Definition of the Domain for Summative Evaluation

MTH-5104-1

Mathematics Optimization II

Graphs

Québec

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Formation professionnelle et technique
et formation continue

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des adultes

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1. INTRODUCTION

This Definition of the Domain for Summative Evaluation describes and classifies the essential and representative elements of the secondary-level adult education Mathematics program and, more specifically, of the course entitled Optimization II (Graphs). As such, it gives an overview of the program, but should by no means replace the program itself. The purpose of defining the domain is to ensure that all summative evaluation instruments are consistent with the overall program.

The Definition of the Domain for Summative Evaluation for each course in this program is organized in a similar manner; however, the content of this definition of the domain is specific to the course entitled Optimization II (Graphs).

The goal of the Definition of the Domain for Summative Evaluation is to prepare examinations that are valid from one version to another or from one school board to another, taking into account the responsibilities shared by the Ministère de l'Éducation and the school boards.

2. PROGRAM ORIENTATIONS AND CONSEQUENCES FOR SUMMATIVE EVALUATION

ORIENTATIONS	CONSEQUENCES
The main objective of the secondary-level adult education Mathematics program is to help students fully understand mathematical concepts.	Evaluation should involve verifying whether the student has fully understood the different concepts.
The program is designed to help students master the use of certain mathematical tools used in the field of science and technology or in different trades.	Evaluation items should pertain to situations in the field of science and technology or to situations related to trades.
The program aims to provide students with the skills they need to process information by applying mathematical models and appropriate strategies for solving problems.	Evaluation items should involve performing tasks that require the students to classify information, use mathematical models and solve problems.
The program also aims to improve the students' ability to clearly relate information using mathematical language.	Evaluation items should involve performing tasks that require the use of mathematical language. The appropriateness and clarity of the language used should be taken into account in the marking process.
The program is intended to help students develop a systematic work method.	Evaluation items should require the students to present their work in a clear and structured manner. This should be taken into account in the marking process.
The program will help students master the use of technological tools.	The use of a scientific calculator is permitted for the examinations related to this course.

3. CONTENT OF THE PROGRAM FOR PURPOSES OF SUMMATIVE EVALUATION

Concepts

Characteristics of a graph
- description of a graph or of a component of a graph (vertex, edge, loop, order, degree of a vertex, path, simple path, simple circuit, connected graph, complete graph, etc.)
- types of paths: Euler or Hamiltonian
- types of circuits: Euler or Hamiltonian
- description of a route that passes along every edge or through every vertex of a graph only once

Weighted graphs and trees
- value of the shortest path between two vertices in a weighted graph
- tree of minimum value in a weighted graph
- optimal route
- optimization problems related to the value of an optimal path or circuit in a weighted and directed graph

Weighted and directed graphs
- situation represented by a weighted and directed graph
- value of an optimal path or circuit in a weighted and directed graph
- critical path of a project using a weighted and directed graph
- problems related to conflict resolution
- optimization problems that involve calculating the minimum duration of a given project

Weighted graphs, directed trees and graphs
- types of graphs: tree, weighted graph or directed graph

Skills

Each skill is defined within the context of a mathematics program.

Structuring	Being familiar with the fundamentals of mathematics, understanding some mathematical concepts and establishing simple relations among them. Possible actions: to associate, classify, compare, complete, describe, define, contrast, distinguish, state, enumerate, group, name, rank, organize, recognize, arrange, and so on.
Mathematizing	Interpreting a given situation using a mathematical model (arithmetic, algebraic or graphical). Possible actions: to formalize, illustrate, represent, schematize, symbolize, translate, transpose, and so on.
Operating	Performing a given operation or transformation. Possible actions: to calculate, construct, break down, perform, estimate, evaluate, isolate, measure, reconstruct, solve, transform, verify, and so on.
Synthesizing	Effectively integrating a variety of concepts and skills to solve a problem. Possible actions: to solve a problem.

4. TABLE OF DIMENSIONS

<table>
<tr><th>CONCEPTS
SKILLS</th><th>CHARACTERISTICS OF A GRAPH
25%</th><th>WEIGHTED GRAPHS AND TREES
20%</th><th>WEIGHTED AND DIRECTED GRAPHS
55%</th></tr>
<tr><td rowspan="2">STRUCTURING
20%</td><td>Given a graph or one of its components, determine whether statements are true or false.
OR
Identify the graph or graphs described by a given statement.

1 10% or 5%</td><td colspan="2">Determine the type of graph (tree, weighted or directed), given a number of graphs.

