Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

SURFACE DRAINAGE

WIRSD 301

Perform surface drainage

Competence

RQF Level: 3

Learning Hours 40

Credits: 4

Sector: Agriculture and Food processing

Trade: Water and Irrigation

Module Type: Specific

Curriculum: AFPWIR3001- TVET Certificate III in Water and Irrigation

Issue Date: May, 2022

<table>
<tr><td>Purpose statement</td><td colspan="6">This module describes the skills, knowledge and attitude required to Perform drainage. At the end of this module, learners will be able to plan for drainage system installation, prepare the site for installation of drainage system, undertake installation of drainage system and complete installation of drainage system. Qualified student deemed competent to this competency, may work with others in support of current professional practice in marshland, hillside, small scale irrigation, garden, greenhouses under guidance.</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 project and presentation</td><td>20%</td></tr>
<tr><td>• Individual project /Work</td><td>50%</td></tr>
<tr><td colspan="2"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Plan for drainage system installation	1.1. Site investigation is effectively conducted in accordance with site conditions and designed drainage system
	1.2 Drainage method is properly Identified according to drainage system plan and enterprise work procedure
	1.3 Materials, tools, equipment and machinery for drainage system installation are properly selected according to drainage system design requirements
2 Prepare the site for installation of drainage system	2.1 Land clearing is appropriately performed in accordance with site conditions
	2.2 Drainage system layout is correctly interpreted and components are located on the site according to the drainage design
	2.3 Measurement and setting out of the site are precisely respected according to the system layout

3 Undertake installation of drainage system	3.1 Excavation works are adequately performed without damage to existing services, facilities and features with respect to the set profiles.
	3.2 Drainage system components are properly installed according to the design and with compliance of environmental protection
	3.3 Drainage system test is properly conducted according to the drainage system design.
	3.4 Consultation of supervisor is regularly conducted when the drainage system operation does not meet the plan specifications for remedial action.
4. Complete installation of drainage system	4.1 Backfilling is methodically completed according to the site condition.
	4.2 The site is properly restored according to environmentally safe manner by disposing waste materials.
	4.3 Tools, equipment and machinery are properly maintained and stored according to the operation manual

Course content

Learning outcomes	**At the end of the module the learner will be able to:** 1. Plan for drainage system installation 2. Prepare the site for installation of drainage system 3. Undertake installation of drainage system 4. Complete installation of drainage system

Learning outcome 1: Plan for drainage system installation	Learning hours: 10

Indicative content

- **Conduct site investigation**

✓ Identification of existing infrastructures including buried utilities
✓ Identification drainage area
✓ Benchmarks identification
✓ Identification of main points on the site
✓ Location components of drainage system
✓ Identification of site clearing requirements
✓ Vegetation
✓ Trees
✓ Debris
✓ Water contamination
✓ Ppes requirements
✓ Construction Site description

- **Identify Drainage method**

✓ Differentiation of drainage methods
✓ Surface drainage methods
✓ Subsurface drainage methods
- Open drainage
- Tile drainage
- Well drainage
- Mole drainage
- Bio drainage
- Interceptor drainage
- Bamboo or pole
- drainage
- Stone drainage

✓ Selection criteria of drainage method
✓ Drainage problem
- Water logging
- Water ponding
- Salinization

- Sources of excess water
- Soil properties
- Topography
- Social- economic factors
- ✓ Layouts of drainage systems
- Layouts for Surface drainage systems
- Layouts for Subsurface drainage systems
- ✓ Factors affecting selection of drainage system layout
  - Drainage methods
  - Topography of land to be drained
  - Soil properties
  - Social-Economic factors
- **Select materials, tools, equipment and machinery**

- ✓ Installation methods of drainage system
- Manual
- Mechanical
- Both
- ✓ Advantages and disadvantages of drainage installation methods
- ✓ Identification of tools
- Tools for surface drainage
- Tools for subsurface drainage
- ✓ Identification of materials
- Materials for surface drainage
- Materials for subsurface drainage
- ✓ Identification of equipment And machinery for
- Surface drainage
- Subsurface drainage

Resources required for the learning outcome	
Equipment	• Computer • Printer • Projector
Materials	• White board/Blackboard, Flipchart.
Tools	• Images of lands affected with drainage problems.
Facilitation	• Lectures

techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Project based assessment

