University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2013
Program: B.Sc Engineering (Civil)

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Course Title: Irrigation and Flood Control;	Course Code: CE 461;	Credit hrs: 3
Time: 3 hours		Full Marks: 150

Part A
Answer question no. 4 and any Two from the rest
(Assume any reasonable data if not given)

1. a) What are the Advantages of Irrigation? **(5)**

b) A channel is to be designed for irrigating 6000 hectares in Kharif crop and 5000 hectares in Rabi crop. The water requirement for Kharif and Rabi are 70 cm and 30 cm, respectively. The base period for Kharif is 4 weeks and for Rabi is 5 weeks. Determine the discharge of the channel for which it is to be designed. **(10)**

c) Determine the time required to irrigate a strip of land of 0.05 hectares in area from a tube-well with a discharge of 0.03 cumec. The infiltration capacity of the soil may be taken as 5 cm/h and the average depth of flow on the field as 10 cm. Also determine the maximum area that can be irrigated from this tube well. **(10)**

2. a) Differentiate between Alluvial and non-alluvial Canal. **(4)**

b) What are the advantages of canal lining? Write the distribution system for Canal Irrigation. **(2+4)**

c) What is Launching Apron? Describe the Design procedure of a Launching Apron. **(2+5)**

d) A canal of 5 km length having discharge capacity of 3.5 cumec is proposed to be lined with boulder lining. The total cost of lining is estimated as 4 lakhs. The life of lining is considered as 60 years. Justify the lining in the canal from the following data. **(8)**

Rate of interest	= 8 %
Seepage loss	= 2 %
Revenue for irrigation water	= Tk. 75 per hect-m
Maintenance cost per Km for lined canal	= Tk. 1000
Maintenance cost per Km for unlined canal	= Tk. 2500
Base period of crop	= 120 days
Additional benefit/Km	= Tk. 1000

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3. a) What is Silt Regulation Works? Write Different types of Silt Regulation Works.
    (2+2)

    b) What are the differences between spur and Groyne? What kind of spur you are
    Going to propose for the following condition? a) Attracting b) Deflecting **(2+4)**

    c) What are the different types of pumps that can be used for irrigation? Describe
    Briefly the pump characteristics curve.   **(3+4)**

    d) A centrifugal pump is required to lift water. The brake horse power of the engine
    is 20. The water is directly supplies to the field channel. Suction head = 7 m,
    Coefficient of friction = 0.01, Efficiency of pump = 60%, Diameter of pipe = 18
    cm. calculate the flow Rate.   **(8)**

