TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation & Drainage Engineering *(CE 654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What do you mean by command area, cropping pattern, crop intensity and crop rotation? Write down the necessities of crop rotation practice. [4]

2. a) Describe briefly the Readily available moisture, permanent wilting point and irrigation interval. [2]

   b) Find the irrigation interval in which the field capacity is 32% , permanent wilting point is 13%, dry density of soil is 1.3 gm/cc, effective root zone depth is 130m and daily consumptive use of water for the given crop is 14mm. [5]

3. Explain with appropriate sketch the component of the canals and requirement of borrow pit and spoil bank in canal section. [5]

4. a) Discuss the salient features of Kennedy's theory for the design of earthen channels based on the critical velocity concept and mention its limitations. [5]

   b) Design a concrete-lined canal to carry a discharge of 350 m^3/s at a slope of 1 in 5000. The side slopes of the canal may be taken as 1.5:1. The value of n for lining is 0.014. Assume limiting velocity in the canal is 2 m/s. [6]

5. a) Following corrected pressure potentials were determined underneath a barrage floor by Khosla's theory : At the junction of upstream sheet pile with floor ϕ_{c1}=82%; At the junction of downstream sheet pile with floor ϕ_{c2}=35%. Calculate the minimum thickness of the cistern floor at the beginning and end of the cistern. The following data are given: Full reservoir level = 505 masl, River bed level = 500 masl, Cistern floor level = 499 masl, Total length of barrage between upstream and downstream sheet piles = 40m, Length of cistern = 15m. Assume tailwater depth is nil on the downstream side and specific gravity of concrete floor = 2.4. Also, calculate the exit gradient. [6]

   b) Design a silt excluder for the diversion head works having following data; [5]

   Full supply discharge of canal = 200 m^3/sec

   Crest level of undersluices =225.25m

   Crest level of head regulator = 227.35m

   Bay width of undersluices = 10.2m

6. A barrage is to be constructed across a river, having 100 year flood discharge of 7500 m^3/s and high flood level is 238.00 m. River bed level is 232.00 m and average diameter of bed material is 5.07mm. Find out the desired waterway for the barrage. Design Bell's guide bunds including launching apron. [8]

7. a) Design a vertical type drop structure for the following data: [8]

Discharge = 5.1 m^3/sec;

$$Bed\ level\ \frac{U/s}{D/s} = \frac{255.15}{254.45} m$$

$$Normal\ flow\ depth\ \frac{U/s}{D/s} = 0.95m$$

$$Bed\ width\ of\ canal\ \frac{U/s}{D/s} = 2.5m$$

Side slope of canal = 1:1

Take the top width of crest wall as 0.5m for initial assumption. Assume other suitable data if necessary.

b) Explain ϕ with definition sketches of the cross regulator and describing head regulator. [3]

8. a) What are the different types of cross drainage works that are necessary on a canal alignment? [3]

b) Design the following components of a suitable C/D work for the following data: [8]

Discharge of canal = 50 m^3/s, Bed width of canal = 30m, Depth of water in canal = 1.55m, Bed level of canal = 300.0 m, High flood discharge of drain = 400 m^3/s, High flood level of drainage = 300.50m, Bed level of drainage = 298.8m, General ground level = 300.0m

i) Design of drainage water – way
ii) Design of canal water way
iii) Design of transition
iv) Design of bed levels.

9. a) What is meant by water-logging? Write down the principal causes and effects of water-logging in a canal irrigated farm. [6]

b) In a sub-surface drainage system, 200m long laterals were laid out 50 m apart. The laterals have a grade of 0.3%. [6]

i) If the drainage coefficient of the area is 2 cm/day, what size of tiles would you recommend?
ii) If the drainage coefficient is increased to 3 cm/day, what will be the spacing of the laterals?
Assume the rugosity coefficient of the tile drain materials as 0.011.

