

**B.TECH/CE/7<sup>TH</sup> SEM/CIVL 4115/2021**  
**WATER RESOURCES ENGINEERING**  
**(CIVL 4115)**

**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) Which of the following type of water is not available for plants  
(a) hygroscopic water  
(b) capillary water  
(c) gravitational water  
(d) Both a and c
- (ii) A unit hydrograph has one unit of  
(a) peak discharge (b) rainfall duration  
(c) direct runoff (d) the time base of direct runoff.
- (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 waterlogging can be counteracted  
(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) all of the above.
- (v) The use of unit hydrographs for estimating floods is generally limited to catchments of size less than  
(a) 5000 km<sup>2</sup> (b) 500 km<sup>2</sup>  
(c) 50 Ha (d) 5000 Ha
- (vi) Isolated storm is represented in a hydrograph with  
(a) single peak (b) double peak

- (c) multiple peak (d) complex peak
- (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) In a small catchment, the infiltration rate was observed to be 10 cm/h at the beginning of the rain and it decreased exponentially to an equilibrium value of 1.0 cm/h at the end of 9 hours of rain. If a total of 18 cm of water infiltrated during 9 hours interval, the value of decay constant  $K_h$  in Horton's infiltration equation in ( $h^{-1}$ ) unit is  
 (a) 0.1 (b) 0.5 (c) 1.0 (d) 2.0.
- (ix) The following recording raingauges does not produce the mass curve of precipitation as record:  
 (a) Symon's raingauge (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) Explain the assumptions of unit hydrograph. [(CO2) (Understand/LOCQ)]  
 (c) The normal annual rainfall at stations A, B, C and D in a basin are 80.97, 67.59, 76.28, 92.01 cm respectively. In the year 1985 the station D was inoperative and the stations A, B and C recorded annual precipitation of 91.11, 72.23, and 79.89 cm respectively. Estimate the rainfall at station D in that year. [(CO1) (Analyze/IOCQ)]

**4 + 3 + 5 = 12**

3. (a) Explain the Slope-Area method used for streamflow measurement with diagram. [(CO2) (Remember/LOCQ)]  
 (b) For a drainage basin of 600 km<sup>2</sup>, isohyets drawn for a storm are given below. Estimate the average depth of precipitation over the

Isohyetals (cm)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (cm <sup>2</sup> )	95	128	75	63	77

[(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) The base period, intensity of irrigation and duty of water for various crops under a canal system are given in the table below. Determine the reservoir capacity if the culturable command area is 40,000 hectares, canal losses are 20% and reservoir losses are 15%. [(CO2) (Analyze/HOCQ)]

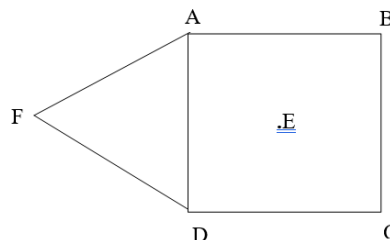
Crop	Base period (days)	Duty of water at the field (hectares/cumec)	Intensity of irrigation (percentage)
Wheat	120	1800	20
Sugarcane	360	1700	20
Cotton	180	1400	10
Rice	120	800	15
Vegetables	120	700	15

- (c) A catchment area has seven raingauge stations. In a year, the annual rainfall recorded is 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. [(CO3) (Analyze/IOCQ)]

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

$5 + 4 + 3 = 12$

5. (a) Discuss in detail the Sub-irrigation method. [(CO4) (Understand/IOCQ)]
- (b) Define  $\emptyset$ -index and W-index. [(CO2) (Understand/LOCQ)]
- (c) The area shown in Fig.1 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)]



**Fig. 1**

$3 + 3 + 6 = 12$

**Group - D**

6. (a) Define the following terms: (i) culturable command area (ii) intensity of irrigation (iii) Spoil banks. [(CO4) (Remember/LOCQ)]
- (b) Present a detail discussion on various classifications of irrigation canals. [(CO5) (Remember/LOCQ)]

- (c) Distinguish between infiltration capacity and infiltration rate.  
 [(CO1) (Remember/LOCQ)]

**5 + 3 + 4 = 12**

7. (a) Discuss the term “water-logging” and it’s causes.  
 [(CO6) (Remember/LOCQ)]
- (b) Following daily meteorological data were obtained for a large reservoir of surface area 15 km<sup>2</sup>. Estimate the average daily evaporation from the reservoir and also the evaporation losses for a period of 1 week using Meyer’s formula. Air temperature: 26<sup>o</sup> C; Atmospheric pressure: 752 mm of Hg; Wind speed at 0.5 m above GL: 25.3 km/h; Relative humidity: 46%. [(CO1)] ( Analyze/HOCQ)]

**6 + 6 = 12**

**Group - E**

8. (a) 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) (Analyse/IOCQ)]

- (b) Discuss the different types of surface irrigation methods with the help of a neat sketch. [(CO6) (Remember/LOCQ)]

**6 + 6 = 12**

9. (a) Discuss your understanding of closed drains and also present in detail the various layouts of the closed drain system. [(CO5) (Remember/LOCQ)]
- (b) Differentiate between AET and PET. [(CO3) (Understand/LOCQ)]
- (c) Ordinates of 6-h unit hydrograph for a catchment are given below. Calculate the ordinates of a DRH due to rainfall excess of 2 cm occurring during first 6-h and a rainfall excess of 3.5 cm occurring in the next 6-h over this catchment.

Time(h)	0	6	12	18	24	30	36	42	48	54	60	66	72	78
6-h UH Ordinates (m <sup>3</sup> /s)	0	15	45	89	127	119	95	72	53	37	25	15	7	0

[(CO4) (Analyse/HOCQ)]

**4 + 3 + 5 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	54.54%	18.19%	27.27%

**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.

**B.TECH/CE/7<sup>TH</sup> SEM/ CIVL 4115/2021**

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

Department & Section	Submission link:
CE & Sec A	<a href="https://classroom.google.com/w/NDA5NjQxODc2MTM2/t/all">https://classroom.google.com/w/NDA5NjQxODc2MTM2/t/all</a>
CE & Sec B	<a href="https://classroom.google.com/w/NDA5NjQ2NDk1NTIx/t/all">https://classroom.google.com/w/NDA5NjQ2NDk1NTIx/t/all</a>