

**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 any 5 (five) from Group B to E, taking at least one 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) With regard to the alignment of canal which of the given statement is incorrect  
(a) alignment should result in the most economical way of distribution of water  
(b) command is as high as possible  
(c) cross drainage works are minimum  
(d) side slope canal is preferred due to economy.
- (ii) Paleo is defined as  
(a) the ratio of the number of days the canal as actually run to the number of days of irrigation period  
(b) the ratio of mean supply to the full supply of a canal  
(c) the initial irrigation required by the land before sowing  
(d) ratio of the area for which the permit has been issued to the mean supply for the base period
- (iii) The drawback of open drains constitutes  
(a) valuable agricultural land is wasted  
(b) these drains obstruct the farming operations  
(c) bridges are required to be constructed to facilitate communication across wide drains  
(d) valuable plant nutrients are washed down in open drains.
- (iv) The spacing of closed drains is independent of  
(a) coefficient of permeability  
(b) drain size  
(c) height above the impervious stratum  
(d) maximum height of the drained water table above the impervious stratum.
- (v) Based on the canal alignment, a canal is classified as  
(a) irrigation canal  
(b) alluvial canal  
(c) branch canal  
(d) contour canal.

- (vi) The rainfall in five successive days on a catchment was 3, 5, 9, 6, and 1 cm respectively. The  $\phi$ -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) 8 cm                      (b) 11 cm                      (c) 20 cm                      (d) 23 cm.
- (vii) The D-hour unit hydrograph of a catchment may be obtained by dividing the ordinates of a single peak direct runoff hydrograph (DRH) due to a storm of D hour duration by the  
 (a) total runoff volume (in cm)                      (b) direct runoff volume (in cm)  
 (c) duration of DRH                      (d) total rainfall (in cm).
- (viii) A watershed 600 ha in area experienced a rainfall of uniform intensity 2.0 cm/h for duration of 8 hours. if the resulting surface runoff is measured as 0.6 Mm<sup>3</sup>, the average infiltration capacity during the storm is  
 (a) 1.5 cm/h                      (b) 0.75 cm/h  
 (c) 1.0 cm/h                      (d) 2.0 cm/h.
- (ix) The following recording raingauges does not produce the mass curve of precipitation as record:  
 (a) Symon's rainauge                      (b) tipping bucket type gauge  
 (c) weighing bucket type gauge                      (d) natural syphon gauge.
- (x) The shape of recession limb of a flood hydrograph depends on  
 (a) basin as well as storm characteristics                      (b) storm characteristics only  
 (c) basin characteristics only                      (d) base flow only.

**Group - B**

- 2. (a) Draw a typical cross-section of an irrigation canal and discuss it's various component parts. [(CO4) (Remember/LOCQ)]
- (b) The following are the rainauge observations from the storm that occurred on 14 August, 1983. For the storm data construct a hietograph.

Time since commencement of the storm (minutes)	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

[(CO1) (Analyse/HOCQ)]

**5 + 7 = 12**

- 3. (a) Write a short note on Direct Runoff and Natural Flow. [(CO2)(Remember/LOCQ)]
- (b) Analysis of data on maximum one day rainfall depth at Chennai indicated that a depth of 300 mm had a return period of 50 years. Determine the probability of a one-day rainfall depth equal to or greater than 300 mm at Chennai occurring once in 20 successive years. [(CO3)(Understand/IOCQ)]
- (c) Calculate the base period of rice if its duty is 432 hectares/cumec and delta for rice is 300 cm. [(CO4) (Analyse/IOCQ)]

**6 + 3 + 3 = 12**

**Group - C**

4. (a) Define evapotranspiration. What are the various factors affecting evapotranspiration? [(CO4)(Remember/LOCQ)]  
 (b) Ten months rainfall-runoff data are available for a particular catchment. Develop an equation for rainfall-runoff correlation.

Year	Annual rainfall (cm)	Annual runoff (cm)
2000	118	54
2001	98	45
2002	112	51
2003	97	41
2004	84	21
2005	91	32
2006	138	66
2007	89	25
2008	104	42
2009	80	11

[(CO2) (Analyze/HOCQ)]

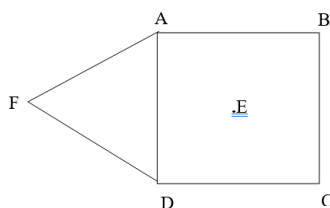
- (c) A catchment area has seven raingauge stations. In a year, the annual rainfall recorded are as follows. Determine the standards error in the estimation of mean rainfall in the existing set of raingauges. For a 10% error in the estimation of mean rainfall, calculate the minimum number of additional raingauges to be established in the catchment.