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Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE 654)*

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1. Write the different methods of surface and sub-surface irrigation and explain about furrow irrigation with their suitability. [6]
2. a) Define: Duty , Delta, Base period and Crop period. [4]

   b) After how many days will supply water to soil in order to ensure sufficient irrigation of the given crop if,
   (i) Field capacity of the soil = 28%
   (ii) Permanent wilting point = 13%
   (iii)Dry density of soil = 1.3 gm/cc
   (iv)Effective depth of root zone = 70cm
   (v)Daily consumptive use of water for the given crop = 12mm [5]
3. Derive the balancing depth for a canal. Calculate the balancing depth for a canal section having a bed width equal to 20m and side slopes of 1.5:1 in cutting and 2:1 in filling. The bank embankments are kept 4 m higher than the ground level (berm) and crest width of banks is kept as 3m. [3+2]
4. An irrigation channel is to carry a full supply discharge of $30m^3/s$ at a velocity of 1.75m/s. The side slopes are to be 1:1. The ratio of full supply depth to bed width is to be1:6. Assuming the Manning's n as 0.018, calculate the full supply depth, bed width, and bed slope of the channel using Kennedy's method. [8]
5. Using Khola's method, calculate the uplift pressures at various key points in the figure below. Also, determine the exit gradient. Take the slope correction factor as 6.5. [12]
6. Design a guide bank for the weir site from the following data provided. [8]
   Bed level of river = 105.00m
   Depth of water during high flood = 5m
   Discharge of river = $6500m^3/s$
   The value of Lacey's silt factor may be taken as 1.
7. a) Design crest, length and thickness of impervious floor of a vertical drop structure for the following data: [8]

   Discharge = 5.2 m^3/sec, Bed level U/S = 205.15m

   Side slope of the channel = 1:1, Bed slope D/S = 204.45m

   FSL U/S = 206.10m Bed width U/S and D/S = 1.5m

   Top width of crest = 0.55m (for initial assumption); C_d=0.415 Sp. Gr. of masonary drop structure = 2.25; Bligh's Coefficient = 6.0

b) What do you understand by head regulator? State functions of outlets and escape structures in irrigation canal. [4]

8. Design siphon aqueduct (Drainage waterway, Canal waterway, Bed levels and transitions) if the following data at crossing of canal and drainage are given: [10]
   a) Discharge of canal = 60 cumecs
   b) Bed width of canal = 35m
   c) Full supply depth of canal = 2m
   d) Canal bed level = 300m
   e) Side slopes of canal = 1.5H:1V
   f) High flood discharge of drainage = 500cumecs
   g) High flood level of drainage = 300.8m
   h) Bed level of drainage = 298.2m
   i) General ground level = 300.2m

9. Derive the equation to find the spacing of tile drain. Calculate the spacing of the title drains for an area having rainfall of 1700mm, if 1.5% is to be drained in 24hrs. From ground level, depth of impervious stratrum is 10m, depth of drain is 2.2m and depth of highest position of water table is 1.2m, coefficient of permeability = 0.001cm/sec. [5+5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Baisakh

Exam.	**Back**		
Level	BE	**Full Marks**	80
Programme	BCE	**Pass Marks**	32
Year / Part	III/II	**Time**	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE 654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Define irrigation; what are the disadvantages of irrigation? Describe scope of irrigation in Nepal. [1+1+2]

2. A reservoir has to supply irrigation water to 40,000 hectares land. Calculate the storage required in the reservoir to meet the irrigation demand of various crops as detailed below: [8]

Crop	Base period (days)	Duty (ha/cumecs)	Intensity of irrigation
Wheat	120	2400	20%
Rice	140	1000	15%
Maize	100	1800	20%

3. a) Lacey's theorem is an advantage over Kennedy's theory. Explain. [4]

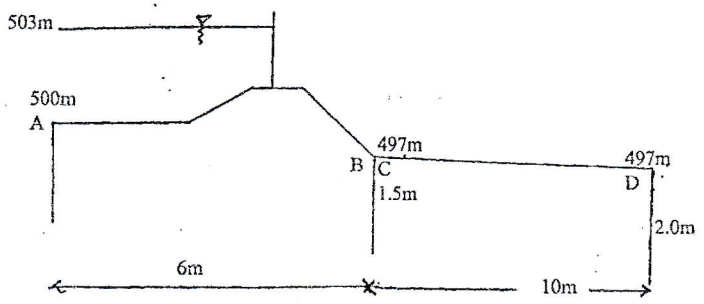
   b) Design an irrigation canal using Lacey's theory, when Q=15 cumec mean diameter of silt particle is 0.33mm; side slope = ½:1 (H:V). [8]

