**-SQA-SCOTTISH QUALIFICATIONS AUTHORITY**

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# NATIONAL CERTIFICATE MODULE DESCRIPTOR

**-Module Number-** **0091061** **-Session-1989-90**

**-Superclass-** **RB**

**-Title-** **MATHEMATICS: BOOLEAN ALGEBRA (A) ($x^1/_2$)**

**-DESCRIPTION-**

Purpose

This module is designed to enable the student to use symbolic representation of bistable devices and introduce switching circuits and other control devices.

Refer to the Appendix for guidance on the framework of the mathematics modules.

Preferred Entry Level

81057 Mathematics: Grade 3
or equivalent

Learning Outcomes

The student should:

1. use the laws of Boolean algebra as they apply to sets;
2. use the laws of Boolean algebra as they apply to circuits;
3. simplify Boolean expressions;
4. apply mathematical knowledge and skills in a problem solving context.

Content/ Context

Corresponding to Learning Outcomes 1-4:

1. The work should involve the following: using the notation +, . and - for set union, intersection and complement and 0 and 1 for the empty set and the universal set; using Venn Diagrams to derive the laws of the algebra of sets, to simplify Boolean expressions, and to show the equivalence of 2 Boolean expressions; awareness that the algebra of sets is an example of a Boolean algebra, and an awareness of duality; using the laws of Boolean algebra to simplify simple Boolean expressions, eg.

   $AB + AB\overline{C}, \quad (AB + AC)(B + \overline{B}), \quad A + \overline{A}B, \quad \overline{\overline{A} + B}.$

2. Writing Boolean expressions representing circuits using the symbols +, ., $\bar{}$, 0 and 1; drawing circuits representing Boolean expressions and for logic circuits using the British Standards or American symbols for AND, OR, NOT, NAND and NOR gates; writing Truth Tables for Boolean expressions and using them to prove the laws of Boolean algebra, to simplify Boolean expressions and to show the equivalence of two Boolean expressions. Whilst the student may concentrate on either switching circuits or logic circuits, (s)he should be aware that the laws of Boolean algebra apply to both.

3. Writing the Truth Table for a circuit with given properties; writing the Disjunctive Normal Form from the Truth Table; using Veitch-Karnaugh maps to simplify Boolean expressions.

4. The problems/investigations should involve the application of the content of the other Learning Outcomes. The problems could involve designing circuits to perform given tasks, eg. half adders and full adders; simplifying complex circuits.

Suggested Learning & Teaching Approaches

In simplifying Boolean expressions the emphasis should be on the use of Veitch-Karnaugh maps rather than on algebraic simplification.

Practical circuit problems, such as the control of a single lamp from two switches on a staircase, are not only useful but also create interest and discussion.

Students should maintain a workfile. This should form a complete record of the student's work throughout the module. The tutor should ascertain periodically throughout the module that each student is maintaining his/her workfile adequately. The workfile should contain (as appropriate) the student's notes, class handouts, completed worksheets, exercises, assignments, report(s) of investigation(s), log book of computer activities and a summary of the important details of the module for later revision purposes.

Assessment Procedures

Acceptable performance in the module will be satisfactory achievement of all the performance criteria specified for each Learning Outcome.

The following abbreviations are used below:

LO Learning Outcome
IA Instrument of Assessment
PC Performance Criteria

LO1 USE THE LAWS OF BOOLEAN ALGEBRA AS THEY APPLY TO SETS

PC The student:

(a) uses Venn Diagrams;

(b) simplifies simple Boolean expressions using the laws of Boolean algebra.

IA Calculation and Graphical Exercise

Topics should be assessed as follows on the number of occasions indicated:

(a) Venn Diagrams to illustrate the laws of Boolean algebra or to show the equivalence of two Boolean expressions (involving three variables) 2

(b) Boolean algebra (involving three variables) 2

One question may cover more than one topic.

Satisfactory achievement of the Learning Outcome will be demonstrated by the student producing at least 3 correct responses for (a) and (b) together.

LO2 USE THE LAWS OF BOOLEAN ALGEBRA AS THEY APPLY TO CIRCUITS

PC The student:

(a) states the Boolean expression representing circuits;
(b) draws circuits representing the Boolean expression (involving not more than 3 variables), using British Standard notation when it is a logic circuit;
(c) uses Truth Tables;

IA Calculation and Graphical Exercise

Topics should be assessed on the number of occasions indicated:

(a) Boolean expressions for circuits (involving 3 variables) 2
(b) circuits for Boolean expressions (involving 3 variables) using appropriate notation 2
(c) Truth Tables to prove the laws of Boolean algebra or to show the equivalence of two Boolean expressions (involving 3 variables) 2

In each of (a) and (b) one circuit should be a switching circuit and the other circuit should be a logic circuit.

One question may cover more than one topic.

Satisfactory achievement of the Learning Outcome will be demonstrated by the student producing at least 5 correct responses for (a), (b) and (c) together.

LO3 SIMPLIFY BOOLEAN EXPRESSIONS

PC The student:

(a) obtains Boolean expressions in Disjunctive Normal Form;
(b) simplifies Boolean expressions (involving not more than 3 variables) using Veitch-Karnaugh maps.

IA Calculation and Graphical Exercise

Topics should be assessed on the number of occasions indicated:

(a) Disjunctive Normal Form for expressions (involving 3 variables) 2

(b) Veitch-Karnaugh maps for expressions (involving 3 or 4 variables) 2

One question may cover more than one topic.

Satisfactory achievement of the Learning Outcome will be demonstrated by the student producing at least 3 correct responses for (a) and (b) together.

LO4 APPLY MATHEMATICAL KNOWLEDGE AND KILLS IN A PROBLEM SOLVING CONTEXT

PC The student:

(a) interprets the problem;
(b) selects a strategy to solve the problem;
(c) obtains a satisfactory solution;
(d) communicates the solution accurately and logically.

IA Assignment

2 problems to test the student's ability to draw together various mathematical ideas and techniques developed in the module. The problems should be expressed in a practical context and each must test the 4 processes in the performance criteria. The 2 problems should take approximately half an hour in total to complete.

Satisfactory achievement of the Learning Outcome will be demonstrated by the student completing all 4 processes in the performance criteria for at least one of the questions.