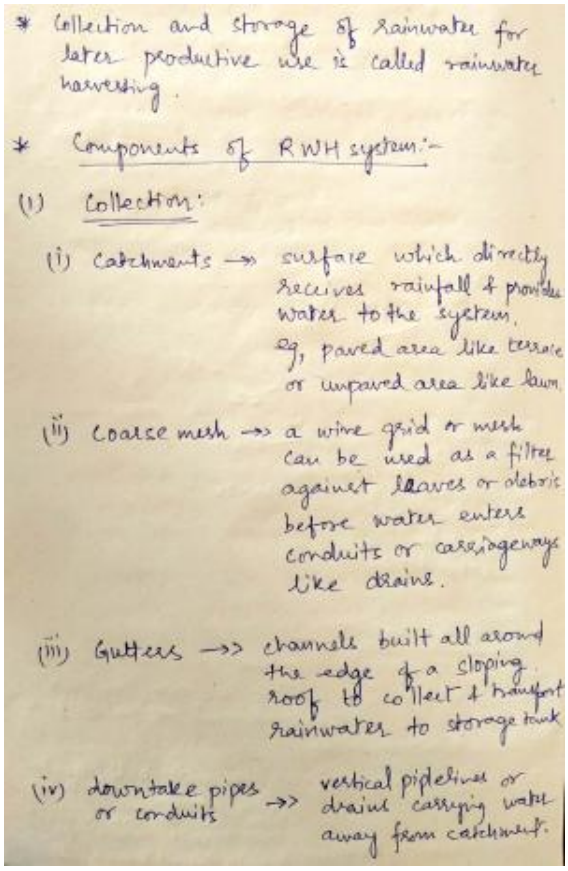
IAT-2 WRM questions and solutions

1. Explain rain water harvesting and it's components of collection, storage, application and optimum utilization? Describe the types of microcatchment.



* Collection and storage of rainwater for later productive use is called rainwater harvesting.

* Components of RWH system:-

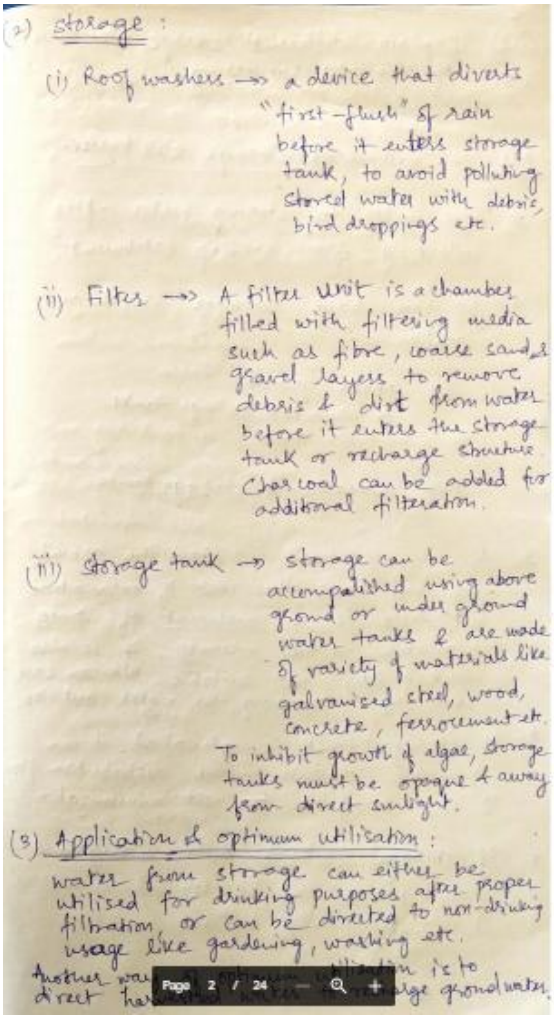
(1) Collection:

(i) Catchments → surface which directly receives rainfall & provides water to the system. eg, paved area like terrace or unpaved area like lawn.

