Notes by-

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Irrigation : Dams : Reservoir Planning

① The main canal in canal irrigation project is to be designed to irrigate total area of 3000 ha for the following crop pattern.

Crop	Sugarcane	Overlapping Sugarcane	Ground Nuts	Wheat	HW Vegetables	Rice
Base Period (days)	280	100	120	120	120	120
Intensity of irrigation	13%	5%	30%	30%	11%	11%
Duty (ha/cumec)	700	700	2000	1750	850	800

If time factor = 0.7 ; capacity factor = 0.8 ; Evaporation losses = 10% ; Dead storage is 10% and canal losses = 15% Find the required reservoir capacity.

② In order to determine factor of safety of the d/s slope during steady seepage the section of homogeneous earthen dam was drawn to a scale of 1cm = 10m ; and the following results were obtained on a trial slip circle.

Area of N- diagram = 12.15 sq.cm
Area of T- diagram = 6.50 Sq.cm
Area of U diagram = 4.02 Sq.cm
Length of arc = 11.60 cm

The dam material has following properties
Effective angle of internal friction = 26°
Unit of cohesion = 19.62 m²
Unit weight of soil = 19.62 m²

Ans 1.21

Determine the factor of safety of the slope.

③ The mean monthly flows over a year for a river are as given below what would be the minimum storage required every year ① to meet a demand of 40 m³/s.

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean flow m³/s	55	44	33	22	11	22	44	66	88	77	66	55

② if the entire inflow is to be drawn off at a uniform rate (average demand)

④ Find the life of a reservoir with a initial capacity of 3700 ha-m if the average annual flo inflow is 7400 ha-m average annual sediment inflow is 2×10^6 kN. Assume a specific weight of sediment as 11.2 kN/m³. The useful life of the reservoir will terminate when 80% of its initial capacity is filled with sediment. The values of trap efficiency for different values of capacity-inflow ratio as obtained from the following table.

Capacity Inflow ratio	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Trap Efficiency %	87	93	95	95.5	96	96.5	97	97.3	97.4	97.5

Ans : 176.9

⑤ A mass concrete non-overflow gravity dam has a top width of 9.0 m. The height of dam is 62.0m above the river bed, the water standing to a height of 60m. The upstream face has a slope of 1 in 24 from a point 38.0m below the top and the d/s face has a slope of 0.75H to 1V from a point 14.0m below the top Assume uplift to be 50% at heel and zero at toe.

① Find all the forces and their moments.

⑥ Following data were obtained from the stability analysis of a concrete gravity dam.

1. Total resisting moment about toe = 14.715×10^5 kN-m
2. Total Overturning moment about toe = 9.81×10^5 kN-m
3. Total Vertical force about the base = 49.05×10^3 kN-m
4. Base width of the dam = 50m
5. Slope of the d/s face of the dam = 0.7H : 1V

Calculate the maximum and minimum vertical stress to which the foundation will be subjected to. What is the max. principal stress at toe? Assume there is no tail water.

27.468×10^2 kN/m² comp. ; 7.848×10^2 kN/m² tensile ; 40.927×10^2 kN/m²

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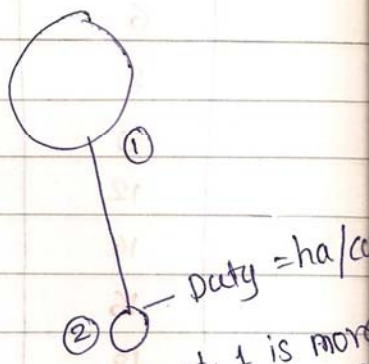
Pro: 7] ~~12hr Given → 6 hr asked.~~

Irrigation

Dams: Reservoir Planning

Pro: 1]

	Crop	Intensity of Irrigat^n	Area (ha)	Duty ha/cumec	$Q = \frac{A}{D}$ (m^3/s)
1)	Sugar cane	13·1.	390	700	0·557
2)	Overlapping Sugarcane	5·1.	150	700	0·214
			0		
3)	Ground nuts	30·1.	900	2000	0·45
4)	Wheat	30·1.	900	1750	0·514
5)	HW vegetables	11·1.	330	850	0·388
6)	Rice	11·1.	330	800	0·413
			Total x %		



Duty at pt. 1 is more than pt. ② as there is losses at ②

Total area = 3000 ha.

Classification of Crops:-

Rabi (All season)	Kharif	HW
Sugar cane 0·567	Sugar cane 0·567	Sugar cane 0·567
wheat 0·514	Rice 0·413	HW vegetable 0·388
	Ground nut 0·45	Overlapping sugarcane 0·214
Q = 1·081 cu	1·43 cu	1·154 cu

Design Discharge = 1·43 cu ... (Max.)

