-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

HIGHER NATIONAL UNIT SPECIFICATION

GENERAL INFORMATION

Unit Number	**D3PS 04**
Unit Title	ENGINEERING PRINCIPLES (ELECTRICAL NETWORKS)
Superclass Category	XJ
Date of Publication (month and year)	
Originating Centre for Unit	Cleveland Open Learning Unit

DESCRIPTION

GENERAL COMPETENCE FOR UNIT:

Applying electrical circuit theory and principles to issues commonly encountered in electrotechnology.

OUTCOMES:

1. apply circuit theorems to d.c. networks;
2. apply complex algebra to the analysis of a.c. networks;
3. analyse electrical systems when modelled as two-port networks;
4. analyse three-phase circuits;
5. investigate the transient response of first-order circuits.

CREDIT VALUE: 1 HN Credit

ACCESS STATEMENT:

Access to this unit is at the discretion of the centre. It would, however, it would be beneficial if the student had competence in basic instrumentation systems and mathematics. Evidence of this competence could be possession of National Certificate modules in Instrumentation Systems and Mathematics or their equivalent.

Additional copies of this unit can be obtained from: The Administrative Services Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ (Tel: 0141-242 2166).

At the time of publication, the cost is £2.50 (minimum order £5.00)

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STATEMENT OF STANDARDS

Unit Number

Unit Title ENGINEERING PRINCIPLES (ELECTRICAL NETWORKS)

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

OUTCOME

1. APPLY CIRCUIT THEOREMS TO D.C. NETWORKS

PERFORMANCE CRITERIA

(a) The application of Kirchhoff's current and voltage laws to the solution of problems involving d.c. networks is complete and accurate.
(b) The equivalent circuit for a d.c. network is complete and accurate in terms of Norton's and Thévenin's theorem.
(c) Matching of generator to load for maximum-power transfer is in accordance with the maximum power transfer theorem.

RANGE STATEMENT

The range for this outcome is fully expressed within the performance criteria.

EVIDENCE REQUIREMENTS

PC(a) Two correct examples of the application of the laws to networks that involve two e.m.f.s in different meshes and one of which has three meshes.
PC(b) Two correct examples of the application of each theorems.
PC(c) One correct application of the theorem.

OUTCOME

2. APPLY COMPLEX ALGEBRA TO THE ANALYSIS OF A.C. NETWORKS

PERFORMANCE CRITERIA

(a) The manipulation of complex variables is correct.
(b) Representation of a series R, L and C circuit by complex impedance is correct.
(c) Representation of a parallel R, L and C circuit by complex admittance is correct.
(d) Calculations involving series and parallel R, L and C circuit parameters are correct in terms of method, representation and units.

RANGE STATEMENT

Manipulation:	addition; subtraction; multiplication; division using the method of complex conjugates; conversion to and from polar form.
Circuit parameters:	$\mathbf{Y} = G + \mathrm{j}B$; $\mathbf{Z} = R + \mathrm{j}X$; $S = VI$; $P = \mathrm{Re}[\mathbf{VI}^*]$; $Q = \mathrm{Im}[\mathbf{VI}^*]$.

EVIDENCE REQUIREMENTS

PC(a)	Correctly worked examples to cover the range.
PC (b) & (c)	One correct example for each criterion.
PC(d)	One correct example each in the calculation of Z and Y for a series and a parallel circuit respectively and one example each of the calculation of real, reactive and apparent power.

OUTCOME

3. ANALYSE ELECTRICAL SYSTEMS WHEN MODELLED AS TWO-PORT NETWORKS

PERFORMANCE CRITERIA

(a) Modelling of a circuit by a two-port network is correct in terms of input and output equations, equivalent circuit, parameters, current convention and units.
(b) Solutions to problems involving the frequency characteristics of a two-port network, capacitively coupled to a parallel RC load, are correct.
(c) Conversion from one set of parameters to another is correct in terms of units, equations and equivalent circuit

RANGE STATEMENT

Two-port network:	z-parameter; y-parameter; h-parameter.
Frequency characteristics:	lower half-power frequency; upper half-power frequency; bandwidth; low-frequency voltage gain; mid-band voltage gain; high-frequency voltage gain; mid-band power gain.

