B.Tech Even Semester (CBCS) Exam., April—2017

AGRICULTURAL ENGINEERING

(6th Semester)

Course No. : AE–604 (C)

(Irrigation and Drainage Engineering)

Full Marks : 75
Pass Marks : 30

Time : 3 hours

Note : 1. Attempt **one** question from each Unit.

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.

UNIT—I

1. Briefly describe about the following : 5×3=15

(a) Classification of irrigation projects

(b) National water policy, 2002

(c) Environmental impact of irrigation project

2. Briefly describe about the following : 5×3=15

(a) Base, duty and delta of water requirements

(b) GCA, CCA and intensity of irrigation

(c) Crop ratio and Kor watering

UNIT—II

3. *(a)* A single-acting reciprocating pump has its piston diameter 15 cm and stroke 25 cm. The piston makes 50 double strokes per minute. The suction and delivery heads are 5 m and 15 m, respectively. Find—

(i) the discharge capacity of the pump in liters per minute;

(ii) the force required to work the piston during the suction and delivery strokes if the efficiency of suction and delivery strokes are 60% and 75%, respectively;

(iii) the HP required by the pump for its operation. 8

(b) What is a hydraulic ram? What are the main components of a hydraulic ram? 4

(c) A centrifugal pump at its best point of efficiency discharges 0·03 cubic meters of water per second against a total head of 40 m when the speed is 1450 r.p.m. Compute the specific speed of the pump. 3

4. *(a)* What are the basic criteria a person must follow while selecting a pump for irrigation or water lifting? 5

(b) A centrifugal pump is used to pump water to an overhead tank at a height 8 m from central line of pump. The overhead tank supplies water to 5 carp hatchery units with peak requirement of 20 litters/second per unit. Water is conveyed through a 15 cm diameter, 100 m long PVC pipe which includes 1 gate valve and 2 elbows. The outlet is submerged. Also, given that viscosity is

$$1{\cdot}054 \times 10^{-6}\ m^2/s.$$

K_{elbow} 0 8, K_{GV} 0 2,

$$4f \quad 0\ 003 \quad (0\ 25/R_e^{0\ 24}).$$

(i) Find the pressure at the delivery end of the pump.

(ii) If the total suction head is 6 m with 50% efficiency, then calculate the power requirement. 10

UNIT—III

5. *(a)* Define soil-water potential. What are the principal factors influencing the amount of capillary water in soils? 5

(b) Distinguish between the following : 5

(i) Infiltration rate and Cumulative infiltration

(ii) Hygroscopic, Capillary and Gravitational water

(c) An area of 50 ha (wheat field) is to be irrigated by a pump working 12 hr a day. The moisture at field capacity and wilting point is 40 and 20 cm/m, respectively. The depth of root zone of the crop is 60 cm. Irrigation is to be done when 75% of the available moisture in the root zone is depleted. Peak rate of moisture used by the crop is 4 mm/day. Determine—

(i) time of irrigation;

(ii) net depth of water application;

(iii) amount of water pumped per application;

(iv) required capacity of the irrigation system. 5

6. *(a)* What are the basic soil, plant and atmospheric factors influencing the water relations of plants? 4

(b) Write short notes on the following : 6

(i) Coefficient of uniformity (CU)

(ii) Gravitational potential and metric potential

(iii) Irrigation efficiencies

(c) A stream of 135 lps was diverted from a canal and 100 lps was delivered to the field. An area of 1·6 ha was irrigated in 8 hr. The effective depth of root zone was 1·8 m. The run-off loss in the field was 432 cm^3. The depth of water penetration varied linearly from 1·8 m at the head end of the field to 1·2 m at the tail end. Available moisture capacity of the soil is 2 cm per depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture. 5

UNIT—IV

7. *(a)* Distinguish between with neat sketch : 10

(i) Weirs and Parshall flumes

(ii) Water meter and Venturi meter

(b) A mass concrete rectangular surplus weir is to be designed for a farm pond having 5 km^2 of watershed area. Find the length of the weir if maximum depth of water over the Weir sill should not exceed 1 m. Maximum intensity of rainfall for the time of concentration of

the watershed is 50 mm/h for a return period of 10 years. Assume run-off coefficient value for the watershed to be 0·6 and coefficient of discharge for the weir is 0·623. 5

8. *(a)* Design a most economical trapezoidal section of a channel to carry a discharge of 10 m^3 /s in a bed slop of 1 in 3000. For stability the side slope is 1·5:1 and the value of Manning's n is 0·025. 5

(b) Write the rules for setting and operating weirs. Also write the limitations in the use of weirs. 3+2=5

(c) Using Francis' formula, compute the discharge of a rectangular weir 45 cm long with a head of 12 cm, under the following conditions : 5

(i) With no end contraction

(ii) With one-end contraction

(iii) With two-end contraction

UNIT—V

9. *(a)* What are the main aims of field drainage? 3

(b) What are the major considerations needed to be taken while designing a sub-surface drain? 2

(c) A moist soil sample has a volume of $484\ cm^3$ in the natural state and a weight of 7·94 N. The dry weight of the soil is 7·36 N and the relative density of the soil particles is 2·65. Determine the porosity, soil moisture content, volumetric moisture content, volumetric moisture content and the degree of saturation. 10

10. *(a)* In the design of an irrigation system, the following properties exist :

Soil field capacity is 28% by weight, permanent wilting point is 17% by weight;
Bulk density = 1 36 g/cm^3;
Root zone depth is 1 m; peak ET is 5 mm/day;
Irrigation efficiency is 60%;
Water conveyance efficiency is 80%;
50% of water lost in canals contribute to seepage;
Rainfall for January is 69 mm and evapotranspiration is 100 mm;
Salinity of irrigation water 0·80 mmhos/cm while that acceptable is 4 mmhos/cm.

Compute the drainage coefficient. 10

(b) What are the causes of waterlogging and what are the direct and indirect effects of waterlogging? 5

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