



**UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER**

**PROGRAMME: BSC IN LWM, AGRONOMY &
HORTICULTURE 3**

COURSE CODE: LUM 302

TITLE OF PAPER: IRRIGATION

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO
OTHER QUESTIONS**

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN
GRANTED BY THE CHIEF INVIGILATOR**

SECTION I: COMPULSORY QUESTION**QUESTION 1**

You are asked to produce a standard design to irrigate a 10 ha unit. The project is intended to grow cotton. The irrigation system is to be a conventional hand-move sprinkler system. All pipes will be surface portable pipes. The land is rectangular (250m x 400m) and flat. There is no prevailing wind direction. The water supply is from an open source at one corner with a maximum vertical lift of 2 m. The cotton is intended to be scheduled to avoid it coming under water stress. The peak design water requirements have already been determined from CROPWAT as 10 mm/day, with a maximum allowable soil moisture deficit of 100 mm. The soil is clay loam and has a final infiltration rate of 13 mm/hr.

Prepare the first part of the design exercise, making any reasonable assumptions where necessary and give reasons for all your choices. This part of the design should include the following:

- plan showing the field, the water supply and the location of the pump
- selection of net and calculation of gross applications at each irrigation
- corresponding intervals between irrigations
- using the table attached, select a suitable nozzle size, design operating pressure, the sprinkler spacing along laterals and the spacing between lateral positions
- determine the application rate, set time, and the maximum number of moves per day

[40 marks]

SECTION II: ANSWER TWO QUESTIONS FROM THIS SECTION**QUESTION 2**

- a) With the aid of a clearly labelled diagram, explain the concept of pipe size optimisation in as far as irrigation costs are concerned. [10 marks]
- b) In irrigation, a pump duty is defined by the required discharge, Q and the required pumping head, H . Briefly discuss what compose the pumping head in a sprinkler system. [10 marks]
- c) Explain why and when two or more pumps may either be connected in series or in parallel. [10 marks]

QUESTION 3

Discuss the following concepts as used in physics of soil and water:

- a) soil water equilibriums
- b) Soil water potentials
- c) Soil moisture characteristic curve
- d) Bulk density
- e) Porosity

[30 marks]

QUESTION 4

Discuss in detail the importance of uniformity in irrigation, and how it can be measured in the field, including the formulae used in the relevant calculations. Your discussion should also include the causes of reduced uniformities and how these can affect irrigation water management and crop productivity. **[30 marks]**

APPENDIX 1

Irrigation manual

Table 5
Performance of some sprinklers

Sprinkler Specifications				Sprinkler precipitation rate (mm/hr)							
Nozzle Size (mm)	Pressure (kPa)	Q (m ³ /hr)	Wetted Diam. (m)	Sprinkler spacing (m x m)							
				9x12	9x15	12x12	12x15	12x18	15x15	18x18	
3.0	250	0.57	25.00	5.28	4.22	3.96					
3.0	300	0.63	25.60	5.83	4.67	4.38					
3.0	350	0.68	26.20	6.30	5.04	4.72					
3.5	250	0.75	26.85	6.94	5.56	5.21	4.17				
3.5	300	0.82	27.60	7.59	6.07	5.69	4.56				
3.5	350	0.89	28.35	8.24	6.59	6.18	4.94				
4.0	300	1.08	26.60		8.00	7.50	6.00	5.00	4.60		
4.0	350	1.16	30.50		8.59	8.06	6.44	5.37	5.16		
4.5	300	1.32	30.95			9.17	7.33	6.11	5.87		
4.5	350	1.42	32.00			9.86	7.89	6.57	6.31		
4.5	400	1.52	33.05			10.56	8.44	7.04	7.56		
5.0	300	1.70	33.00				9.44	7.87	8.18	5.25	
5.0	350	1.84	34.30				10.22	8.52	8.18	5.68	
5.0	400	1.96	35.60				10.89	9.07	8.71	6.05	

- Nozzle size indicates the diameter of the orifice of the nozzle
- Pressure is the sprinkler operating pressure at the nozzle
- Discharge indicates the volume of water per unit time that the nozzle provides at a given pressure
- Wetted diameter shows the diameter of the circular area wetted by the sprinkler when operating at a given pressure and no wind
- The sprinkler spacing shows the pattern in which the sprinklers are laid onto the irrigated area. A 12 m x 18 m spacing means that sprinklers are spaced at 12 m along the sprinkler lateral line and 18 m between sprinkler lines.