SeAMK

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Laboratory Assignments in Control Systems

Report

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Group 5

CONTENT

1. PURPOSE AND GOAL OF THE LAB WORK

In addition to building and installing the control panels, the prerequisite for passing the course is to return the report in accordance with these instructions. More detailed instructions on the return can be found at the end of this document.

1.1 Purpose and goal of the work

Understanding Basic Connections: Students will gain knowledge about fundamental connections in electrical and automation engineering. This includes learning about wiring, circuits, and how different components interact in these systems.

Competence in Constructing Automation Systems: The primary goal is for students to become proficient in constructing automation systems. This involves practical application and hands-on experience in assembling systems that include mechanics, programmable logic controllers (PLCs), sensors, actuators, and motor outputs.

Insight into Regulations and Technical Aspects: Students will also develop an understanding of the regulations governing electrical installations and the technical aspects involved in installing electrical instruments. This includes safety protocols, compliance standards, and technical considerations related to installations.

1.2 What did you learn during the work?

We have been learning a lot in this course. We learn about the basic connections involved in electrical and automation engineering. I gain insight into the regulations and technical aspects of installing electrical instruments. I construct a small-scale automation system time by time. The automation systems involve mechanics, programmable logic controllers, and various sensors, actuators, and motor output. We know how to design and program them to function effectively.

1.3 What was the most difficult part?

I think the connection is the most difficult part because when we make the actual connections between components to ensure proper wiring, avoid short circuits, and correctly link various

elements of the circuit according to the diagram can be intricate. We are in the situation of short circuits two times when we try to connect and fortunately, we can find the mistakes and fix it.

1.4 Why do panels and switchgears always have to undergo a commissioning inspection? Use the Electrical Safety Act as a source and mark the source in your answer.

Section 43.

Electrical installation may only be put into service after it has been adequately established in a commissioning inspection that the installation does not cause any danger or disturbance referred to in section 6. A commissioning inspection shall also be carried out on modifications and extensions of electrical installations. The commissioning inspection of the electrical installation is the responsibility of the installer of the electrical installation. If the installer neglects its obligations or is prevented from performing them, the possessor of the electrical installation is responsible for the inspection.

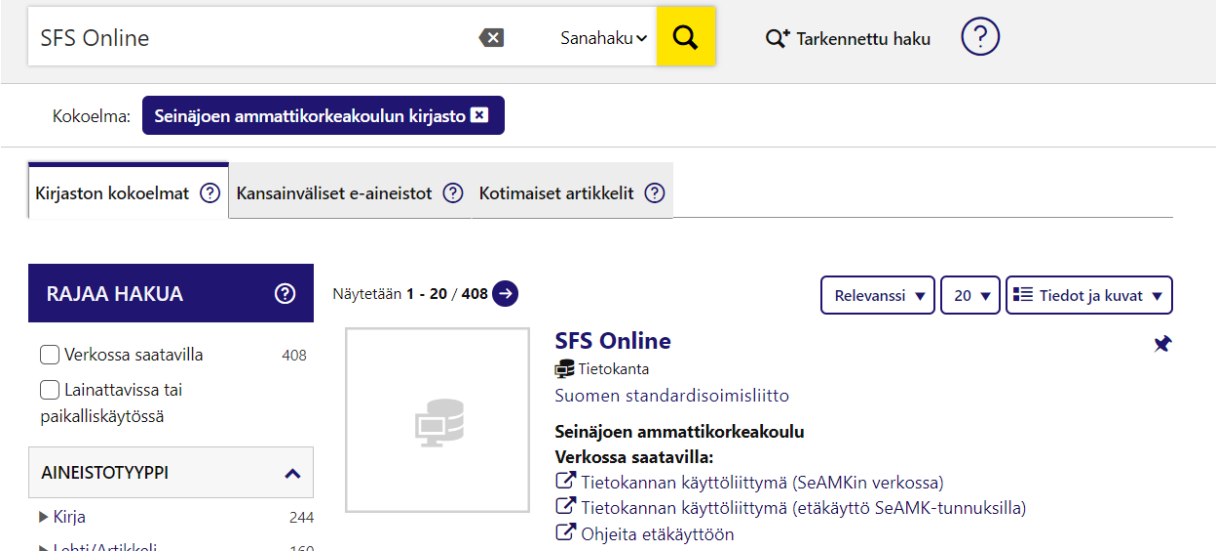
The installer of the electrical installation shall draw up an inspection record of the commissioning inspection for the use of the possessor of the electrical installation, with the exception of minor work. However, in such cases, too, the results of the electrical installation testing shall be made available to the possessor of the electrical installation, if necessary.

Further provisions on the content of the commissioning inspection record and the minor work of which no record is required are laid down by government decree.

2 ANSWER THE QUESTIONS BELOW

Use standard SFS-EN 60204 Safety of machinery as a source. Also write down from which chapter (e.g. 3.1.12) you found the answetr from.