(ii) Coarse mesh → a wire grid or mesh can be used as a filter against leaves or debris before water enters conduits or carcinogens like drains.

(iii) Gutters → channels built all around the edge of a sloping roof to collect & transport rainwater to storage tank.

(iv) downtake pipes or conduits → vertical pipelines or drains carrying water away from catchment.



(2) storage:

(i) Roof washers → a device that diverts "first-flush" of rain before it enters storage tank, to avoid polluting stored water with debris, bird droppings etc.

(ii) Filter → A filter unit is a chamber filled with filtering media such as fibre, coarse sand & gravel layers to remove debris & dirt from water before it enters the storage tank or recharge structure. Charcoal can be added for additional filteration.

(iii) Storage tank → storage can be accomplished using above ground or under ground water tanks & are made of variety of materials like galvanised steel, wood, concrete, ferrocement etc. To inhibit growth of algae, storage tanks must be opaque & away from direct sunlight.

(3) Application & optimum utilisation:

water from storage can either be utilised for drinking purposes after proper filtration or can be directed to non-drinking usage like gardening, washing etc.

Another way ... tion is to direct har... ge ground water.

Page 2 / 24

2. Explain the different storage structures of water harvesting? Briefly explain the various techniques of rain water harvesting in urban area.

Ans: Small-scale storage structures:-

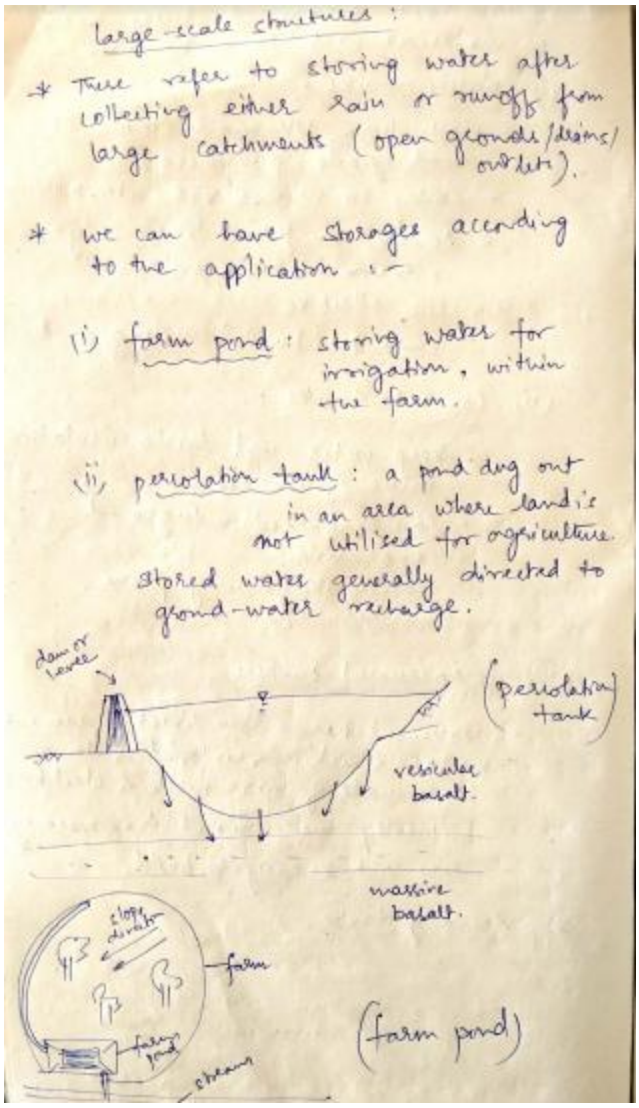
* These refer to storing water after collecting rain from rooftop catchment.
* We can have storages based on location :-
  (i) above ground or elevated storage tanks.
  (ii) underground storage tanks
* If storage tank is above the ground, we can save the cost of excavation but there is a constraint of space available in the vicinity. It is also aesthetically not suitable. We can save cost of pumping the water out also.
* If storage tank is elevated, it can generate pressure in the distribution flow & thus beneficial for cost minimization.
* If storage tank is built underground, ground space can be utilised as well as it is aesthetically better.