4 5%</td></tr>
<tr><td>For a given graph, determine whether statements on the Euler or Hamiltonian paths and circuits are true or false.
OR
Identify the graph or graphs that correspond to a statement on the Euler or Hamiltonian paths and circuits.
2 10% or 5%</td><td></td><td></td></tr>
<tr><td>MATHEMATIZING
10%</td><td></td><td></td><td>Draw a weighted and directed graph representing a word problem illustrated by a table or a figure.

9 10%</td></tr>
<tr><td rowspan="3">OPERATING
40%</td><td>Describe a route that passes along every edge or through every vertex of a graph only once, given a word problem illustrated by a figure.

3 10%</td><td>Determine the tree of minimum value in a weighted graph.

5 10%</td><td></td></tr>
<tr><td></td><td>Determine an optimal route, given a word problem illustrated by a table or a figure.

6 10%</td><td></td></tr>
<tr><td></td><td colspan="2">Calculate the value of the shortest path between two vertices in a weighted graph.
OR
Calculate the value of an optimal path or circuit in a weighted and directed graph.

7 10%</td></tr>
<tr><td rowspan="2">SYNTHESIZING
30%</td><td rowspan="2"></td><td></td><td>Solve a problem that involves finding the critical path and the minimum duration of a project.
10 10%</td></tr>
<tr><td colspan="2">Solve two optimization problems involving graphs.

8 20%</td></tr>
</table>

5. OBSERVABLE BEHAVIOURS

Examination items should be formulated on the basis of the observable behaviours listed below. The requirements and restrictions specified in the dimensions and the objectives of the program must be observed.

Dimension 1

Given a graph or one of its components, determine whether statements are true or false.

/10

or

Given a number of graphs, identify which graph or graphs correspond to one or more statements describing a graph or a component of a graph.
(structuring) /5

Dimension 2

Given statements describing a graph that is given, determine whether statements about a type of path or circuit are true or false.

/10

or

Given a number of graphs, identify which graph or graphs correspond to one or more statements about a graph illustrating a type of path or cycle.
(structuring) /5

Note: If the first option in Dimension 1 is chosen, the second option in Dimension 2 must be selected. Similarly, if the second option in Dimension 1 is chosen, then the first option in Dimension 2 must be selected.

Dimension 3

Given a word problem illustrated by a figure that can be expressed as a graph, describe a route corresponding to the given situation that passes along every edge or through every vertex of a graph only once. The route must be described by listing, in order, the edges along which it passes or the vertices through which it passes.
(operating) /10

Dimension 4

Given a number of graphs and terms (tree, weighted or directed graph), determine the type of graph represented by each.
(structuring) /5

Dimension 5

Given a weighted graph illustrating a situation, determine the tree of minimum value that optimizes this graph. The tree should contain no more than 5 edges.
(operating) /10

Dimension 6

Determine the optimal route of a word problem illustrated by a table or a figure that can be represented by a graph containing no more than 5 vertices. The route may be a path or a circuit. The students must draw the required graph and clearly show all their work.
(operating) /10

Dimension 7

Given a weighted graph illustrating a situation, calculate the value of the shortest path between two vertices. The path should contain no more than 5 edges. The students must clearly show all their work.

or

Given a weighted and directed graph illustrating a situation, calculate the value of the optimal path or circuit corresponding to a route. The path or circuit should contain no more than 5 arcs. The students must clearly show all their work.
(operating) /10

Dimension 8

Solve two optimization problems using graphs. Solving the problems may require resolving conflicts or calculating the value of the optimal path or circuit in a weighted and directed graph. The students must clearly show all their work.
(synthesizing) /20

Dimension 9

Draw a weighted and directed graph of a word problem illustrated by a table or a figure. The graph must have at least 3 vertices and between 10 and 15 arcs. The students must clearly present the graph.
(mathematizing) /10

Dimension 10

Using a weighted and directed graph, solve a problem that involves finding the critical path and the minimum duration of a project. The project is presented as a word problem and includes a table of the steps required to complete the project. There must be between 5 and 10 steps. The description of each step must include the previous and simultaneous step or steps. The students must draw the corresponding graph and clearly show all their work.
(synthesizing) /10

6. JUSTIFICATION OF CHOICES

In the examination, 20% of the items test the students' **STRUCTURING** skills by verifying their understanding of certain concepts:

- identification of types of graphs or components of graphs
- identification of types of paths or cycles
- description of a route that passes along every edge or through every vertex of a graph only once

In the examination, 10% of the items test the students' **MATHEMATIZING** skills by verifying whether they are able to translate a given situation into a mathematical model:

- drawing a weighted and directed graph to represent a situation

In the examination, 40% of the items test the students' **OPERATING** skills by verifying whether they have mastered certain operations or transformations:

- calculating the value of the shortest path between two vertices in a weighted graph
- determining the tree of minimum value in a weighted graph
- calculating the value of an optimal path or circuit in a weighted and directed graph

In the examination, 30% of the items test the students' **SYNTHESIZING** skills by verifying their ability to:

- solve problems
- use a rigorous work method
- communicate clearly using mathematical language

7. DESCRIPTION OF THE EXAMINATION

A. TYPE OF EXAMINATION

The summative examination will be a written examination consisting of multiple-choice, short-response or extended-response items.