Station	A	B	C	D
Rainfall (cm)	130	142	118	92

[(CO3) (Analyze/IOCQ)]

**5 + 4 + 3 = 12**

5. (a) An irrigation channel is carrying 3 cumecs of water to a CCA of 1500 ha with an intensity of irrigation 50%. If the base period of the crop is 140 days, calculate the delta of the crop. [(CO4) (Understand/IOCQ)]  
 (b) Define Ø-index and W-index. [(CO2) (Understand/LOCQ)]  
 (c) The area shown in figure is composed of a square plus an equilateral triangular plot of side 20 km. The annual precipitations at the rain-gauge stations located at the four corners A, B, C, D, Centre 'E' of the square plot and apex 'F' of the triangular plot are 46 cm, 65 cm, 76 cm, 80 cm, 70 cm, and 60 cm respectively. Find the mean precipitation over the area by Thiessen polygon method, and compare with the arithmetic mean.



[(CO1) (Analyze/HOCQ)]

**3 + 3 + 6 = 12**

**Group – D**

6. (a) “The irrigation canals can be classified in different ways on the basis of various considerations”. Present a detail discussion on those various classifications. [(CO4)(Remember/LOCQ)]  
 (b) Explain the various causes for the losses of water in an irrigation canal. [(CO5)(Remember/LOCQ)]  
 (c) Distinguish between infiltration capacity and infiltration rate. [(CO1)(Analyze/IOCQ)]

**7 + 3 + 2 = 12**

7. (a) Discuss the term “water-logging” and it’s causes. [(CO6)(Remember/LOCQ)]  
 (b) Explain Unit Hydrograph with the help of a diagram. [(CO3)(Understand/LOCQ)]

**8 + 4 = 12**

**Group – E**

8. (a) Discuss the different types of surface irrigation methods with the help of a neat sketch. [(CO6)(Remember/LOCQ)]  
 (b) The infiltration capacity of a catchment is represented by Horton's equation as,  $f_p = 0.5 + 1.2e^{-0.5t}$ , where  $f_p$  is in cm/h,  $t$  is in hours. Assuming the infiltration to take place at capacity rates in a storm of 4 hours duration, estimate the average rate of infiltration for the duration of the storm. [(CO4)(Analyze/IOCQ)]

**6 + 6 = 12**

9. (a) Explain the term Water Year. [(CO5)(Remember/LOCQ)]  
 (b) The 6-hour unit hydrograph of a basin is triangular in shape with a peak of 100 m<sup>3</sup>/s occurring at 24-h from the start. The base is 72-h.  
 (i) What is the area of the catchment represented by this unit hydrograph?  
 (ii) Calculate the flood hydrograph due to a storm of rainfall excess of 2.0 cm during the first 6 hours and 4.0 cm during the second 6 hours interval. The base flow can be assumed to be 25m<sup>3</sup>/s constant throughout. [(CO4)(Analyze/HOCQ)]

**4 + 2 + 6 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45%	35%	20%

**Course Outcome (CO):**

After the completion of the course students will be able to

1. Understand the design of water resources systems utilizing the basic principles of the hydrologic cycle and the watershed.
2. Know about the concepts of movement of ground water beneath the earth.
3. Understand the value of probability and statistical analysis in deriving precipitation and stream flow data and hydrograph theories.

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4. Impart the knowledge of irrigation techniques, efficiencies, optimal irrigation of the fields, consumptive water requirements of the crops and crop types.
5. Understand the distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals system.
6. Master the concept of water logging and drainage systems.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

<b>Department &amp; Section</b>	<b>Submission link:</b>
<b>CE</b>	Google Classroom joining Code lez6kh6
	Google Classroom joining Link <a href="https://classroom.google.com/c/MTQ4MzQwMTM0NDA2">https://classroom.google.com/c/MTQ4MzQwMTM0NDA2</a>
	Answer Script Upload Link <a href="https://classroom.google.com/c/MTQ4MzQwMTM0NDA2/a/NDY5MjUxMTUyNDg5/details">https://classroom.google.com/c/MTQ4MzQwMTM0NDA2/a/NDY5MjUxMTUyNDg5/details</a>