HYELAPATUHDA CHIDAMA

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CHEMICAL ENGINEERING

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfallIn the modern challenge of improving the growth of plants and reducing costs justifies that the development of an irrigation system that will minimize the waste of water and reduce workers and monitor overhead is crucial.

Q1. This module centres around three principal design problems, namely: establishing the operating· regime: selecting the emitter on the basis of required operating pressure, discharge and spacings; and sub-division of the field into blocks. The first step of the process entails calculating the basic soil/plant/water relationships from the input data. These include the soil moisture holding capacity and infiltration rates and the plant water requirements. These relationships are then used as constraints in the ensuing trial and error process for emitter selection and determination of the operating regime. A set of required operating and capacity characteristics is calculated; a number of emitters are then considered and their performance in relation to the required characteristics is examined. This process is repeated for several sets of required characteristics and in this way a matrix of possible emitters and related operating characteristics is developed. The designer is then able to make a selection that best suits the prevailing circumstances.

Q2. **Hardware**

Components:

1. Emitters -type.

2. Block network

- lateral pipe diameters
- manifold diameters

3. Mainline network

- pipe diameters

4. Control elements

- valves : type, size:
- Flow and pressure regulators: if needed; type, size
- meters: if needed; type, size
- automation equipment: if needed; type
- filters: if needed. type, size

5. Pumps - main pump size

- booster pump sizes
- fertilizer injection equipment: if needed; type, size

6. Temperature sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require direct contact with the physical object that is being monitored (contact temperature sensors), while others indirectly measure the temperature of an object (non-contact temperature sensors).

7. Soil moisture content sensor

A soil moisture sensor measures the quantity of water contained in a material, such as soil on a volumetric or gravimetric basis.

To obtain an accurate measurement, a soil temperature sensor is also required for calibration.

8. Gauge to detect water level

Level of water is measured by a vented strain gauge. A differential strain gauge transducer measures pressure with one side of the transducer exposed to the water and the other side vented to the atmosphere.

Design parameters;

1. Spacing; Nominal operating pressure; Costs; Pressure/discharge relationship; Operating regime;
2. Hydraulic grade line; Allowable pressure variation; Coefficient of uniformity; Pipe refinements; Topography; Pipe costs;
3. Hydraulic grade line; Pipe costs; Energy costs; Flow end pressure requirements;
4. Allowable pressure requirements; Hydraulic grade line; Discharge volumes; Water quantity; Costs;
5. Hydraulic grade line; Discharge volumes; Flow and pressure requirements; Costs;

System characteristics

1. Capacity
- maximum system discharge
- flow and pressure distribution
- system application rate
- maximum appllication depth
2. Layout and alignments
    - division of field into blocks
    - emitter spacings
    - orientation of laterals
    - positioning of manifold
    - location of blockvalves

- configuration of mainline network

3. Control system
    - location of control elements
    - degree of automation
4. Operating regime
    - irrigation set time
    - irrigation cycle length
    - timing of irrigation sets i.e. times of the day, days of the week)
    - sequencing of block valves
    - filter flushing programme
    - fertilizer Injection programme

5. Pumping requirements
    - maximum pumping capabilities
    - the pumping regime, Including operation of booster pumps

6. Performance
    - coefficient of uniformity
    - application and requirement efficiencies
    - capital and operating costs
    - return on Investment

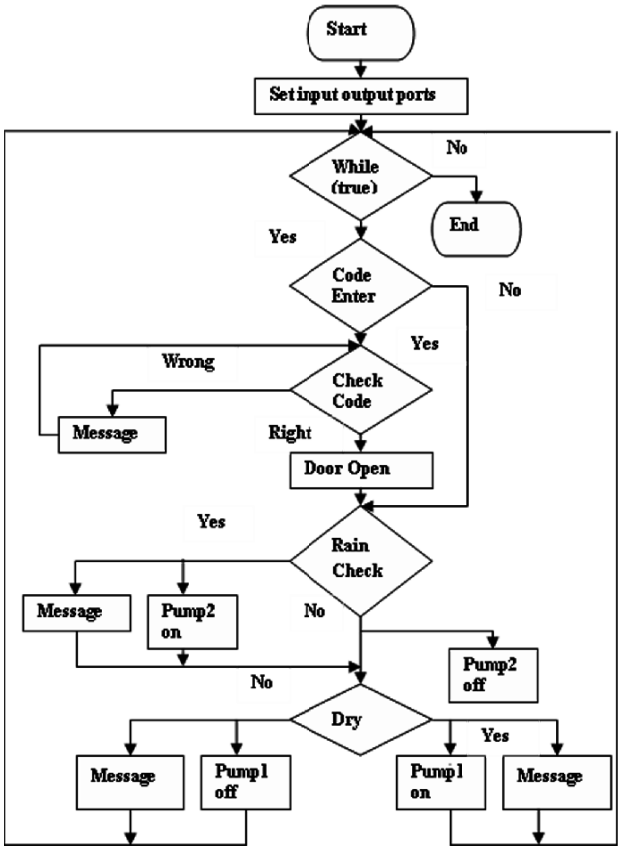
Software:

- security
- soil temperature reader
- moisture content reader
- water dispenser

Q3. For the algorithm:

- Start
- Login to software
- Is reservoir low on water? If yes, THEN SOUND ALARM skip to step 7
- Read soil temperature and content
- Is there enough moisture in soil at this temperature? If yes, THEN GO to step 3
- Set time interval for water system
- END

For the flowchart:



Q4. Top-down design approach