Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

SURVEYING COMPUTATION AND ADJUSTMENT

LSVSC402

Perform Basic Surveying Computation and Adjustment

Competence

RQF Level: 4

Learning Hours

100

Credits: 10

Sector: Construction and Building services

Trade: Land surveying

Module Type: Specific

Curriculum: CBSLSV4001 – TVET certificate IV in Land Surveying

Date Issued: May, 2023

<table>
<tr><td>Purpose statement</td><td colspan="6">This module describes the knowledge, skills, and attitudes required to perform surveying computations and adjustment. It is designed for students pursuing RQF Level 4 in Land Surveying.
At the end of this module, the student will be able to apply theory of measurement and adjustments; apply traversing computation techniques, perform intersection computation, and perform resection computation.</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">Coordinate measurement, Applied mathematics; applied physics, computer literacy.</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>• Group work and presentation</td><td>30%</td></tr>
<tr><td>• Individual work</td><td>40%</td></tr>
<tr><td colspan="3"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Apply theory of measurement errors and adjustments	1.1. Errors in surveying measurements are correctly identified according to their sources.
	1.2. Errors are properly classified according to their categories.
	1.3. Accuracy and precision adequately assessed correctly according to the indices of precision.
	1.4. Error propagation adjustment in indirect measurements is correctly done according to standard statistical procedures.
2. Apply traversing computation techniques	2.1. Bearings of the traverse legs are accurately computed according to the geometry of the traverse network.
	2.2. Distances are accurately computed according to the survey coordinate system in use.

	2.3. Traverses are accurately computed according to the Bowditch method.
	2.4. Closing error is accurately computed according to the Bowditch method
	2.5. Errors are accurately adjusted according to the Bowditch method
3. Perform intersection Computations	3.1. Unknown point position is properly marked according to its intended use.
	3.2. Coordinates of the unknown point are correctly computed using the solution of triangle method.
	3.3. Coordinates of the unknown point are correctly computed by intersection of the observed angles method.
4. Perform resection Computations	4.1. Known points are properly selected in order to avoid a danger circle solution.
	4.2. Unknown point position is properly marked according to its intended use.
	4.3. Coordinates of the unknown point are correctly computed using angular resection method.

Intended Knowledge, Skills, and Attitude

Knowledge	Skills	Attitude
✓ Identify basic Surveying technology ✓ Identify surveying materials, tools and equipment ✓ Identify theory of measurement errors and adjustments ✓ Identify traversing computation techniques ✓ Identify resection computation methods	✓ Assess indices of precision. ✓ Adjust error propagation in indirect measurements ✓ Compute bearings of the traverse legs ✓ Compute distances ✓ Compute traverses ✓ Perform intersection computations ✓ Perform resection computations	✓ Use creativity and innovation throughout surveying works ✓ Pay attention to surveying projects details ✓ Demonstrate punctuality during the implementation of surveying projects ✓ Demonstrate analytical skills in selection of the unknown point position during intersection and resection.

Course content

Learning outcomes	At the end of this module the student will be able to: 1. Apply theory of measurement errors and adjustments 2. Apply traversing computation techniques 3. Perform Intersection Computations 4. Perform Resection Computations
Learning outcome 1: Apply theory of measurement errors and adjustments	**Learning hours: 20**

Indicative content

- **Identification of Errors in surveying measurements**
  - ✓ natural errors
  - ✓ personal errors
  - ✓ Instrumental errors
- **Classification of errors according to their categories**
  - ✓ Systemic errors
  - ✓ Random errors.
  - ✓ Mistake/blunder/gross errors
- **Assessment of accuracy and precision**
  - ✓ Indices of precision
    - Standard deviation
    - Variance
    - Standard error of the mean
    - Weight
    - Outliers
- **Adjustment of errors propagation**

- ✓ Error of sum
- ✓ Error of products
- ✓ Error of mean
- ✓ Standard deviation
- ✓ Weighting of observation
- ✓ Least square adjustment

Resources required for the learning outcome	
Equipment	▪ Computer, white/black board, Projector
Materials	▪ Eraser, drawing pins, cello tape, notebooks, chalks, markers, pencil, pens, flipchart.
Tools	▪ Ruler, calculator, duster.
Facilitation techniques	▪ Group discussion, presentations, individual and group work, trainer guide
Formative assessment methods /(CAT)	▪ Written assessment, oral assessment.

Learning outcome 2: Apply traversing computation techniques	**Learning hours: 35**

Indicative content

- **Computation of the traverse legs' bearings**
  - ✓ Identification of traverse network types
    - Open Traverse
    - Closed Traverse
  - ✓ Compute whole circle (azimuth) bearing.
  - ✓ Compute quadrantal (reduced) bearing.
  - ✓ Compute fore bearing.
  - ✓ Compute Back bearing.
- **Computation of distances**
  - ✓ Types of coordinate systems

- Geographic
- Cartesian
- Polar coordinate

✓ Coordinate system transformation

✓ Compute distance of traverse legs

✓ Compute joins

- **Computation of traverse by Bowditch method**

✓ Adjustment of angular misclosure

✓ Compute departures and latitudes

✓ Compute coordinates of unknown points

- **Computation of closing error by Bowditch method**

✓ Compute latitudes and departure misclosure

✓ Apply linear misclosure

✓ Compute relative precision

- **Adjustment of errors by Bowditch method**

✓ Apply traverse adjustment

Resources required for the learning outcome	
Equipment	▪ Computers, white/black board, projector
Materials	▪ Eraser, drawing pins, notebooks, chalks, markers, pencil, pens, flipchart
Tools	▪ Clipboard, ruler, calculator, duster
Facilitation techniques	▪ Group discussion, presentations, individual and group work, trainer guide
Formative assessment methods /(CAT)	▪ Written assessment, oral assessment