* We can have storage structures based on material used to make them:-

(i) plastic tanks:
- made from UV-stabilized, food grade polythene.
- easy to manoeuvre into position.
- As they can flex a little, they can withstand earthquakes.
- cost effective.
- can't be buried underground.

(ii) Concrete tanks:
- keep water cool due to insulation value of concrete.
- can be buried underground.
- expensive
- earthquake-damage prone.
- longer life.

(iii) ferro cement tanks:
- ferrocement has a thin sheet of cement mortar which is reinforced with a cage made of wire mesh & steel bars
- structurally more efficient than masonry.
- low-cost & easy-to-build.



3. What is the rainwater harvesting? Explain the needs for rain water harvesting. What is the rural model for rain water harvesting?

4. What is microcatchment? What are the merits and demerits of micro catchment?

5. What is percolation tank? Describe general guidelines to be followed in proposing a percolation tank.

- percolation tanks are the most prevalent structures in India as a measure to recharge the groundwater reservoirs both in alluvial as well as hard rock formation
- A percolation tank is an artificially created surface water body, submerging in its reservoir, a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage.
- percolation tank should be constructed preferably on 2nd to 3rd order streams located on highly fractured & weathered rocks, for speedy recharge
- size of percolation tank is governed by percolation capacity of strata in the tank bed as well as yield from the catchment.
- Site selection parameters:
  - rainfall pattern
  - number of rainy days
  - dry spells
  - evaporation rate
  - detailed hydrological studies.

(E) Design:

(i) Capacity of percolation tank has to be calculated on basis of rainfall & catchment area of the tank.

✓ After site selection, compute catchment yield from rainfall & runoff coefficient using 'strange tables'.

✓ For this, catchment is first decided or identified as one of the following:

→ Good catchment

Hills or plains with little cultivation & moderately absorbant soil.

→ Average catchment

Flat, partly cultivated stiff gravely / sandy absorbent soil.

→ Bad catchment

Flat & cultivated sandy soil.

(ii) Make suitable assumptions such as no. of fillings per year, utilisation of yield per filling etc. Thus, capacity of the tank can be computed.

(iii) develop capacity table & decide FTL (full tank level) in the tank. It is done by getting capacity for contours.

(iv) Computes other levels (MWL, TBL)

Max. water level = FTL + max. head of water (0.3–0.6m)

Top bund level = MWL + free board (0.5–1m)

(v) Compute design flood from Dicken's eq^n or Ryve's eq^n

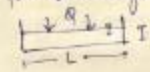
$Q = C_D A^{3/4}$ → area of catchment
→ Dicken's coeff.

or

$Q = C_R \times A^{2/3}$
→ Ryve's coeff.

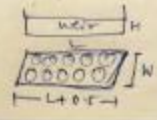
(vi) Calculate length of weir using design flood.

for rectangular weir, $Q = C_d \frac{2}{3}\sqrt{2g}\, L H^{3/2}$
↓ Coeff of discharge ≈ 0.62



(vii) design of horizontal floor

provided at downstream of weir for smooth exit of water. It is stone pitched.



length of floor = L + 0.5
width " ≥ 2(D+H)
D = Wt. of drop = FTL − GL
H = max. head of water ground level

(viii) Design of embankment :

✓ Top width (w.t) $\frac{h}{5} + 1.5$ m

h = total height of embankment (m)
= TBL − GL

✓ Length of embankment is distance between points where h.t. intersects contour having same elevation.

✓ Based on type of material, suitable side slopes for embankments are decided.

	u/s	d/s	u/s	d/s
side slope	2.5:1	2:1	3:1	2.5:1
material	silty clay		sandy / gravelly.	

(ix) Check suitability or stability of the structure by locating the saturation line on the base.