4. Using the Khosla's curves, determine the following for the apron shown below:
    a) If percentage of pressure at C_2 is 56%, what will be the percentage of pressure at
        this point after corrections due to pile interference and slope
    b) Find exit gradient where, corrections factor for slope, 3:1 = 4.5,
        Assume floor thickness = 1 m.   **(25)**
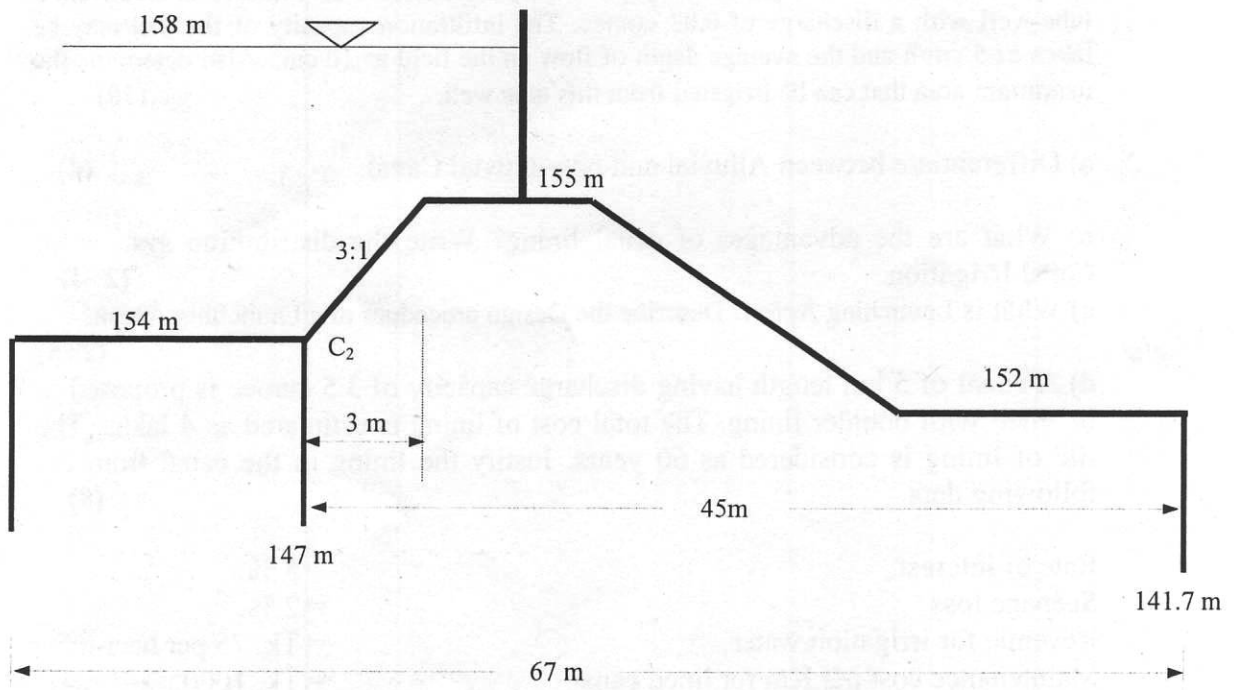
There are **four questions**. Answer **any three**.

1. (a) Differentiate between the following terms :   (2x3=6)
    i. Capillary water and hygroscopic water
    ii. Moisture content by mass and moisture content by volume.

   (b) Describe briefly the working principle of a tensiometer with a neat sketch. Also state its limitations.   (8+2=10)

   (c) A stream of 140 liters per second was diverted from a canal and 105 liters per second were delivered to the field. An area of 1.5 hectares was irrigated in 8 hours. The effective depth of root zone was 1.5 m. The runoff loss in the field was 350 m³. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 20 cm per meter depth of soil. Determine
    i. water application efficiency
    ii. water storage efficiency and
    iii. water distribution efficiency.

Irrigation was started at a moisture extraction level of 50% of the available moisture. (9)

2. (a) List the climatic factors affecting evapotranspiration. Describe the principle of non-weighing percolation type lysimeter for measuring the rate of evapotranspiration.   (4+8=12)

   (b) Wheat has to be grown at a certain place, the useful climatological conditions of which are tabulated below. Determine the evapo-transpiration and consumptive irrigation requirement of wheat crop. Also determine the field irrigation requirement if the water application efficiency is 80%. Use Blaney-Criddle equation and a crop factor is 0.8. (8)

Month	Monthly temperature (°C) averaged over the last 5 years	Monthly percent of day time hour of the year computed from the Sun-shine	Useful rainfall in cm averaged over the last 5 years
Nov	19.0	7.40	1.75
Dec	16.0	7.15	1.42
Jan	14.5	7.25	3.01
Feb	13.5	7.10	2.75

   (c) Show the distribution system for Canal Irrigation in a neat sketch.   (5)

3. (a) Write short note on the following items: (2x3=6)
    iv. Contour canal
    v. Pumping head
    vi. Multi-stage pump.

(b) The culturable commanded area of a watercourse is 1200 hectares. Intensities of sugarcane and wheat crops are 30% and 40% respectively. The duties for the crops at the head of the watercourse are 780 hectares/cumec and 1700 hectares/cumec respectively. Find **(11)**

    (i)   The discharge required at the head of the watercourse

    (ii)   The design discharge at the outlet, assuming a time factor equal to 0.8

(c) Show the components of a centrifugal pump in a neat sketch. Deriver the following relation to describe the effect of Speed on the performance of a centrifugal pump.

$$\frac{n}{n_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

(3+5=8)

4. (a) Show a typical layout of the diversion head works. Also write down the functions of the following components:

    (i)   Under-sluice

    (ii)   Fish ladder.