4. Design a suitable cross drainage structure for the following data. [12]

Canal Data	Drainage data
Discharge=300m^3/s	Discharge=500m^3/s
Bedwidth= 30m	Bedlevel=198m
FSL=209m	HFL=207.70m
Bedlevel=202.50m	Silt factor(f)=1.0
Side slope= ½:1 (H:V)	
Rugosity Coefficient (N)=0.016	

5. Write the design steps of Guide bank with suitable sketch. [8]

6. For the figure shown below ignoring floor thickness and slope corrections, find the percentage pressure at the key points of the piles using Khosla's theory. The floor thickness may not be less than 30cm anywhere. If permissible exit gradient is 0.15, check the floor against piping failure. Also find the thickness of floor at A, B, C and D points. [12]



7. Design a suitable Sarada Type fall for a canal carrying a discharge of $12m^3/s$ with the following data. [12]
   U/S bed level=103m
   D/S bed level = 101.50m
   Side Slope of canal = 1½:1 (H:V)
   Full Supply level U/S=104.50
   Bed width of canal=10m
   Bligh's coefficient=6
8. Design a canal Head Regulator for the data given below. [12]
   Crest level of under sluice=300m
   Pond level = 304m
   Silt factor (f) = 1
   U/S HFL = 307m
   Full Supply discharge= 200 m^3/s
   Full Supply level = 303m
   Bed level of canal = 299.50m
   A silt excluder is provided in the under sluice; Take GE = 1/6.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE 654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Being an agriculture country Nepal, why it is not developed as expected in this sector? Give your own reason. [5]
2. Following data are given below, calculate the depth and frequency of irrigation.
   Field capacity = 80%, Permanent Wilting Point (PWP) = 30%
   Root depth = 70 cm, soil density = 1.5 gm/cc, Consumptive use = 4 mm/day
   Application efficiency = 80%, Readily available moisture (RAM) = 70% [6]
3. Explain with appropriate sketches the component of canal irrigation system. [5]
4. a) Design a regime channel (using Lacey's equation) for the following data:
   Discharge Q = 30 cumecs Silt factor f = 1.1 Side slope = 0.5:1
   Find also the longitudinal slope. [6]
   b) Using tractive force approach, design a channel in alluvial soil for the following data:
   Discharge Q = 45 cumecs, Bed slope = 1/4500, Manning's n = 0.0225,
   Permissible tractive stress = 0.0035 kN/m^2, Side slope = 0.5: 1 [4]
5. a) Describe briefly the design step of silt excluder with neat sketches. [6]
   b) A weir has a solid horizontal floor length of 50 m with two lines of cutoff of 8 m depth below the river bed at its two ends. The floor thickness is 1m at upstream end and 2m at downstream end, with its upper level being in flush with river bed. For an effective head of 5m over the weir, calculate the uplift pressure at the two inside corner points and also the exit gradient. [8]
   c) How do you fix design discharge of undersluices? [2]
6. a) Determine the length and thickness of launching apron for the straight portion of a guide bund in a river for the following data given below. Max. discharge = 6000 m3/s, Average dia. of bed material = 1.0 mm, Highest flood level (HFL) = 330m and River bed level = 326m [6]
   b) Write the different stages of river and their characteristics along flow path. [4]
7. a) Design crest, length and thickness of impervious floor of a vertical drop structure for the following data: [8]
   Discharge = 2.1 m^3/sec
   Side slope of the channel = 1:1,
   FSL U/S = 276.10 m,
   Top width of crest = 0.55 m (for initial assumption)
   Sp. Gr. of masonry drop structure = 2.25;
   Bed level U/S = 275.15 m
   Bed level D/S = 274.45 m
   Bed width U/S and D/S = 1.5 m
   For rectangular crest C_d = 0.415
   Bligh's coefficient = 6.0
   b) Describe escape structures with neat sketch. [3]

8. a) Define cross drainage structures. Enlist the different types of cross drainage structures. Which type of cross drainage structure is favorable in hilly areas of Nepal?[1+2+1]

   b) From the following data, select and sketch the suitable type of cross drainage structure and determine the drainage water way and canal water way. [6]

Canal data	Drainage data
Full supply discharge = 32 cumecs	High flood discharge = 303 cumecs
Full supply level = 213.5 m	High flood level = 210.0 m
Canal bed level = 212.0 m	High flood depth = 2.5 m
Canal bed width = 20m	General ground level = 212.5 m

