

**WATER RESOURCES ENGINEERING
(CIV3202)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The double-mass curve technique is adapted to
 - (a) check the consistency of rainfall records
 - (b) to find average rainfall over number of years
 - (c) to find the number of raingauges required
 - (d) to estimate the missing rainfall data
- (ii) A hyetograph is a plot of
 - (a) cumulative rainfall vs time
 - (b) rainfall intensity vs time
 - (c) rainfall depth vs duration
 - (d) discharge vs time
- (iii) If the maximum depth of a 50-year 15h rainfall depth at Agra is 260 mm, the 50-year 3h maximum rainfall depth at the same place is
 - (a) < 260mm
 - (b) >260 mm
 - (c) = 260 mm
 - (d) 160 mm
- (iv) A unit hydrograph represents runoff produced by
 - (a) 1 cm effective rainfall for a specified duration
 - (b) 10 cm rainfall
 - (c) Any rainfall
 - (d) Rainfall for 24 hours
- (v) The part of hydrograph representing direct runoff is called
 - (a) Base flow
 - (b) Groundwater flow
 - (c) Storm runoff
 - (d) Seepage flow
- (vi) Duty is defined as the area irrigated per cumec of discharge running for
 - (a) crop period
 - (b) base period
 - (c) sow period
 - (d) kor period
- (vii) Duty of water is usually expressed in:
 - (a) hectares per cumec
 - (b) hectares per litre/sec
 - (c) hectares per m³
 - (d) m³ per hectare

- (viii) If rice requires about 10 cm depth of water at an average interval of about 10 days, and the crop period for rice is 120 days, find out the delta for rice.
 (a) 130 cm (b) 120 cm
 (c) 150 cm (d) 100 cm
- (ix) Land is considered waterlogged when the water table rises within about
 (a) 0.5 m of the ground surface (b) 1 m of the ground surface
 (c) 2–3 m of the ground surface (d) 10 m of the ground surface
- (x) The drainage system used to lower groundwater table is:
 (a) Surface drainage (b) Subsurface drainage
 (c) Vertical drainage (d) Both B and C

Fill in the blanks with the correct word

- (xi) _____ is a polygon obtained by joining adjacent raingauge stations.
- (xii) The standard Symon's type raingauge has a collecting area of diameter _____
- (xiii) Area irrigated per unit discharge of water is known as _____
- (xiv) The ratio of irrigated crop area to the culturable command area is called _____
- (xv) The decreasing part of a hydrograph after peak flow is called _____

Group - B

2. (a) Short note on Mass curve of rainfall. [[CO1](Remember/LOCQ)]
 (b) Short note on: Non-recording raingauge; Isohyetal method. [[CO2](Remember/LOCQ)]

9 + 3 = 12

3. (a) A catchment area has 7 raingauge stations. In 2000 the rainfall recorded by the stations are given in the table. For a 7% error in the estimation of mean rainfall, calculate the minimum number of additional stations required to be established in the catchment.

Station	P	Q	R	S	T	U	V
Rainfall (cm)	130	142.10	118.20	108.50	165.20	102.10	147

[[CO3](Analyse/HOCQ)]

- (b) On the basis of isopluvial maps, the 50-year, 24-hour maximum rainfall at Bangalore is found to be 16.0 cm. Determine the probability of a 24-hour rainfall of magnitude 16.0 cm occurring at Bangalore in the following cases:

(i) Once in ten successive years. (ii) Twice in ten successive years.

(iii) At least once in ten successive years.

[[CO3](Analyse/HOCQ)]

6 + 6 = 12

Group - C

4. (a) The ordinates of a 6-h unit hydrograph of a catchment is given below.

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
Ordinate of 6-h UH	0	25	50	85	125	160	185	160	110	60	36	25	16	8	0

Derive the flood hydrograph in the catchment due to storm given below:

Time from start of storm (h)	0	6	12	18
Accumulated rainfall (cm)	0	3.5	11	16.5

[[C03](Analyse/HOCQ)]

- (b) Define S-Curve. Differentiate between: D-h UH and IUH;

[[C04](Remember/LOCQ)]

8 + 4 = 12

5. (a) Define Infiltration and explain the distribution of soil moisture in the infiltration process?

[[C04](Remember/LOCQ)]

- (b) What is infiltration capacity and discuss the factors affecting infiltration capacity of an area?

[[C04](Remember/LOCQ)]

- (c) The mass curve of rainfall of duration 180 minutes on a catchment is given below. The catchment had an initial loss of 0.5 cm. The ϕ -index of the catchment is 0.4 cm/hr. Calculate the total surface runoff from the catchment due to the storm.

Time from start (min)	0	30	60	80	100	120	150	180
Cumulative rainfall (cm)	0	0.6	1.3	2.6	2.8	3.0	3.2	3.3

[[C02](Apply/IOCQ)]

3 + 3 + 6 = 12

Group - D

6. (a) The intensity of irrigation for Kharif season is 50 % for an irrigation project with CCA of 50,000 ha and duty is 1000 ha/cumecs. Determine the required discharge at the head of the canal if transmission loss is 10%.

[[C03](Analyse/HOCQ)]

- (b) Define duty of water? How duty is classified?

[[C04](Remember/LOCQ)]

- (c) The transplantation of rice requires 10 days and total depth of water required during transplantation is 48 cm. During transplantation, there is an effective rainfall (useful for irrigation) of 8 cm. Calculate the duty of irrigation water (in hectares/cumec)?

[[C02](Apply/IOCQ)]

6 + 3 + 3 = 12

7. (a) The CCA for a distributary is 16000 hectares. The intensity of irrigation for wheat is 35% and for rice is 15%. If the total water requirements of the two crops are 37cm and 122cm and their periods of growth are 120 days and 105 days respectively. (i) Determine the outlet discharge from the average demand considerations (ii) Also determine the peak demand discharge, assuming that the kor water depths for crops are 24cm and 29cm. And their kor periods are 3 weeks and 4 weeks respectively.

[[C02](Apply/IOCQ)]

- (b) Define crop ratio and evapotranspiration.

[[C04](Remember/LOCQ)]

9 + 3 = 12

Group - E

8. (a) Short note on: Open Drainage. Advantages of closed drains over open drains.

[[C05](Remember/LOCQ)]

- (b) Discuss your understanding of closed drains and also present in detail the various layouts of the closed drain system. *[[CO6](Remember/LOCQ)]*

6 + 6 = 12

9. (a) Design an irrigation channel using Kennedy's and Lacey's theory to carry a discharge of 45 cumecs. Take $N=0.0225$ and $m = 1.05$, Bed slope = 1 in 5000, $f = 1$; Side slope=1/2:1. *[[CO5](Analyse/HOCQ)]*

- (b) Differentiate between inundation canal and perennial canal. *[[CO6](Remember/LOCQ)]*

9 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.29	31.25	36.46