(5+4=9)

(b) Explain rigid module with a neat sketch. Show that 'flexibility' of an outlet structure is given by

$$F = \frac{m}{n}\frac{y}{H}$$

(4+6=10)

(C) Distinguish between the following terms:

    (i)   Aqueduct and syphon aqueduct

    (ii)   Weir and barrage.

(2x3=6)

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Plate 11.2

Scale for λ

Scale for $1/\pi\sqrt{\lambda}$

Exit Gradient = G_E

W.L. H

d b

Curve 2

α, π

$\alpha = b/d$

$\lambda = \dfrac{1+\sqrt{1+\alpha^2}}{2}$

$G_E = \dfrac{H}{d}\,\dfrac{1}{\pi\sqrt{\lambda}}$

$\alpha, 1/\pi\sqrt{\lambda}$

Curve 1

$\alpha = b/d$

Plate 11.2

Khosla's Pressure Curves

Plate 11·1(a)

Sheet pile not at end

$\alpha_1 = \dfrac{b_1}{d}$

$\alpha_2 = \dfrac{b_2}{d}$

$\phi_E = (1/\pi)\cos^{-1}\left(\dfrac{\lambda_1 - 1}{\lambda}\right)$

$\phi_C = (1/\pi)\cos^{-1}\left(\dfrac{\lambda_1 + 1}{\lambda}\right)$

$\phi_D = (1/\pi)\cos^{-1}\left(\dfrac{\lambda_1}{\lambda}\right)$

W.L. H

b

b_1 E C b_2

$\alpha = b/d$

To find ϕ_E for any value of α and base ratio b_1/b, read ϕ_C for base ratio $(1-b_1/b)$ for that value of α and subtract from 100

Thus ϕ_E for $b_1/b = 0.4$ and $\alpha = 4$, $= 100 - \phi_C$ for $b_1/b = 0.6$ and $\alpha = 4$, $= 100 - 29.1 = 70.9\%$

To get ϕ_D for values of b_1/b less than 0.5 read ϕ_D for base ratio $(1-b_1/b)$ and subtract from 100

Thus ϕ_D for $b_1/b = 0.4$ and $\alpha = 4$ $= 100 - \phi_D$ for $b_1/b = 0.6$ and $\alpha = 4$ $= 100 - 44.8 = 55.2$

$\lambda_1 = \dfrac{\sqrt{1+\alpha_1^2} - \sqrt{1+\alpha_2^2}}{2}$

$\lambda = \dfrac{\sqrt{1+\alpha_1^2} + \sqrt{1+\alpha_2^2}}{2}$

$\alpha = \infty$

Values of $1/\alpha = d/b$

W.L. b B

W.L. b E C

Sheet pile at end

Depressed floor

$\phi_{D'}$

ϕ_D

Depressed floor

W.L. H

b

D_1 O'

$\phi_E = (1/\pi)\cos^{-1}\left(\dfrac{\lambda - 2}{\lambda}\right)$

$\phi_D = (1/\pi)\cos^{-1}\left(\dfrac{\lambda - 1}{\lambda}\right)$

$\phi_{C_1} = 100 - \phi_E$

$\phi_{D_1} = 100 - \phi_D$

$\phi_{D_1'} = 100 - \phi_{D'}$ (Depressed floor)

$\phi_{D'} = \phi_D - 2/3\,(\phi_E - \phi_D) + 3/\alpha^2$ (Depressed floor)

$\lambda = \dfrac{1+\sqrt{1+\alpha^2}}{2}$

$\alpha = \dfrac{b}{d}$

ϕ_E

Scale for $\phi = \dfrac{P}{H} \times 100$

$\alpha = 0$

Values of $\phi_C = \dfrac{P_C}{H} \times 100$

Curves of ϕ_C

Curves of ϕ_D

Values of $\phi_D = \dfrac{P_D}{H} \times 100$

Ratio $\dfrac{b_1}{b}$

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