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B.Tech Even Semester (CBCS) Exam., May—2018

AGRICULTURAL ENGINEERING

(6th Semester)

Course No. : AECC–30

(Irrigation and Drainage Engineering)

Full Marks : 50
Pass Marks : 15

Time : 2 hours

Note : 1. Attempt *any* **five** questions.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the margin indicate full marks for the questions.

1. Write short notes on the following : 10

(a) Cavitation and priming of pump

(b) D'Aubuisson's efficiency ratio

(c) NPSH

(d) Pump performance curve

(e) Submersible pump

2. *(a)* Describe the basic hydraulic principle of centrifugal pump. 3

(b) Distinguish between single-acting and double-acting type positive displacement pumps with figure. 4

(c) Express the relationahips between pump speed and impeller diameter in the performance of centrifugal pump. 3

3. *(a)* A volute centrifugal pump installed in a deep well is driven by a diesel engine, using a two-stage belt drive. The pump discharge is 20 l/s. The suction pipe is 10 cm in diameter and 7 m long. The pumping water level is 5·8 m below the centre line of the pump. The suction pipe is connected to the pump by a long sweep bend of 10 cm in diameter. A 10 cm diameter of foot valve is fixed at the intake of the suction pipe. The static discharge head is 12 m. The discharge pipe is 8 cm in diameter and 16 m long. Three long sweep bends and a reflux valve, each of 8 cm diameters are fixed on the discharge line. The pump discharge into a pressure tank, the pressure inside which is 0·6 kg/cm^2.

Determine the—

(i) total head;

(ii) BHP of engine if the pump efficiency is 74% and drive efficiency 80%.

If the specific fuel consumption of the diesel engine is 0·23 l/kWh, what will be the monthly requirement of diesel to run the engine, if the pump works for 10 hours each day? 7

(b) What are the specific advantages of drip irrigation over sprinkler irrigation? 3

4. *(a)* Describe in brief the characteristic features, suitablilities and limitations of the following irrigation methods : 6

(i) Border

(ii) Basin

(iii) Furrow

(b) Determine the size of the stream of the irrigation stream required to irrigate 20 ha rice field having no effective rainfall in the region and peak consumptive use rate of 9 mm/day. The irrigation system is operated for 8 hours per day. The field irrigation efficiency is 80%. 4

5. *(a)* For a wheat field, the following information is available :

Field capacity = 41% by volume
Wilting point = 19% by volume
Effective root zone depth = 35 cm

Irrigation is given up to field capacity considering the above root zone.
Average daily ET rate for that period = 6 mm/day.

Determine the—

(i) maximum plant available water within the root zone;

(ii) time of irrigation (days from the moisture reading) allowing 70% depletion of plant available moisture;

(iii) depth of irrigation required. 5

(b) What are the soil moisture tension relationships of hydroscopic water, capillary water and gravitational water? 5

6. *(a)* Write brief notes on any *three* of the following : 6

(i) V-notch weir

(ii) Orifice

(iii) Parshall flume

(iv) Headworks

(v) Venturi meter

(b) Using Francis' formula, compute the discharge of a rectangular weir 45 cm long with a head of 12 cm, under the following conditions : 4

(i) With no-end contraction

(ii) With one-end contraction

(iii) With two-end contraction

7. *(a)* Write short notes on the following : 4

(i) Leaching requirement and their control

(ii) Controlled drainage system and interceptor drain

(b) The EC of canal water used for irrigating wheat is 1·2 m-mhos/cm while it can tolerate a maximum EC of 6 m-mhos/cm. The ET of wheat is 0·8 cm/day and soil hydraulic conductivity is 0·9 cm/h. The area is to be drained by the tile drains laid at a depth of 2·5 m below ground level so as to maintain water table depth at 1·5 m.

The impervious layer is located at a depth of 4 m below the ground surface.

(i) Compute the drain spacing using Hooghoudt's equation.

(ii) Calculate the drainage flow rate out of 400 ha field.

(iii) What is the size of drain pipe laid on a gradient of 0·001 m/m, assuming that drain is running full and Manning's is 0·01? 6

8. *(a)* Write the arrangements of surface and subsurface drain systems in fields. Also define the drainage coefficient and drainage area. 7

(b) A field soil has four distinct soil layers within 1·4 m depth from the surface. The depth and vertical hydraulic conductivity of the layers are 0·3 m, 0·4 m, 0·3 m and 0·4 m; and 1·0, 0·5, 0·7 and 0 6 $m^3/m^2/d$, respectively. A constant water supply of 0·88 m/d is provided at the soil surface. What will be the resultant hydraulic conductivity of the soil column through the bottom of the soil layer? 3

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