The items should take into account the restrictions and the requirements specified in the dimensions and the objectives of the program. The weighting of marks should be consistent with the percentages set out in the table of dimensions.

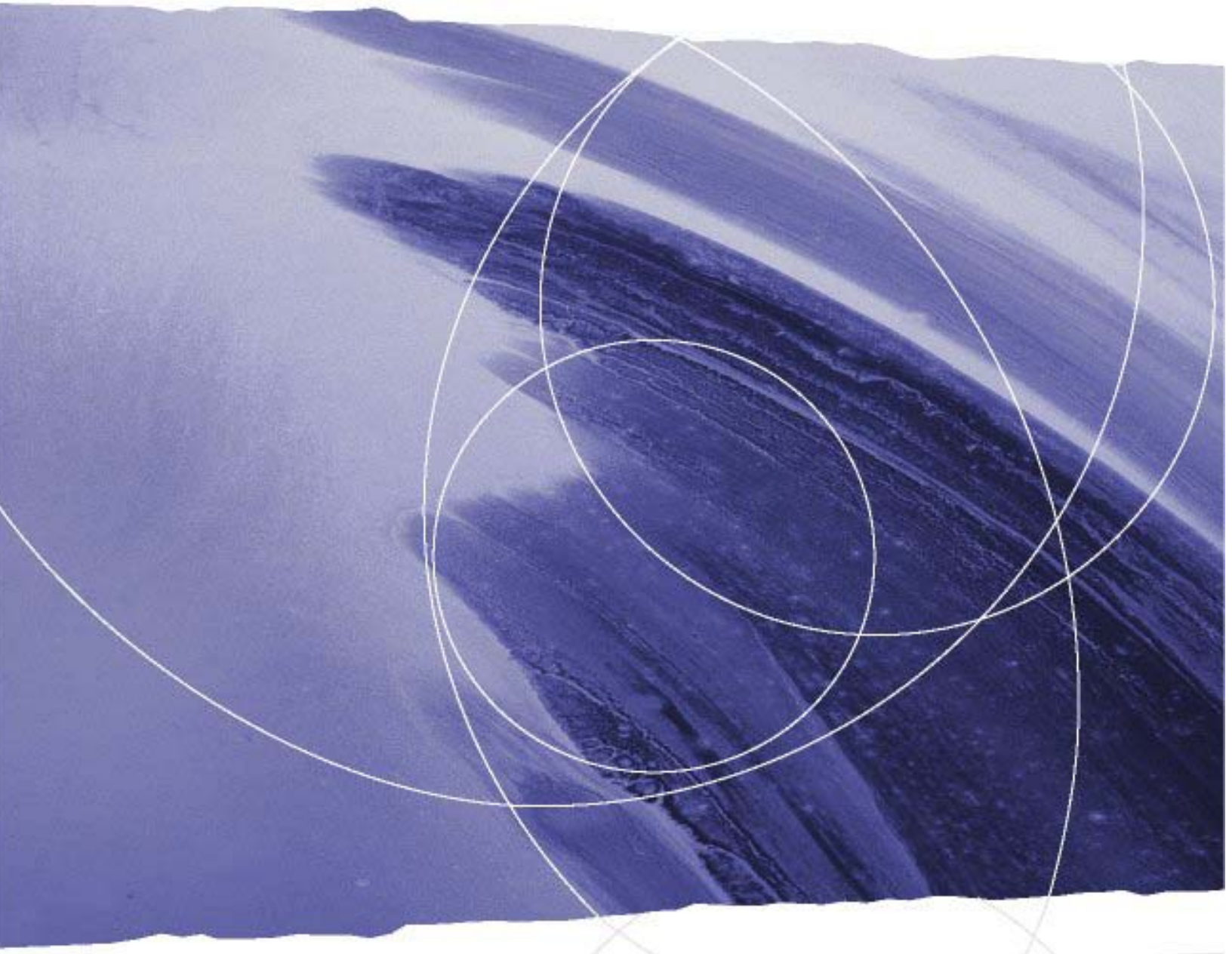
B. CHARACTERISTICS OF THE EXAMINATION

The examination will be administered in a single session lasting no more than two and a half hours.

Students are permitted to use a scientific calculator; however, they are not permitted to use a graphing calculator.

C. PASS MARK

The pass mark is set at 60 out of 100.



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