Learning outcome 2: Prepare the site for installation of drainage system	**Learning hours: 10**
Indicative content	

- **Perform land Clearing**
  - ✓ Techniques for land clearing
  - ✓ Selection of tools, equipment and machinery according to work conditions
  - ✓ Management and Disposal of debris
- **Interpret Drainage system layout and locate components**
  - ✓ Types of drainage system layouts
  - ✓ Components of a drainage system and symbols
  - ✓ Map interpretation
  - ✓ Staking out techniques
- **Measure and set out the site**
  - ✓ Setting out methods
  - ✓ Measuring the vertical and horizontal distances
  - ✓ Finding out the relative direction of lines
  - ✓ Staking out and pegging main points on the field.
  - ✓ Tools, Equipment and machinery settings for
    - Land forming
    - Moling
    - Trenching
    - Land grading
    - Cut and fill process
    - Furrow grade
    - Cross slope

Resources required for the indicative content	
Equipment	Computer Printer Projector equipment and machinery
Materials	• -Books- Flipchart - White board/Blackboard
Tools	• Land cleaning tools
Facilitation techniques	• Lectures • Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 3: Undertake installation of drainage system	**Learning hours: 10.**
Indicative content	
• **Excavate set profiles** ✓ Types of excavation ✓ Procedures for excavation ✓ Marking the Area ✓ Marking the location of buried utilities ✓ Mark of set profiles as per layout plan • **Install Drainage system components** ✓ Land forming methods ✓ Components of a Drainage system.	

- Main
- Field drains
- Pumping units
- Outlet

✓ Conditions and time for drains installation
✓ Steps in Installation of drains
✓ Methods of deep and shallow open drains construction.
✓ Pipe works
✓ Construction of other hydraulic structures of the system

- **Conduct a Drainage system test.**

✓ Causes of the drainage system malfunctioning
✓ Tools and equipment for drainage system testing
✓ Important parts of drainage system for testing
✓ Design parameters that need testing
- Drainage discharge at outlets
- Water table fluctuations /water-head midway between drains
- Salinity
- Pressure
- Lasting time of Ponding
- Depth of ponds

✓ Recommendations techniques

- **Conduct Consultation to supervisor**

✓ Reporting cases
✓ Report format and components
✓ Proposed solutions
✓ Reaction to feedback

Resources required for the indicative content	
Equipment	Computer Printer Projector equipment and machinery
Materials	-Books- Flipchart - White board/Blackboard
Tools	Land cleaning tools
Facilitation techniques	• Demonstration and simulation • Individual and group work

	• Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment • Etc

Learning outcome 4: Complete installation of drainage system	**Learning hours: 10**
Indicative content	
• **Backfill trenches and other excavations** ✓ Methods of backfilling for: - Surface drainage systems - Subsurface drainage systems ✓ Precautions in backfilling • **Restore the site and dispose waste materials** ✓ Restoring activities: - Runoff Reduction - Water Quality Protection - Site Topography - Water Table ✓ Identification of Waste materials ✓ Methods of Wastes disposal - Solid wastes disposal - Wastewater disposal • **Maintain and store Tools, equipment and machinery** ✓ Arrangement of tools, equipment and machinery in store and workshops ✓ Machinery maintenance - Maintenance of electrical connections - Replacing or repairing safety guards; - Sharpening or replacing machines' cutting blades; - Regular maintenance of engines, cooling systems;	

- Lubrication, oil changes, filter changes
- Maintenance of lifting equipment;
- Clearing blockages;
- Light metal machining, welding;
- Operations with compressed air/tyres;
- Maintenance of oil mill's machinery as olives transporters, cleaner and washing machine, mill, mixer, transfer pumps, centrifuges, screw extractor, receiving hoppers,

presses

- Cleaning and lubricating power-take-off shaft guarding;
- Maintenance of hydraulic systems.
- ✓ Maintenance of portable tools
- Cleaning
- Lubricating
- Sharpening blades, saw chains and drills
- Replacing broken and used parts
- Replacing broken cords
- ✓ Disinfection of tools and equipment
- ✓ Calibration of measuring instruments.