9. Determine drainage rate in mm/day required to meet the following conditions for healthy growth of rice in bunded field of plain area in Nepal. [7]

   Initial water level in field = 55 mm
   Maximum water level is 400 mm which may persist for up to 1 day
   Depth of excess of 250 mm may persist for up to 2 days
   No rainfall follows the design rainfall for several days
   Design 3 days rainfall is 400 mm
   Neglect ET and deep percolation losses

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe in brief stages of planning of irrigation projects. [4]
2. After how many days will you irrigate your field in order to ensure healthy growth of crops if [8]

   Field capacity of soil = 29%
   Density of soil = 1.3 gm/cc
   Daily consumptive use = 12 mm
   Permanent Wilting Point = 11%
   Effective root zone depth = 65 cm

   For healthy growth moisture content must not fall below 25%. How much irrigation water required at outlet of the field, if the application efficiency is 75%
3. Describe economic analysis of canal lining during design of irrigation canal. [5]
4. Design concrete lined canal to carry a discharge of 45 cumec. The bed slope of canal is assumed to be 1 in 7000. Take side slope of canal as 45° and manning coefficient is 0.015. [8]
5. Why Kholsa's theory is appropriate than other methods? Write down limitation of mutual interference correction while applying Khosla's seepage theory. [3+2]
6. Design crest elements, cistern elements and draw HGL line of a designed glacis fall on a canal waterway with the following data: [15]

Full supply discharge = 118 cumec	Canal bed level (U/S) = 207.5 m
Full supply level of canal (U/S) = 209.7 m	Canal bed level (D/S) = 206.0 m
Full supply level of canal (D/S) = 208.2 m	Canal bed width (U/S & D/S) = 62 m
Safe exit gradient of canal material = 1/6	Fluming ratio = 75 %

7. Write down essential requirement of outlet. Derive the relationship between Flexibility and Sensitivity. [2+3]
8. Neatly sketch a guide bund and design the following components of guide bund for river discharge of 4000 cumec of flood height 5.0 m and silt factor 1.1. [8]

   Length of guide bund
   Thickness of pitching
   Width of launching apron
   Depth of launching apron

9. A distributary channel having bed with 5.0 m full supply depth of 1.20 m carries 3.0 cumec of water. A semi modular pipe outlet in this channel has a command area of 15 ha growing rice with a kor depth 20 cm and kor period of 3 weeks. Determine the size of the outlet and set it for sub proportionality with a flexibility of 0.9. Assume length of pipe as 3.0 m and friction factor as 0.03. [8]

10. Design a siphon for the data given below: [8]

	Canal	Drainage
Discharge (m^3/s)	18.0	60
Bed level (m)	100.0	101.5
Side slope (V:H)	1:1.5	
Bed width (m)	6.0	
FSL/high flood level (m)	103.0	103.5

Lacey's silt factor = 1.0, Rugosing coeffient N = 0.016
Normal ground level = 102.0 m

11. Explain causes and remedial measures of water logging in the agriculture land and write the method as well as assumption adapted to design the surface drainage in terai region of Nepal. [3+3]

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07 TRIBHUVAN UNIVERSITY
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2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) Explain GCA, CCA, NCA, Cropping Intensity and Cropping Pattern. [5]
   b) Write down the steps for calculating irrigation requirement for Rice crop. [4]
   c) The field capacity of soil is 40%, Permanent wilting point is 20%, Density of soil is 1.2gm/cc, effective root depth is 90cm, ET crop is 10mm/day. Calculate the irrigation interval (IR) if the readily available moisture (RAM) is 75% of available soil moisture capacity and show AMC, RAM and irrigation interval on graph of Available moisture and time. [5+2]
2. a) Write down the concept of Kennedy and Lacey's Silt Theory. [8]
   b) Proof using Lacey's Theory that $P = 4.75\ (Q)^{0.5}$ [4]
   c) Design a canal using Lacey's Theory carrying a discharge of 20 cumec, silt factor = 1.5 and side slope is 0.5:1(H:V) [4]
3. a) Write down the cause and effects of water logging. Also explain method of reclamation of water logged area. [6]
   b) Derive the expression for subsurface drainage spacing. [5]
   c) Explain different types of outlets used in irrigation projects. [5]
4. a) Neatly sketch a guide bund and design the following components of a guide bund for a river discharge of 4000 m^3/s and silt factor 1.1. [8]
      (i) length of guide bund
      (ii) thickness of pitching
      (iii)width of launching apron
      (iv)depth of launching apron
   b) Explain different level of planning in irrigation projects, also explain different types of maintenance in irrigation projects. [8]
5. Write short notes: [4×4]
   a) Irrigation Development in Nepal
   b) Types of Irrigation Method
   c) Different types of cross Drainage works
   d) Different types of Fall structures

