WATER RESOURCES ENGINEERING
(CIVL 4101)

**Time Allotted : 3 hrs**   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The double mass curve technique is adopted to
(a) check the consistency of raingauge records
(b) to find the average rainfall over a number of years
(c) to find the number of raingauges required
(d) to estimate the missing rainfall data.

(ii) A canal is 80 km long and has an average surface width of 15 m. If the evaporation measured in a class A pan is 0.5 cm/day, the volume of water (in m^3) evaporated in a month of 30 days is
(a) 12600   (b) 18000
(c) 180000   (d) 126000

(iii) A 90 km^2 catchment has the 4- hr unit hydrograph which can be approximated as a triangle. If the peak ordinate of this unit hydrograph is 10 m^3/s, the time base is
(a) 120 h   (b) 64 h
(c) 50 h   (d) none of the above.

(iv) A watershed 600 ha. In Area experienced a rainfall of uniform intensity 2.0 cm/h for duration of 8 hours. If the ... runoff is measured as 0.6 Mm^3, the average infiltrati... ...orm is
(a) 1.5 cm/h
(c) 1.0 cm/h

(v) The rainfall in five successive days on a catchment was 2, 6, 9, 5 and 3 cm respectively. The Φ index for the storm can be assumed to be 3 cm/day. The total direct runoff from the catchment due to this storm was
(a) 20 cm   (b) 11 cm   (c) 10 cm   (d) 22 cm.
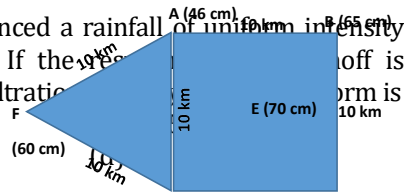
(vi) A triangular DRH due to a storm has a time base of 80 hours and a peak flow of 50 m^3/s occurring at 20 hours from the start. If the catchment area is 144 km^2, the rainfall excess of the storm was
(a) 20 cm   (b) 7.2 cm   (c) 5 cm   (d) 18 cm.

(vii) Find the delta for a crop if the duty for a base period of 120 days is 1500 hectares/cumec
(a) 650 mm   (b) 690 mm   (c) Zero   (d) 702 mm.

(viii) A unit hydrograph has one unit of
(a) peak discharge   (b) rainfall duration
(c) direct runoff   (d) the time base of direct runoff.

(ix) The waterlogging can be counteracted by
(a) by increasing the F. S. L. of the canal
(b) by lowering the F. S. L. of the canal
(c) by using unlined canal section for irrigation
(d) allowing seepage from canal.

(x) The drawback of open drains constitutes
(a) valuable agriculture land is wasted
(b) obstruction of the farming operations
(c) valuable plant nutrient are washed down in open drains
(d) all of the above.

Group – B

2. (a) The following are the rain gauge observations during a storm. Construct Hyetograph of the precipitation.

Time since Commencement of the storm (minute)	5	10	15	20	25	30	35	40	45	50
Accumulated rainfall (cm)	0.1	0.2	0.8	1.5	1.8	2.0	2.5	2.7	2.9	3.1

(b) The area shown in the figure below is composed of a square plus an equilateral triangular plot of side 10 km. The annual precipitation at the rain gauge stations located at the four corners and centre of the square plot and apex of the triangular plot are indicated in the figure. Find the mean precipitation over the area by Thiessen polygon method, and compare with the arithmetic mean.

A (46 cm), B (65 cm), F (60 cm), E (70 cm), C (36 cm), D (80 cm), 10 km

           3 + 9 = 12

3. (a) Explain the terms Potential Evapotanspiration, Permanent Wilting point, Infiltration capacity and Φ- index

   (b) A 24-hour storm occurred over a catchment of 1.8 km^2 area and the total rainfall observed was 10 cm. An infiltration capacity curve prepared had the initial infiltration capacity of 1 cm/h and attained a constant value of 0.3 cm/h, with a Horton's constant k = 5 hr^{-1}. An IMD pan (evaporimeter) installed in the catchment indicated a decrease of 0.6 cm in the water level (after allowing for rainfall) during 24 hours of its operation. Other losses were found to be negligible. Determine the runoff from the catchment. Assume a pan coefficient of 0.7.

   6 + 6 = 12

Group – C

4. (a) Draw neatly a stream channel ordering in a fourth order stream.

   (b) Mention various elements of a flood hydrograph in a schematic diagram of a flood hydrograph.

   (c) The ordinates of a 3- hour unit hydrograph are given below. Derive the ordinates of a 6 hour Unit hydrograph and plot the same.

Time (hr)	0	3	6	9	12	15	18	21	24
3-hr. UGO (cumec)	0	1.5	4.5	8.6	12.0	9.4	4.6	2.3	0.8

   2 + 2 + 8 = 12

5. (a) Present a neat sketch for different types of surface irrigation methods and discuss in detail.

   (b) Duty of water, delta and base period of a crop presents a relationship. Derive the equation presenting the relationship.

   10 + 2 = 12

Group – D

6. (a) Draw a typical cross section of an irrigation canal and discuss its various component parts.

   (b) A canal has a bed width of 8 m, full supply depth of water is 1.5 m, bank width is 1.8 m, cutting slope 1:1, and filling slope is 1.5:1. Free board is kept 0.6 m. Calculate balancing depth for most economical section.

   6 + 6 = 12

7. (a) "The irrigation canals can be classified in different ways on the basis of various considerations". Present a detail discussion on those various classifications.

   (b) In an irrigation canal enlist the various causes for the loss of water.

   10 + 2 = 12

Group – E

8. Discuss the term "waterlogging", its causes and the various preventive measures to counteract the waterlogging.

   12

9. (a) Discuss in detail the Open and Closed drains used as anti-logging measures.

   (b) To determine discharge and spacing of Closed drains, derive the relevant equations mentioning various assumptions as and where required.

   5 + 7 = 12