



National Unit Specification: general information

UNIT Rotating Electrical Machines (SCQF level 5)

CODE F5JK 11

SUMMARY

This Unit is designed for candidates with little or no prior knowledge of rotating electrical machines but who wish to develop knowledge and understanding of a range of motors and generators. The Unit is particularly suitable for those candidates training to be electrical craftspersons or technicians.

The aim of this Unit is to provide candidates with the knowledge and understanding of the constructional features, principles of operation and applications of direct current (dc) motors and generators, stepper motors, three phase synchronous motors and generators and three phase induction motors.

This Unit may form part of a National Qualification Group Award or may be offered on a free-standing basis.

OUTCOMES

- 1 Describe the constructional features, principles of operation, applications and drawbacks of conventional dc motors and generators.
- 2 Describe the constructional features, principles of operation and applications of stepper motors.
- 3 Describe the constructional features, principles of operation and applications of synchronous generators and motors.
- 4 Describe the constructional features, principles of operation and applications of three phase induction motors.

Administrative Information

Superclass: XJ

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National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard Grade Physics — General Level
- ◆ Standard Grade Technological Studies — General Level
- ◆ NQ Unit *Electrical Fundamentals* at SCQF level 5

CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Communication (SCQF level 5)
- ◆ Using Information Technology (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Describe the constructional features, principles of operation, applications and drawbacks of conventional dc motors and generators.

Performance Criteria

- (a) Identify accurately the main constructional features of a dc machine.
- (b) Describe correctly the principle of operation of a dc machine operating as a motor.
- (c) Describe correctly the principle of operation of a dc machine operating as a generator.
- (d) State correctly applications of dc motors and generators.
- (e) Describe correctly the draw backs of commutator type dc machines and explain correctly how these are overcome in the brushless dc motor.

OUTCOME 2

Describe the constructional features, principles of operation and applications of stepper motors.

Performance Criteria

- (a) Identify accurately the main constructional features of a basic stepper motor.
- (b) Describe correctly the principle of operation of a stepper motor.
- (c) State correctly different types of stepper motors.
- (d) State correctly the applications of stepper motors.

OUTCOME 3

Describe the constructional features, principles of operation and applications of synchronous generators and motors.

Performance Criteria

- (a) Identify accurately the constructional features of a three phase synchronous machine.
- (b) Describe correctly the principle of operation of a three phase synchronous generator.
- (c) Describe correctly the principle of operation of a three phase synchronous motor.
- (d) State correctly the applications of three phase synchronous generators and motors.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Describe the constructional features, principles of operation and applications of three phase induction motors.

Performance Criteria

- (a) Identify accurately the constructional features of a three phase squirrel cage induction motor.
- (b) Describe correctly the principle of operation of a three phase squirrel cage induction motor.
- (c) State correctly the advantages of three phase induction motors over other types of motors.
- (d) State correctly the applications of three phase induction motors.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate the candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria.

Outcomes may be assessed on an individual basis, as combinations of Outcomes (eg Outcomes 1 and 2 together and Outcomes 3 and 4 together) or as a single assessment covering all four Outcomes. Regardless of which approach is taken total assessment time should not exceed two hours. Assessment(s) should be conducted under controlled, supervised, closed-book conditions in which candidates should not be allowed to bring any notes, handouts, textbooks or any other relevant materials into the assessment.

For Outcomes 1, pc (a), Outcome 2, pc (a), Outcome 3, pc (a) and Outcome 4, pc (a) candidates can either be asked to sketch and label a diagram of the electrical machine or can be provided with a diagram of the machine and be asked to label the main parts.

With regard to Outcome 1 candidates should state:

- ◆ two applications of dc motors
- ◆ two applications of dc generators

With regard to Outcome 2 candidates should state:

- ◆ two different types of stepper motors
- ◆ three applications of stepper motors

With regard to Outcome 3 candidates should state:

- ◆ one application of three phase synchronous generators
- ◆ two applications of synchronous motors

With regard to Outcome 4 candidates should state:

- ◆ three advantages of three phase induction motors over other types of motors (such as three synchronous motors and dc motors)
- ◆ a minimum of three applications of three phase induction motors

National Unit Specification: statement of standards (cont)

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The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a restricted core Unit within the National Certificate in Electrical Engineering at SCQF level 5. This Unit can also be delivered on a free-standing basis.

The aim of the Unit is to allow candidates to develop a sound knowledge and understanding of the constructional features, principles of operation and applications of dc motors and generators, stepper motors, synchronous generators and motors and three phase induction motors. When providing examples of the applications of various motors and generators lecturers should relate such applications to the power ratings of the motors and generators.

This Unit could be delivered in a classroom and/or laboratory environment where candidates have access to electrical motors and their ancillary equipment.

Candidates should be provided with appropriate Health and Safety training before undertaking any laboratory work.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit may be delivered by a combination of lectures, tutorial work, investigations using paper based and electronic sources and practical exercises which may include candidates disassembling different types of motors and generators and examining the various constructional features of the motors and generators. Centres may also wish to allow candidates to perform experiments on motors and generators to investigate some of their performance characteristics although such experiments should not be included in the formal assessment of the Unit. It should be noted that the Internet contains a rich source of information on the construction, principles of operation and applications of various types of motors and generators. Well annotated wall charts of motor and generator constructional features can also act as an important source of learning.

National Unit Specification: support notes (cont)

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OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Although the Core Skill of *Communication* is not formally assessed candidates should be encouraged to research, produce and present written and oral work to a standard acceptable in industry. Skills in analysing and evaluating a range of sources providing underpinning knowledge and understanding should be developed, in order that candidates are able to consult and apply relevant reference materials from a range of paper based and Internet sites. Evaluation of materials should include a check on currency. Candidates should be expected to present written ideas accurately and concisely, using appropriate terminology. Aids to ensure correct spelling and punctuation could be provided.

Investigations of the performance characteristics and constructional features of motors and generators could be used to enhance oral communication skills as the class group work together to discuss and analyse various principles and operations using the terminology, tone and style of the workplace.

The Core Skill *Using Information Technology* is developed via internet research on the construction, principles of operation and applications of various types of motors and generators.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Formative assessment exercises involving candidates in writing up answers to questions about motors and generators should be used to reinforce candidate learning.

The suggested approach for assessment in this Unit is as follows:

Outcomes 1 and 2 — an assessment paper comprising a balance of short answer and restricted response questions lasting one hour. The assessment should be conducted at a single assessment event and be conducted under controlled, supervised, closed-book conditions in which candidates should not be allowed to bring any notes, handouts, textbooks or any other relevant materials into the assessment.

Outcomes 3 and 4 — an assessment paper comprising a balance of short answer and restricted response questions lasting one hour. The assessment should be conducted at a single assessment event and be conducted under controlled, supervised, closed-book conditions in which candidates should not be allowed to bring any notes, handouts, textbooks or any other relevant materials into the assessment.

National Unit Specification: support notes (cont)

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DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements