higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 4

(6040334)

22 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 5 pages.

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TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Keep subsections of questions together.
5. Use IEC symbols in ALL circuit diagrams.
6. Fully label ALL circuit diagrams and show terminal numbering as well as markings/designations.
7. Write neatly and legibly.

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QUESTION 1

1.1 Define the term *project*. (2)

1.2 Define the term *project brief*. (2)

1.3 Which ONE of the following project briefs (A or B) meets the requirements of a project brief:

Project brief A
Design and construct a conveyor-belt teaching aid using shaped aluminium plates bolted together with turned aluminium rollers having dimensions of 3 000 × 80 × 40 mm and an O-ring for work-piece transfer driven by a 24 V DC-geared motor controlled by a PLC using feedback sensors to start the conveyor and push buttons to start and stop the application.

Project brief B
Design and construct a conveyor-belt teaching aid to be used with a PLC-control. (3)

1.4 Define the term *project specification*. (3)

[10]

QUESTION 2

2.1 List FIVE costs to consider when designing and developing the conveyor-belt teaching aid mentioned in QUESTION 1.3. (5)

2.2 List THREE documents that must be produced when designing the conveyor-belt teaching-aid system. (3 × 1) (3)

2.3 The PLC-controlled conveyor-belt teaching-aid system will be made up of THREE subsystems.

Draw a system diagram showing how the subsystems are connected via information, energy and materials flow. (8)

2.4 Explain the difference between *PLC LAD* and *hardwired (RLL)* control. (2 + 2) (4)

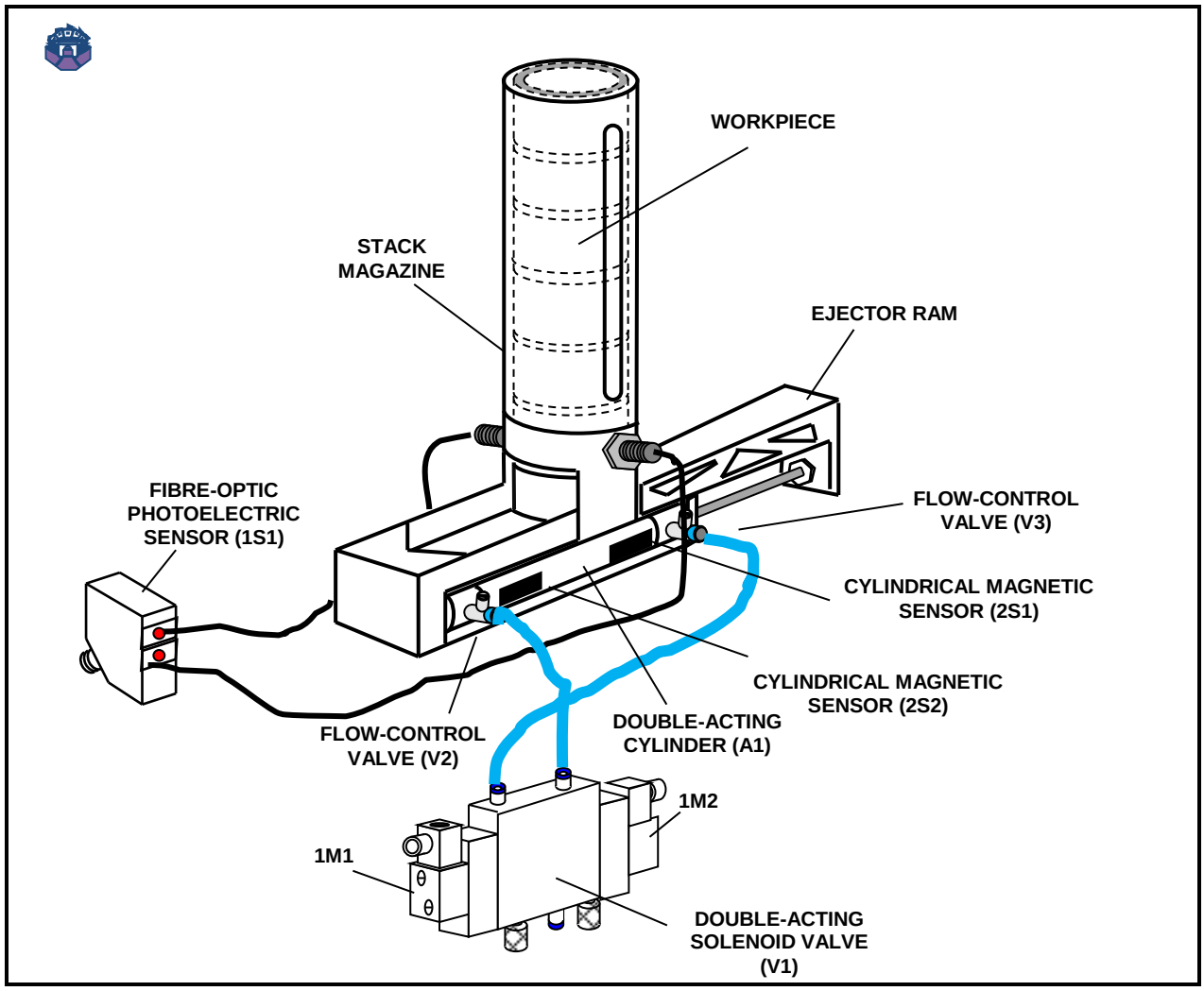
2.5 Demonstrate how a time chart would be used to manage a design project over a period of FIVE weeks under each of the following task headings:

- Design
- Manufacture
- Assemble
- Test and commission
- Handover (5)

[25]

QUESTION 3

Study the diagram of an electro-pneumatic gravity feeder and answer the questions.



3.1 A project designer must have a sound knowledge of various fields and the components used.

3.1.1 What is the purpose of valve (V1)? (2)

3.1.2 What is the purpose of (1M1) on the solenoid valve? (2)

3.1.3 What is the purpose of the sensor (1S1)? (2)

3.1.4 What is the purpose of flow-control valves (V2) and (V3)? (2)

3.1.5 What is the purpose of the cylindrical magnetic-reed switches (2S1 and 2S2)? (2)

3.2 Draw the status/sequence/step diagram that represents the motion of cylinder A1 in the gravity feeder. (10)

3.3 Compile a commissioning checklist for the gravity feeder. (10)

[30]

QUESTION 4

4.1 Explain why it is necessary to make adjustments on various control elements. (2)

4.2 List THREE system-commissioning phases to carry out during commissioning. (3)

4.3 Explain the *simulation phase*. (2)

4.4 Explain why it is necessary to perform functional-performance testing during the commissioning process. (3)

4.5 Explain, with the aid of a diagram, how a spider diagram is used to design the project specification for the project brief given in QUESTION 1.3. (5)

[15]

QUESTION 5

5.1 Explain *dead-circuit testing*. (2)

5.2 Explain how live-circuit testing is done. (4)

5.3 Explain *product-quality testing*. (2)

5.4 Explain *remote monitoring* with the aid of a simplified drawing. (8)

5.5 Explain the difference between an *audible warning* and a *visual warning* when used in a remote monitoring application. (2 + 2) (4)

[20]

TOTAL: 100

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