

**PROGRAM** : BACHELOR ENGINEERING TECHNOLOGY  
*ELECTRICAL ENGINEERING*

**SUBJECT** : MECHATRONICS & CONTROL B2

**CODE** : MCCELB2

**DATE** : END YEAR SUPPLEMENTARY EXAMINATION  
DECEMBER 2019

**DURATION** : 09:00- 12:00

**WEIGHT** : 40:60

**TOTAL MARKS** : 100



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**EXAMINER** : MR. D.R. VAN NIEKERK 720011220

**MODERATOR** : JANE-ANNE BUISSON-STREET

**NUMBER OF PAGES** : 3 PAGES AND 1 ANNEXURES

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**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.
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**QUESTION 1**

- 1.1 Explain in point form how an inductive proximity sensor operates to detect a target object. (5)
- 1.2 Explain in point form how a capacitive proximity sensor operates to detect a target object (5)
- 1.3 Explain in point form how a photo-electric sensor operates. (5)
- 1.4 Explain in point form how a diffuse scan sensor operates and how it can detect a certain point on a target object. (5)
- [20]
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**QUESTION 2**

- 2.1 The load-carrying capacity of relay contacts is normally given as a current value for a resistive load. Give two examples of load devices that will require this value to be de-rated and by how much. (4)
- 2.2 Calculate the amperes that a relay contact can safely switch at 125 V AC, if its contacts are rated as 10A at 250V AC? (2)
- 2.3 Discuss six advantages SSRs have compared to electro-mechanical relay types. (6)
- 2.4 Outline and discuss five operating characteristics of an AC solenoid. (10)
- [22]
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**QUESTION 3**

- 3.1 Point out five common names used to reference a drive that controls the speed of a squirrel-cage induction AC motor, by altering the frequency of the supplied voltage? (5)
- 3.2 Explain what the VSD communications port is used for. (4)
- 3.3 List eight types of typical real time data, that can be assessed through the VSD communications port. (8)
- 3.4 Explain the disadvantage of using separate independent controllers, to control the production flow in a plant. (2)
- [19]

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**QUESTION 4**

- 4.1 Using a sketched block diagram of a direct digital control production system, explain the advantage(s) and disadvantage(s) of this control system. (7)
- 4.2 Explain how a feedback two-point on/off control strategy can be used to control the liquid level in a tank with an inlet pump and a slow leaking outlet valve? (3)
- 4.3 Explain how a bias signal can be used in a proportional controlled system to eliminate the steady state error? (3)
- 4.4 Using a program segment flowchart, explain how a digital controller can determine the derivative of the error input signal? (8)
- [21]
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**QUESTION 5**

- 5.1 Explain how phase lag can cause a control system to become unstable at a given frequency. (3)
- 5.2 Name the two classical methods developed by Zieler and Nichols to tune a PID controller and explain the difference between these two methods. (5)
- 5.3 Outline and discuss ten advantages of using compressed air for carrying out mechanical work. (10)
- [18]
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TOTAL [100]

## PNEUMATIC COMPONENTS AND PLC FUNCTION BLOCKS

		<p>CTUDInst</p>