Learning outcome 3: Perform intersection computations	**Learning hours: 20**
Indicative content	
• **Marking of unknown point position**	

- ✓ Establishment of point location
- ✓ Monumentation of point
- ✓ Point protection

- **Computation of unknown coordinates by solution of triangle method**
  - ✓ Compute distances
  - ✓ Compute angles
  - ✓ Compute coordinates
- **Computation of unknown coordinate by intersection of observed angles**
  - ✓ Angles
  - ✓ Bearings

Resources required for the learning outcome	
Equipment	▪ DGNSS receiver, Total station, PPE
Materials	▪ Field book, pens, warning tape, marker pen, pencil, flags, paper, first aid kit, pegs, nails
Tools	▪ Tape measure, hammer, panga, plumb bob, arrows, compass, calculator, reflector, tripod, communication radio
Facilitation techniques	▪ Group discussion, presentations, individual and group work, trainer guide, demonstration
Formative assessment methods /(CAT)	▪ Written assessment, oral assessments, performance assessment.

Learning outcome 4: Perform Resection Computations	**Learning hours: 25**

Indicative content

- **Selection of known points**
  - ✓ Identification of danger circle
  - ✓ Locating known points
  - ✓ Selection of known points
- **Marking unknown points**
  - ✓ Establishment of points location

- ✓ Monumentation of point
- ✓ Point protection

- **Computation of unknown coordinates by angular resection**
  - ✓ Tangent method (blunt's method)

Resources required for the learning outcome	
Equipment	▪ DGNSS receiver, Total station, PPE
Materials	▪ Field book, pens, warning tape, marker pen, pencil, flags, paper, first aid kit, pegs, nails
Tools	▪ Tape measure, hammer, panga, plumb bob, arrows, compass, calculator, reflector, tripod, communication radio
Facilitation techniques	▪ Group discussion, presentations, individual and group work, trainer guide, demonstration
Formative assessment methods /(CAT)	▪ Written assessment, oral assessments, performance assessment.

Integrated/Summative assessment

Integrated situation

The Surveying Contractors LTD wants to hire the professional land surveyor to work on land boundary demarcation project of UBUMWE Primary School. As Surveyor assistant employed by Surveying Contactors LTD, you have been given the following tasks:

- To perform measurement of school parcel boundaries.
- To compute traverses of all boundaries.
- To apply intersection and resection to find the coordinates of a point located within the plot at 15 meters from the main entrance.

Softcopy pdf file and a printed map on A3 size paper must be submitted. Instrument, materials, and tools are provided by the company, and the work should be completed in 12 hours.

Resources

Tools	▪ Tape measure, hammer, pangs, plumb bob, arrows, compass, calculator, reflector, tripod, communication radio
Equipment	▪ DGNSS receiver, Total station, PPE
Materials/ Consumables	▪ Field book, pens, warning tape, marker pen, pencil, flags, paper, first aid kit, pegs, nails

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Apply Theory of Measurement Errors and Adjustments (10%)	1.1. Errors in surveying measurements are correctly identified according to their sources.	1. Natural errors are well identified			1
		2. Personal errors are well identified			1
		3. Instrumental errors are well identified			1
	1.2. Errors are properly classified according to their categories.	1. Errors are well classified			1
	1.3. Accuracy and precision are adequately assessed correctly according to the indices of precision.	2. Indices of precision are accurately assessed			1
	1.4. Error propagation	1. Error of products is			1

	adjustment in indirect measurements is correctly done according to standard statistical procedures	correctly adjusted			
		2. Standard deviation is correctly adjusted			1
		3. Weighting of observation is well performed			1
		4. Least square adjustment is well performed			2
2. Apply Traversing Computation Technique (25%)	2.1. Bearings of the traverse legs are accurately computed according to the geometry of the traverse network.	1. Open traverse is well identified			1
		2. Closed traverse is well identified			1
		3. Bearings are correctly computed			4
	2.2. Distances are accurately computed according to the survey	1. Distance of traverse leg is correctly computed			3
	2.3. Coordinate system in use.	1. Joins are correctly computed			3
	2.4. Traverses are accurately computed according to the Bowditch method.	1. Angular misclosure is correctly adjusted			2
		2. Departures and Latitudes are correctly computed			3
		3. Coordinates of unknown points are correctly computed			4

	2.5. Closing error is accurately computed according to the Bowditch method.	1. Relative precision is correctly computed			1
	2.6. Errors are accurately adjusted according to the Bowditch method.	1. Traverse adjustment is well applied			3
3. Perform Intersection Computations (30%)	3.1. Unknown point position is properly marked according to its intended use.	1. Safety rules are well respected			2
		2. Unknown points location is well established			3
		3. Unknown points is well monumented			3
		4. Unknown points is well protected			3
	3.2. Coordinates of the unknown point are correctly computed using the solution of triangle method.	1. Distances are correctly computed			5
		2. Angles are correctly computed			4
		3. Coordinates are correctly computed			5
	3.3. Coordinates of the unknown point are correctly computed by intersection of the observed angles method.	1. Bearings are correctly computed			5
4. Perform	4.1. Known points are	1. Danger circle is well			6

Resection Computation (35%)	properly selected in order to avoid a danger circle solution.	identified			
		2. Known points are well located			4
		3. Known points are well selected			5
	4.2. Unknown point position is properly marked according to its intended use.	1. Unknown point location is well established			5
		2. Unknown points is well monumented			4
		3. Unknown points is well protected			4
	4.3. Coordinates of the unknown point are correctly computed using angular resection method.	1. Tangent method (Blunt's method) is correctly applied			7
Total marks					100
Percentage Weightage					100%
Minimum Passing line % (Aggregate):					70%

References

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