SFS standards can be found in SFS Online, which can be logged in with a school license through the library's website. Just type “SFS Online” in the search box and choose a right link depending on whether you are online at the school or somewhere else.



SFS Online search on SeAMK library website.

2.1 Potential equalization

2.1.1 What is meant by potential equalization?

Specific requirements in case of induction (FI) Conductors or conductive parts in the proximity of live conductors may be electrically influenced. In addition to the following requirements of 6.2 and 6.4, specific precautions shall be taken when working on electrical systems influenced by induction (this is particularly so for work on overhead lines): — by earthing at adequate intervals in order to reduce the potential between conductors and earth at a safe level; — by equipotential bonding at the work location in order to avoid the possibility of workers inserting themselves in an induction loop. HNational Supplementary Requirement Live or current carrying conductors or conductive parts may induce to other conductors or conductive parts located in the vicinity, dangerous voltage or electric charge coming inductively from

magnetic field caused by electric current or capacitively due to electric field. Possible appearing of dangerous voltages depends on voltage and current of the live system, the interim distances of the system parts and the parallel lengths of the conductors of the systems in question. Necessity of applying earthing devices has to be justified based on these factors. Dangerous induction voltage may appear specifically in cases when working on overhead lines separated from earth and the line under work is running for longer line part in parallel to a high-voltage line. Appearing of dangerous voltages shall be prevented by earthing and by equipotential bonding: — If the work activity is done on completed overhead line, it shall be earthed with a main earthing device capable to withstand direct short-circuit current in accordance with Clause 6.2.5 and shall additionally be earthed at work location or at a maximum distance of 1 km from work location with an auxiliary earthing device (earthing and equipotential bonding) having minimum cross-section of 16 mm2 copper or corresponding device. — If the work activity is done on an overhead line under construction or on line being dis-assembled or any other longer and conductive construction, it shall be earthed at every work location or at a maximum distance of 1 km from work location with an earthing device (earthing and equipotential bonding) having minimum cross-section of 16 mm2 copper or corresponding device. On long line under construction earthing and equipotential bonding shall be done at each end of the line.

Source: 6.1.2

2.1.2 How should protective conductors be identified?

We use color for identifying protective conductors is the bicolor combination GREEN-AND-YELLOW. Protective conductors serve the purpose of providing a path for fault currents to ensure the safe operation of electrical systems. The identification of protective conductors is crucial for maintaining electrical safety standards. (SFS-EN 60204 13.2.2)

2.1.3 When there is no need to protective grounding of parts exposed to voltage?

Protective grounding is typically a crucial safety measure to prevent electric shock hazards. Therefore, we need to ensure safety compliance with relevant electrical codes and standards

for the specific electrical equipment and installation as "SFS-EN 60204 Safety of machinery" does not specifically mention conditions where there is no need for protective grounding of parts exposed to voltage.

2.2 Wires and cables

2.2.1 How wires and cables should be chosen in general?

In general, the selection of wires and cables should be based on various factors to ensure their suitability for the intended application, such as:

- Select wires and cables with voltage and current ratings that match or exceed the requirements of the electrical system.

- Choose insulation and jacket materials suitable for the environmental conditions where the wires and cables will be installed.

- Determine the appropriate conductor size based on the current-carrying capacity required for the load.

- Ensure that the selected wires and cables comply with relevant standards in the provided source for electrical equipment.

- Consider the method of installation, whether in cable trays, conduits, or direct burial.

(SFS-EN 60204 13.1.1; 13.2.1 ; 13.2.4; 13.3; 13.4)

2.2.2 What things determine the load capacity of the wire and cable?

The load capacity of wires and cables needs to refer to standards specific to electrical conductors, such as: Table 6 in Examples of current-carrying capacity (Iz) of PVC-insulated copper conductors or cables under steady-state conditions in an ambient air temperature of +40 °C for different methods of installation

(SFS-EN 60204 12.4)

2.2.3 What colors are allowed to use to identify conductors (other than protective and the neutral conductor)?

The allowed colors to identify conductors (other than the protective and neutral conductors) are as follows:

BLACK: AC and DC power circuits;

RED: AC control circuits;

BLUE: DC control circuits;

ORANGE: excepted circuits in accordance with 5.3.5.

(SFS-EN 60204 13.2.4)

2.2.4 How to identify a protective conductor?

The protective conductor can be identified in the following ways:

- Color: The bicolor combination GREEN-AND-YELLOW

- Symbol or Letters: The ends or accessible locations of the protective conductor shall be identified by the graphical symbol IEC 60417-5019 or with the letters PE.

- Exception: Protective bonding conductors may be marked with the letters PB and/or the symbol IEC 60417-5021.

