

-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

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NATIONAL CERTIFICATE MODULE DESCRIPTOR

-Module Number- 4110120 -Session- 1990-91
-Superclass- XJ

-Title- PROTECTION AND EARTHING

-DESCRIPTION-

Purpose This module is designed to develop a technical knowledge and understanding of overcurrent protection and earth leakage protection methods for electrical installations.

It is intended that this module is taught in conjunction with other related modules and forms part of a course of study which should include complementary industrial experience. It is aimed at those following a career in electrical installation work.

Preferred Entry Level 4110113 Electrical Installation: Circuit Fundamentals.
2160010 Electrical Fundamentals.

Outcomes The student should:

1. identify the types of overcurrent and its associated dangers;
2. select a suitable device which provides protection against overcurrent in a given situation;
3. identify the conditions of earth leakage and earth fault currents and their subsequent dangers;
4. plan an earth fault protection arrangement.

Assessment
Procedures

Acceptable performance in the module will be satisfactory achievement of all the Performance Criteria for each Outcome.

Students should have access to the current edition of the IEE Wiring Regulations when carrying out assessment of the Outcomes.

The following abbreviations are used below:

PC Performance Criteria
IA Instrument of Assessment

Note: The Outcomes and PCs are mandatory and cannot be altered. The IA may be altered by arrangement with SQA. (Where a range of performance is indicated, this should be regarded as an extension of the PCs and is therefore mandatory.)

OUTCOME 1

IDENTIFY THE TYPES OF OVERCURRENT AND ITS ASSOCIATED DANGERS

PCs

- (a) The identification of the type of overcurrent in the given situation is as defined by the current IEE Wiring Regulations.
- (b) The description of the effects of installation overload current is correct in terms of danger to the installation.
- (c) The description of the effects of short circuit current is correct in terms of danger to the installation.

IA Objective Items

The student will be presented with an exercise consisting of objective items to test comprehension of the causes and subsequent dangers associated with overcurrent.

The exercise will consist of 8 questions allocated as follows:

- | | | |
|-----|----------------------------------|-----|
| (a) | type of overcurrent | - 4 |
| (b) | dangers of overload current | - 2 |
| (c) | dangers of short circuit current | - 2 |

Objective items could be either short answer questions, multiple choice questions, completion items, matching exercise or assertion/reason.

Satisfactory achievement of the Outcome will be demonstrated by all the Performance Criteria being met. This will be demonstrated by the student producing a correct response to each of the 8 questions.

OUTCOME 2**SELECT A SUITABLE DEVICE WHICH PROVIDES PROTECTION AGAINST OVERCURRENT IN A GIVEN SITUATION**

PCs

- (a) The description of the selected overcurrent protective device is correct in terms of construction and mode of operation.
- (b) The identification of the selected overcurrent protective device is correct in terms of the appropriate BS number.
- (c) The selected device is appropriate in terms of its advantages and limitations in the given situation.
- (d) The selected device to provide overcurrent protection is in accordance with current IEE Wiring Regulations.

IA Structured Question

The student will be presented with an exercise consisting of one structured question to test the application of knowledge required to select a suitable device for protection against overcurrent.

The student should be provided with a description of a domestic or small commercial installation detailing an Ip value and the type of load being supplied by the circuit.

The question will be sub-divided as follows:

- (i) selection of device;
- (ii) construction and mode of operation of selected device;
- (iii) BS number;
- (iv) advantages and limitations in the given situation.

Satisfactory achievement of the Outcome will be demonstrated by all the Performance Criteria being met. This will be demonstrated by the student producing a correct response to each part of the structured question.

OUTCOME 3 IDENTIFY THE CONDITIONS OF EARTH LEAKAGE AND EARTH FAULT CURRENTS AND THEIR SUBSEQUENT DANGERS

- PCs
- (a) The description of earth leakage and fault currents is correct in accordance with current IEE Wiring Regulations terminology.
 - (b) The description of the dangers resulting from earth leakage and fault currents is relevant in terms of the user.
 - (c) The description of the effects of earth leakage and fault currents is correct in terms of the possible subsequent damage to the installation and premises.