Design discharge, considering all the losses

$$= \frac{1.43}{\text{losses.}}$$

$$= \frac{1.43}{0.7 \times 0.8 \times 0.9 \times 0.9 \times 0.85}$$ ← canal losses

(0.7: Time, 0.8: capacity, 0.9: Evaporat^n, 0.9: Dead storage, 0.85: canal losses)

$$\boxed{Q = 3.7088 \ m^3/s.}$$

Capacity of Reservoir = Q = ... m^3 per year

$$= 3.7088 \times 60 \times 60 \times 24 \times 365$$

$$\boxed{Q = 116.96 \times 10^6 \ m^3}$$

Area of Normal component dia. × Descaling factor × Wt. of soil

Pro: 2 $A_N \times 100 \times \gamma_s = 12.15 \times 100 \times 19.62 = 23.8383 \times 10^3$ kN/m

$A_U \times 100 \times \gamma_w = 4.02 \times 100 \times 9.81 = 3943.62$ kN/m

$A_T \times 100 \times \gamma_s = 6.50 \times 100 \times 19.62 = \cancel{2268}\ 12753$ kN/m.

$$FOS = \frac{[\Sigma(N-U)]\tan\phi - CS}{\Sigma T}$$

$$= \frac{(23.838 \times 10^3 - 3943.62) \times \tan 26 - 19.62 \times 11.6 \times 10}{12.75 \times 10^3}$$

$= 0.5825$ WRONG ANS. . . .

MPSC

Pro 3] Reservoir Planning :-

Month	Mean flow (m^3/s)	Inflow Vol. Mm^3	outflow vol Mm^3	Deficit (−)	Surplus (+)	cumulative Deficit	cumulative surplus
Jan	55	144.936	105.41		39.52	→	39.52
Feb	44	115.949	105.41		10.54	→	50.06
March	33	86.9616	105.41	18.45	→	18.45	–
Apr	22	57.974	105.41	47.436	→	65.886	–
May	11	28.987	105.41	76.42		142.306	–
June	22	57.974	105.41	47.44		189.746	–
July	44	115.949	105.41		10.54		60.6
Aug	66	173.92	105.41		68.51		129.11
Sept	88	231.89	105.41		126.48		255.59
Oct	77	202.91	105.41		97.5		353.09
Nov	66	173.92	105.41		68.51		421.6
Dec.	55	144.936	105.41		39.53		461.13 − 51.06 = 411.13

PREFERANCE TO 'GRAPH' SOLUTION

With spilling allowed, capacity = 189.75 Mm^3

without spilling water, capacity = 411.13 Mm^3

Consider days of each month = 30.5 days.

∴ Inflow vol. multiplying factor = $\frac{30.5 \times 24 \times 3600}{10^6}$ Mm^3

No need to convert in Mm^3; convert Resourvoir capacity at last.

= 2.6352 Mm^3

Out flow = $40 \times \cancel{\text{Inflow}}\ \text{Inflow} \times 2.6352 = 105.41$ Mm^3

Max. uniform Rate = $\frac{\Sigma \text{Inflow}}{12} = 128.11$ Mm^3

If outflow is not given, Design outflow vol = 128.11 Mm^3

~~Max~~. In case spilling of water is not allowed go for max. value of deficient & surplus.

In case spilling is allowed go for max deficient.

Pro: 4] Initial Capacity = 3700 ha-m.
Avg. annual inflow = ~~2×10^6 kN~~ 7400 ha-m
~~Sedi~~ Annual sediment inflow = 2×10^6 kN/yr.
Sp. wt. of sediment = 11.2 kN/m^3 = γ_s
Reduced capacity = 80 %.

Soln:- Vol. of sediment in flow. = $\frac{2\times10^6}{11.2}$ m^3/yr = 178.57×10^3 m^3/yr

= 17.86 ha-m-/yr.

Initial capacity inflow ratio = $\frac{C.}{I} = \frac{3700}{7400} = 0.5$

Capacity % ①	Capacity ha-m ②	C/I ③ 2 % 740	η % Trap effi (Table) ④	Avg. % η for capacity ⑤ interval	Vol. of sediment trapped ha-m/yr ⑥ = ④ × 17.86	Vol. of Capacity interval 20 % of 3700 ⑦	Yr. of Fill ⑧ = ⑥/⑤
100	3700	0.5	~~97.5~~ 96	95.75	17.10	740	43.27
80	2960	0.4	95.5	95.25	17.01	740	43.50
60	2220	0.3	95	94.00	16.79	740	44.07
40	1480	0.2	93	90.00	16.07	740	46.05
20	740	0.1	87				
						Σ	176.89 years

80 % Reduction

Hydrological Life.

∴ ie. after 176.89 years 80 % of dam will be filled by sedimen