(SFS-EN 60204 13.2.2)

2.2.5 How to identify a neutral conductor?

A neutral conductor in a circuit is distinguished solely by the BLUE color. In order to avoid confusion with other colors, it is recommended that an unsaturated blue be used, called here "light blue" (see 6.2.2 of IEC 60445:2010)

(SFS-EN 60204 13.2.3)

2.2.6 What colors are recommended to use with insulated single-core cables?

The recommended colors to use with insulated single-core cables for identification are:

- BLACK: For AC and DC power circuits.

- RED: For AC control circuits.
- BLUE: For DC control circuits.

(SFS-EN 60204 13.2.4)

2.3 Testing and verification

2.3.1 What kind of tests should be carried out on the electrical equipment of machines if the machine does not have its own product standard? Write down all tests listed in the standard.

If the machine does not have its own product standard, we require tests to Confirm that electrical equipment complies with its technical manual, confirmation of the protective bonding circuit's continuity, and the requirements for protection by automated disconnection.

· Insulation Resistance Test (SFS-EN 60204 18.3)

· Voltage Test (SFS-EN 60204 18.4)

· Protection Against Residual Voltages Test (SFS-EN 60204 18.5)

· Functional Tests (SFS-EN 60204 18.6)

· Retesting After Modification (SFS-EN 60204 18.7)

· Conditions for Protection by Automatic Disconnection of Supply (SFS-EN 60204 18.2)

2.3.2 Tests applicable to machinery which does not have its own product standard may include one or more of the tests mentioned in the previous paragraph. However, which or which tests (verifications) must always be done?

The tests applicable to machinery that does not have its own product standard must al-ways be done, such as:

· Verification of Compliance with Technical Documentation: to ensure that the electrical equipment complies with its technical documentation.

· Verification of Continuity of the Protective Bonding Circuit: to ensure the integrity of the protective bonding circuit for safety and effective protection against electric shocks.

· Verification of Conditions for Protection by Automatic Disconnection: to ensure that the protective measures for automatic disconnection in case of faults are in place, contributing to safety.

2.3.3 Which electrical installations of building electrification must undergo a commissioning inspection in accordance with SFS standard EN-60204, e.g. here at Frami A?

The electrical installations of building electrification that must undergo a commissioning inspection in accordance with the SFS standard EN-60204 typically include systems related to machinery or equipment in the building. This standard primarily covers the safety of machinery and electrical equipment connected to machines.
At Frami A:
Electrical systems related to industrial machinery.

1. Control panels, wiring, and electrical components associated with manufacturing equipment.
2. Power distribution systems that support machinery or equipment within the building.
3. Safety measures, emergency stop systems, and protective devices integrated with machinery.

To guarantee safety, appropriate operation, and compliance with electrical rules, these installations must meet the specifications given in the SFS standard EN-60204. Before these facilities are put into service, commissioning examinations are performed to ensure they fulfil the necessary requirements and operate as intended.

3 FEEDBACK ON THE COURSE

What more would you like? What do you think was missing or too much? Any other comments?

No. It’s okay for us.

Appropriate feedback is very welcome for the development of the course. / Matti

4 TWINCAT LOGIC PROGRAMS

Return tested TwinCAT logic programs with clear commentary on the I/O list and each circuit.

5 DOCUMENTATION

5.1 General information about documentation:

Kaikki dokumentointi tehdään samoilla tekstin asetteluilla ja ohjeilla kuin opinnäytetyö tehdään. Opinnäy-tetyöohjeita löytyy intrasta. Sieltä löytyy koko opinnäytetyöohje pdf-versiona, valmis opinnäytetyön malli-pohja asetteluineen word-versiona.

5.2 Submitting the report

The report to be returned must include:

- Written report (answers to chapters 1-3)
- Commented, tested and functional logic program

Return your group's report (in pdf format, one submission per group) and logic program file (xml format, one submission per group) to the recovery folder found on the course's Moodle page.

- Name your report as Group_Lab group_Lab assignment.pdf. (e.g. **AE21_Group1_Lab assignment.pdf**)
- Name your logic program as Group_Lab group_PLC program.xml. (e.g. **AE21_Group1_PLC program.xml**)

The report must be returned no later than the time marked in the Moodle recovery folder!

Once both parts of your laboratory work have been approved, I will add a "passed" (H) label to all team members in the PEPPI.

BIBLIOGRAPHY

Don’t forget to write down which sources you have used! See examples below.

Finnish Standard Association. (2015). *Sterilization: Steam sterilizers: Large sterilizers*. (SFS-EN 285).

Government Decree on Communicable Diseases 146/2017. https://www.finlex.fi/en/laki/kaannokset/2017/en20170146.pdf

Health Care Act 1326/2010. https://www.finlex.fi/en/laki/kaannokset/2010/en20101326_20131293.pdf

International Council of Nurses. (n.d.-a). *ICN strategic priorities*. https://www.icn.ch/nursing-policy/icn-strategic-priorities

Electrical Safety Act (1135 / 2016)

Electrical Safety Act

ANNEX

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