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Why is irrigation development important for Nepal? Define cropping pattern and cropping intensity. [3+2]

2. a) If daily consumptive use of the crop is 5 mm and the canal may operates from 6 AM to 5 PM only. Available moisture for the given soil is 220 mm per m and maximum depth of root zone for the crop is 1.2 m. Assume that only 50% of soil moisture is available to the crop. Application efficiency is 65%. Calculate the required discharge if CCA is 450 ha. Calculate Irrigation interval and outlet discharge. [6]

   b) Define irrigation water requirement for rice crop. [2]

3. a) With a neat sketch, explain the canal distribution system suitable in Terai region of Nepal. [2]

   b) A canal has bed width of 8m. Full supply depth of water is 1.5m, side slope in cutting 1:1 and filling 1.5:1. Top width of the bank is 1.8m and service bank is 5.0 m. Free board is kept 0.6m. Calculate balancing depth so as to get the most economical section. [4]

4. a) Describe briefly the semi theoretical approach in canal design. [3]

   b) Design an economical trapezoidal lined channel to carry a discharge of 20 cumecs at a slope of 30 cm/km. The side slope of the channel is 1.5:1. The value of Manning's rugosity coefficient is 0.017 and limiting velocity in the channel is 1.5 m/s. [6]

5. a) What are the ways of controlling entry of sediments into canal from headworks? Differentiate between silt ejector and silt excluder in irrigation system. [4]

   b) A canal carrying 150 m^3/s is to take off from the headwork. The HFL and average bed level of river is 257m and 250m respectively. The canal bed level, full supply level and pond level are 249.5m, 253.0m and 254.0m respectively and Lacey's silt factor is equal to unity. Fix the crest level and water way of canal head regulator and also determine the length of impervious floor if safe exit gradient G_E = 1/6. Draw the conceptual sketch of canal head regulator. [8]

6. a) Why river training works are required? Explain with neat sketch, the layout of spurs to train the river in bend. [3]

   b) A bridge is to be constructed across a river having the following hydraulic data:

   Maximum flood Discharge : 5000 m^3/s
   Highest flood level : 254.0 m
   River bed level : 250 m
   Average diameter of river sand : 0.25m
   Design and sketch a guide bank including launching apron to train the river. [5]

7. a) Describe briefly the different types of canal outlet. What is flexibility of outlet? [2+2]

   b) Write the stepwise design procedure of cross regulator and distributary head regulator with supporting sketches.

8. Design a Siphon aqueduct with the data given below: [8]

   Full supply discharge of canal = $30m^3/s$
   Bed width of canal = 24 m
   Full supply depth = 1.25 m
   Side slope of canal section = 1 ½ : 1 (H:V)
   Bed level of the canal = 100.00 m
   Max. flood discharge of drain = 500 m^3/s
   High flood level = 100.50
   Bed level of drainage = 98.00 m
   Normal ground level = 100.00 m
   Lacey's silt factor = 1.0
   Rogosity coefficient (w) = 0.016
   Make suitable assumptions where necessary.

9. a) Write down the effects and preventive measures of water logging. [10]

   b) Determine the drainage rate required to meet the following condition. Maximum yearly precipitation for three consecutive days = 300mm. The design rainfall is to be taken as 10 year return periods. Initial water level in field = 40mm. Maximum water level is 300mm, which may persist for up to one day and depth in excess of 200 mm may persist for up to 3 days. Take growth factor to one day and depth in excess of 200 mm may persist for up to 3 days. Take growth factor for 10 year return period as 1.5. Assume other suitable data if necessary. [4]

[6]