Resources required for the indicative content	
Equipment	• Computer - Printer - Projector
Materials	• Flipchart, White board/Blackboard
Tools	• Backfilling videos, Books.
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment
Tools	• Building line • Pliers • Pan • Pick axes • Hoe • Spade
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Integrated/Summative assessment

Resources

Tools	Drainage installation tools.
Equipment	equipment and machinery - Surveying equipment - Working drawings
Materials/ Consumables	DVD - Internet connection - Books, materials, equipment and machinery - Surveying equipment - Working drawings

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Learning outcome 1: **(30%)**	1.1 Site investigation is effectively conducted in accordance with site conditions and designed drainage system	Existing infrastructures are identified			4
		Benchmarks and main points are identified			3
		Components of the drainage system are located			3
	1.2 Drainage method is properly Identified according to drainage system plan and	Surface drainage methods are differentiated			5
		Subsurface drainage methods are differentiated			2
		Advantages and disadvantages of drainage methods are explained			3

	enterprise work procedure				
	1.3 Materials, tools, equipment and machinery for drainage system installation are properly selected according to drainage system design requirements	Installation methods of drainage systems are distinguished			4
		Tools and materials for surface drainage are identified			3
		Equipment and machinery for surface drainage are identified			3
Learning outcome 2: **(30%)**	Personal protective equipment is appropriately selected according to work to be done	Types of ppes are stated			4
		Types of ppes are explained			3
		Ppes are selected based on the work to be done			3
	Work-team is properly selected according to drainage system design requirements	Staffing procedures are explained			4
		Required staffs are identified			4
		Required staffs are estimated			2
	Land clearing is appropriately performed in accordance with site conditions	Tools, equipment and machinery are selected according to work conditions			3
		Land clearing techniques			1
		Debris management and disposal is explained			1
	Drainage system	Components of drainage system			2

	layout is correctly interpreted and components are located on the site according to the drainage design	are explained			
		Symbols of components of drainage system are identified			1
		Drainage system layout is interpreted			2
Learning outcome 3: **(20%)**	Measurement and setting out of the site are precisely respected according to the system layout	Setting out methods are identified			2
		Measuring the vertical and horizontal distances are performed			1
		Finding out the relative direction of lines is performed			1
	Excavation works are adequately performed without damage to existing services, facilities and features with respect to the set profiles.	Location and relocation of existing utilities are performed			2
		Types of excavation are explained			1
		Excavation procedures are explained			1
	Drainage system components are properly installed according to the design and with compliance of environmental protection	Conditions and time for drains installation are explained			2
		Land forming is performed			1
		Steps in Installation of drains are explained			1
	Drainage system test is properly conducted according to the drainage system design.	Important parts of drainage system to be tested are mentioned			2
		Design Parameters of the drainage system to be tested are mentioned			1
		Causes of the drainage system malfunctioning are explained			1

	Consultation of supervisor is regularly conducted when the drainage system operation does not meet the plan specifications for remedial action	Reporting procedures/methods are explained			2
		Report Format and components are explained			2
Learning outcome 4: **(20 %)**	Backfilling is methodically completed according to the site condition.	Methods of backfilling are explained			2
		Precautions in backfilling are explained			2
	The site is properly restored according to environmentally safe manner by disposing waste materials.	Activities involved in site restoring are explained			3
		Waste materials found after establishing drainage system are listed			2
		Methods of wastes disposal are explained			2
	Tools, equipment and machinery are properly maintained and stored according to the operation manual	Arrangement of tools and equipment in store and workshop is performed			3
		Activities involved in maintenance of tools, equipment and machinery are listed			3
		Calibration of Measuring instruments is performed			3
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

References:

1. EU-OSH. (2011). Maintenance in Agriculture - A Safety and Health Guide. Luxembourg: Publications Office of the European Union,2011
2. Henk Ritzema. (2005). Installation of subsurface draianage systems. Wageningen, The Netherlands September 2005
3. https://www.researchgate.net/publication/272507858_Drainage_of_Irrigated_Lands /link/54e7a8e40cf2f7aa4d4de633/download
4. Kpmg.com/nz .(2014). Effective reporting for construction projects: increasing the likelihood of project success
5. FAO. (2007). Guidelines and computer programs for the planning and design of land drainage systems. FAO Paper 62