IA Structured Question

The student will be presented with an exercise consisting of a structured question to test comprehension of the conditions of earth leakage and fault currents and their subsequent dangers.

The exercise will consist of 1 structured question covering a situation in which earth leakage current exists.

The question will be sub-divided into 3 parts as follows:

- (a) description of earth leakage and fault currents;
- (b) dangers to user;
- (c) dangers to installation and premises.

Satisfactory achievement of the Outcome will be based on all Performance Criteria being met. This will be demonstrated by the student producing a correct response to each part of the structured question.

OUTCOME 4 PLAN AN EARTH FAULT PROTECTION ARRANGEMENT

- PCs
- (a) The earth fault loop impedance value is within the maximum laid down by the current IEE Wiring Regulations.
 - (b) The selected disconnection device is in accordance with current IEE Wiring Regulations for given values.
 - (c) The selected protective conductors are in accordance with current IEE Wiring Regulations.
 - (d) The identification of items which require bonding and earthing in a given situation is in accordance with current IEE Wiring Regulations.

IA Assignment

The student will be set an assignment to test the application of knowledge required to plan an earth fault protection arrangement.

The student will be provided with a description of a circuit in a domestic or small commercial installation detailing: the ZE value, size and type of live conductors, circuit length, rating and type of proposed overcurrent protection device and/or RCD, type of load and its location and include items of exposed and extraneous metalwork.

The student should also be provided with a formula sheet detailing necessary formulae.

The data given should not require the need for the repeated recalculation of the Zs value.

Using the given information, the student will be required to:

- (i) suggest a suitable minimum size and type of circuit protective conductor;
- (ii) determine the resulting earth loop impedance value (Z_s);
- (iii) verify by calculation that the resulting earthing arrangement meets the shock constraints;
- (iv) verify by calculation that the suggested size of cpc meets the thermal constraints;
- (v) reselect the minimum cpc if necessary;
- (iv) detail the necessary requirements for equipotential bonding.

Satisfactory achievement of the Outcome will be demonstrated by all Performance Criteria being met.

**The following sections of the descriptor are offered as guidance.
They are not mandatory.**

CONTENT/CONTEXT

Safety regulations and safe working practices and procedures should be observed at all times.

Corresponding to Outcomes 1-4:

1. Definitions of: overcurrent, overload and short circuit current. Typical causes and dangers associated with overcurrent: fire risks, thermal and electro-magnetic effects.
2. Construction, operation, advantages and disadvantages of protective device against overcurrent: semi-enclosed fuse, cartridge fuses (inc. HBC fuses), thermal and magnetic trips, miniature circuit breakers.

Recognition of devices by British Standards (BS) numbers.

Terms: current rating, fusing/tripping current, fusing/tripping factor, breaking capacity.

Selection of suitable devices for protection against possible overload and short circuit current.

3. Typical causes and dangers of earth fault current: electric shock and fire risks. An appreciation of effects of corrosion in relation to earthing arrangements.

4. Appreciation of 'direct' and 'indirect' contact.

Commonly used methods of protection against indirect contact: EEBADS, Class II protection and Electrical Separation.

Types of system earthing: TT, TNS, TNC-S, TNC.

Importance of a complete, low impedance, earth fault loop path.

$$Z_s = Z_E + R_1 + R_2$$

Relationship between protective device and earth fault loop impedance to disconnection time.

Construction and operation of residual current device. Selection of suitable operating currents for given situations.

Sizing of conductors by calculation and by selection; IEE Wiring Regulations.

Various types of protective conductors: earthing conductor, circuit protective conductor, main and supplementary equipotential bonding conductors.

Special requirements for rooms containing fixed baths and showers.

SUGGESTED LEARNING AND TEACHING APPROACHES

This module could be taught in conjunction with related modules and could involve both classroom and workshop activities.

This module will be mainly instructional in teaching approach but investigation and demonstration will play a major part in the development of the Outcomes.

The Outcomes may also be achieved by the use of:

discussion;
films slides;
demonstration;
practical work;
manufacturers' catalogues;
questionnaires.

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