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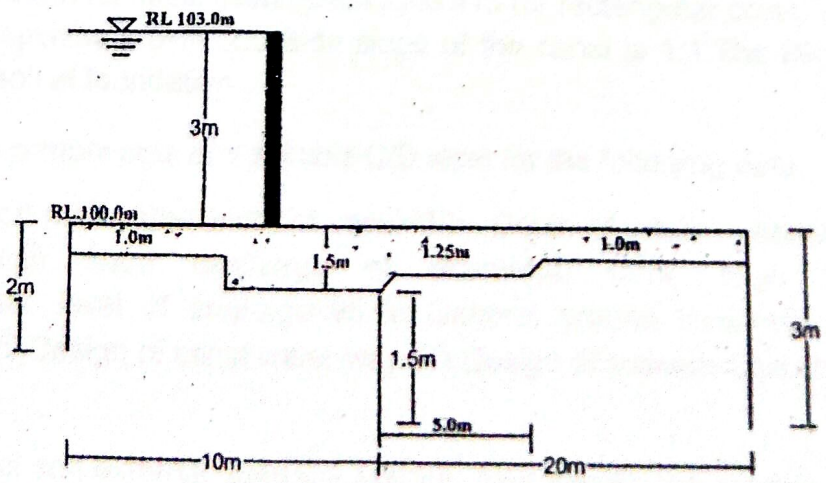
1. Explain the importance of irrigation development in Nepal. What are the problems and challenges of irrigation development in Nepal? [4]
2. A stream of 150 liter per second was diverted from canal and 110 liter per second was delivered to the field. An area of 2.2 hectares was irrigated in 8 hrs. Effective depth of root zone was 1.5 m. The runoff loss in the field was 445 m3. The depth of water penetration varied linearly from 1.5 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 200 mm per meter depth of soil. Determine the water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency. Irrigation was started at a moisture extraction level of 50%. [8]
3. Describe in what way you can align an irrigation canal for an agricultural land? Also write about canal standards and balancing depth. [3+2]
4. a) A canal is to be designed to carry a discharge of 40cumecs. The bed slope is kept 1 in 1200. The soil is course alluvium having a grain size of 5 cm. Assuming the canal is trapezoidal and to be unlined with unprotected banks. Determine a suitable section for the canal. Assume φ 37° [4]

   b) The slope of a channel in alluvium is 1/4000, Lacey's silt factor is 0.9 and side slopes are 0.5:1 (H:V). Find the channel section and maximum discharge which can be allowed to flow in it. [6]
5. a) A river carries a high flood discharge of 16000 m^3/s with its average bed level at 200.0 m. A canal carrying 200 m^3/s is to take off from the headworks. The full supply level of the canal at its head is 203.0 m. The high flood level before construction is 205.7 m and Lacey's silt factor is equal to unity. Fix suitable values for the waterway and crest levels of weir, undersluices and canal head regulator. Assume suitably any other data if required. [6]

   b) Calculate the uplift pressure at key points of the pile of the structure shown in figure below. Draw HGL and also check the thickness provided and safe exit gradient GE = 1/5. [8]



6. Explain with sketch four different methods of river training works. [2×4]

7. a) Why drop structures are required in canal irrigation system? Explain the types of drop structures with neat sketches. [2+2]

   b) Design a crest width, cistern length and its level of a vertical drop structure for the data given below. [8]

   Full supply discharge u/s and d/s = 1.55 cumecs

   Drop height = 0.75 m

   FSL u/s and d/s = 105.997 and 105.247

   Full supply depth u/s and d/s = 0.929 m

   Bed levels u/s and d/s = 105.068 and 104.318

   Bed width u/s and d/s = 1.1 m

   Top width of crest = 0.5 m for initial assumption $C_d = 0.415$ for rectangular crest. The drop structure is of masonry with specific gravity 2.0 side slope of the canal is 1:1. The Bligh's coefficient as 7.0 for sandy loam soil at foundation.

8. Following data are obtained at the crossing of a canal and drainage. [10]

   Canal Data

   Discharge: 25cumec, Full supply depth: 2.0 m, Bed width: 30m, Bed level: 210.3 m, Side slope: 1.5H:1V

   Drainage Data:

   Discharge: 360 cumec, HFL: 211.0 m, Bed level: 208.5 m, General ground level: 210.5 m

   Design the drainage waterway, canal waterway and find the bed levels and FSL at four different sections of the canal Trough.

