
3. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND IN PROPORTION.
4. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.
5. ALL WORK DONE IN PENCIL, EXCEPT DIAGRAMS AND SKETCHES, WILL BE CONSIDERED AS ROUGH WORK AND WILL NOT BE MARKED.
6. MARKS WILL BE DEDUCTED FOR WORK THAT IS POORLY PRESENTED.
7. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF A QUESTION, MUST BE KEPT TOGETHER.
8. ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.

QUESTION 1

1.1 Explain the type of push-button operator head that should be used for an emergency stop and why?

(4)

1.2 Explain the Occupational Safety and Health Administration (OSHA) requirement for an emergency stop of a control process?

(2)

1.3 Sketch the NEMA symbols for N.O. and N.C. limit switches. Now sketch N.O. held closed and N.C. held open limit switch symbols and elaborate on what this type of symbol implies?

(8)

1.4 Elaborate on what type of target object material, an inductive proximity sensor detects?

(4)

[18]

QUESTION 2

2.1 Explain what kind of sensing field is generated by a capacitive proximity sensor and what type of materials it can sense?

(4)

2.2 List the four basic types of temperature sensors commonly used in industry today.

(4)

2.3 List four types of ratings that may be specified for relay coils.

(4)

2.4 List three types of current ratings that may be specified for relay contacts.

(3)

2.5 Explain the disadvantages that SSRs have compared to electro-mechanical relay types?

(5)

[20]

QUESTION 3

3.1 Perceive and then state what are the primary functions of an electronic variable speed drive?

(5)

3.2 Sketch a block diagram of a typical three-phase VSD and then explain the functional operation of each block.

(10)

3.3 An electric motor connected to gear train is used to rotate a robot arm 90° from start to stop as shown in figure 1. The motor generates a torque of 0.25 N·m and the length of the robot arm is equivalent to the pitch circle diameter of the 32 tooth gear. If the pitch circle circumference of the 32 tooth gear is 157 mm determine:

3.3.1 How many shaft rotations are required to rotate the robot arm 90° up as indicated? (5)

3.3.2 What lifting force, in Newtons, will be exerted at the end of the arm? (4)

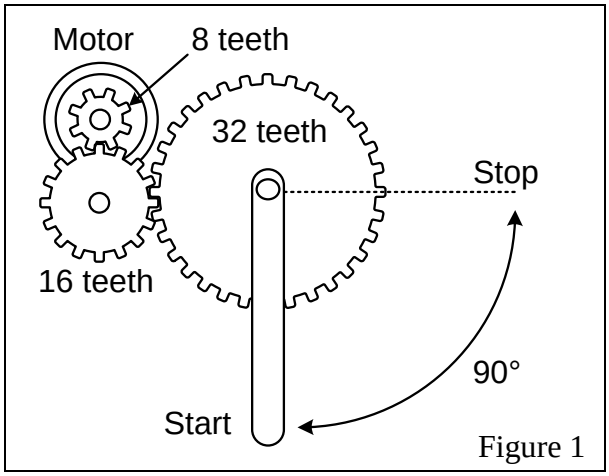

Figure 1

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QUESTION 4

4.1 Explain the difference between a time-driven and an event-driven sequentially controlled system.

(6)

4.2 Explain the type of system that is most suitable for two-point on/off control strategy implementation?

(2)

4.3 Identify what affects the cycle time of a feedback two-point on/off control strategy and why is a higher cycle frequency undesired?

(4)

4.4 Explain how integral "wind-up" can occur during start-up or when a large disturbance occurs and why is it undesired?

(4)

[16]

QUESTION 5

5.1 By using a sketched program segment flowchart, explain how a digital controller can determine the integral of the error input signal?

(7)

5.2 Identify five factors that affect the piston speed of pneumatic linear cylinders?

(5)

5.3 The piston rod of a double acting cylinder can only be extend if a 3/2-way valve is activated by the work piece inserted into the work-piece retainer and by a lowered guard protection and the operator presses a push-button valve. Upon the release of the push button or if the guard is no longer in its lower position, the cylinder is to retract to the initial position. Sketch the pneumatic circuit with the correct valve numbering system for the connection ports, including valve labels.

(10)
[22]

TOTAL [100]

PNEUMATIC COMPONENTS AND PLC FUNCTION BLOCKS