EVIDENCE REQUIREMENTS

PC(a)	Written and graphical evidence of the candidate's ability to model a circuit by each type of network using both an equivalent circuit and a pair of equations.
PC(b)	Correct solutions to problems to cover the range of characteristics using any one of the networks.
PC(c)	A correct example of parameter conversion between any two of the networks.

OUTCOME

4. ANALYSE THREE-PHASE CIRCUITS

PERFORMANCE CRITERIA

(a) Representation of three-phase systems by phasor diagram is correct in terms of scale and annotation.
(b) Solutions to problems involving line and phase values, power and power-factor improvement in balanced three-phase loads are correct.
(c) Analysis of the methods of three-phase power measurement is correct for balanced and unbalanced loads

RANGE STATEMENT

The range for this outcome is fully expressed within the performance criteria.

EVIDENCE REQUIREMENTS

PC (a) Graphical evidence of two correctly annotated and scaled diagrams showing phase and line values, one for a star and one for a delta configuration.

PC (b) Four correct solutions to problems to cover the range that must include examples of both star and delta connected loads.

PC (c) Written evidence to show the candidate can explain the principles of power measurement methods by circuit analysis.

OUTCOME

5. INVESTIGATE THE TRANSIENT RESPONSE OF FIRST-ORDER CIRCUITS

PERFORMANCE CRITERIA

(a) Graphs produced of exponential growth and decay are correct in terms of scale, initial values and steady states.

(b) Solutions to problems involving the transient behaviour of first-order RL and RC circuits are correct and accurate.

RANGE STATEMENT

Transient behaviour: rise time; fall time; time constant; steady state.

EVIDENCE REQUIREMENTS

PC (a) One correct example each of a growth curve and a decay curve.

PC (b) One correct solution each to problems involving growth and decay in RC and RL circuits and that together cover the range.

MERIT

To gain a pass in this unit, a candidate must meet the standards set out in the outcomes, performance criteria, range statements and evidence requirements.

To achieve a merit in this unit, a candidate must demonstrate a superior or more sophisticated level of performance. In this unit this might be shown in one or more of the following ways:

(a) integration of theory with practice
(b) synthesis of two or more outcomes in solving problems
(c) logical and lucid presentation of work
(d) depth of further reading and research.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes.)

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

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SUPPORT NOTES

Unit Number

Unit Title ENGINEERING PRINCIPLES (ELECTRICAL NETWORKS)

SUPPORT NOTES:

This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH:

SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 40 hours. The use of notional design length for programme design and timetabling is advisory only.

PURPOSE

The purpose of this unit is to provide students with the underpinning theoretical knowledge required when studying other Principles and Technology units in an Electrical Engineering HNC.

CONTEXT

All calculations should be made to the accuracy appropriate to the application. Students should be able to make any reasonable approximations given the tolerance of the components etc.

Corresponding to the Outcome:

1 (c) The distinction should be made between maximum power transfer and maximum efficiency.

4 (b) A suitable load for power-factor improvement is a three-phase induction motor.
4 (c) One, two and three wattmeter methods should be described.

5 (b) The equation of the form $v = V(1 - e^{-\frac{t}{T}})$ should be solved for *t*.

APPROACHES TO GENERATING EVIDENCE

An integrative approach to the generating of evidence is encouraged using problems modeled on real applications. If possible the results of calculations and graphs should be confirmed by the use of an appropriate software package.

ASSESSMENT PROCEDURES

Centres can use the instruments of assessment that they consider most appropriate.

REFERENCES

1. Guide to unit writing.
2. For a fuller discussion on assessment issues, please refer to SQA's Guide to Assessment.
3. Information for centres on SQA's operating procedures is contained in SQA's Guide to Procedures.
4. For details of other SQA publications, please consult SQA's publications list.