9. a) What are the preventive measures of water logging of agricultural land? [3]

   b) How many days the field will be innundated above 200 mm depth if a drainage rate of 3 *l*/s per ha is maintained by constructing internal drainage system? Will such system cause the depth to exceed 300 mm? [4+2]

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1) Describe about the different method of surface and sub-surface irrigation and their suitability. (5)

2) How do you calculate the frequency of irrigation on the basis of soil moisture? Water is released at the rate of 16 cumecs at the head sluice.If the duty at the field is 80 ha/cumecs and loss of water in transit 20%.Find the area of the land that can be irrigated. (8)

3) Describe with sketch about possible alignment of irrigation canal. (5)

4) Describe about alluvial and non-alluvial canal. Design a canal using Kennedy's formula with the following data:Q=40 m^3/s, manning's roughness coefficient (n) =0.018, bed slope(s) =0.00020, m=1.0 and side slope=0.5:1(H:V) (2+8)

5) Explain the design method to find the suitable size, length and thickness of floor of barrage Using Khosla's seepage theory. Also draw the typical section of barrage showing the different component. (6+6)

6) what is river training works. Explain with sketch three methods of training works normally adopted in Nepalese rivers. (8)

7) (a) what are the functions of head regulator and cross regulator. Sketch the section of cross regulator (2+2)

(b) Design a vertical drop structure for the data given below.

Full supply discharge u/s and d/s =1.8 cumecs

Drop height=0.75m

FSL u/s and d/s =106.997 and 106.247

Full Supply depth u/s and d/s =0.929m

Bed levels u/s and d/s =106.068 and 105.318

Bed width u/s and d/s =1.2m

Top width of crest =0.5m for initial assumption c_d=0.415 for rectangular crest. The drop structure is of masonry with specific gravity 2.0 Side slope of the canal is 1:1.The Bligh's coefficient as 6.0 for sandy loam soil at foundation. (8)

8) Design the following components of a suitable C/D work for the following data.

Discharge of canal=50 m^3/s , Bed width of canal=30m,Depth of water in canal=1.5m,Bed level of canal=100.0m,High flood discharge of drain=450 m^3/s, High flood level of drainage=100.50m,Bed level of drainage=98.8m,General ground level=100.0m (i)Design of drainage water- way(ii)Design of canal water way (iii) Design of transition and (iv)Uplift pressure on the roof. (10)

9) Explain about internal and external drainage system. Also explain the causes and remedial measures of water logging in the agriculture land and write the method as well as assumptions adapted to design the surface drainage in terai region. (3+3+4)

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the status of irrigation in Nepal. [5]
2. a) Explain about soil-moisture-irrigation relationship. [3]

   b) Three distributories are used for irrigation. The details are given below. Find which one is more efficient. [5]

	Distributary-1	Distributary-2	Distributary-3
Discharge	15 m^3/s	20 m^3/s	25 m^3/s
C.C.A	15,000 ha	25,000 ha	30,000 ha
Intensity of irrigation	60%	80%	50%
Base period	200 days (cotton crop)	120 days (wheat crop)	365 days (sugarcane)

3. An irrigation channel has a bottom width 8 m and side slopes of 1.5H: 1V in cutting and 2H:1V in filing. The width of the crest of bank is 2 m and its height above the ground level is 3m. Compute the balancing depth and draw a neat x-section of the canal illustrating the various dimensions and level it. [3+2]
4. a) A canal has to be designed to carry a design discharge as 50 m^3/s. The slope of the canal is 1:1000 and passes through medium with mean particles as 50 mm. Assuming a trapezoidal section, determine the stable depth of the canal assuming angle of repose of canal bed/side particles as 36°. [5]

   b) Design a stable irrigation canal carrying a discharge of 50 m^3/s, which passes through alluvium (dmean = 0.50 mm). Draw a sketch of the designed section. [5]
5. a) An irrigation barrage has to be designed to pass a flood of 10,000 m^3/s, through alluvium media (median dia of particles = 0.33 mm). The flood level, pond level and downstram floor level are 207.0 m, 204 m and 198.0 m respectively. If the safe exit gradient is 1/6, compute minimum total impervious floor length required to safeguard the structure from piping. Prepare a conceptual section of the designed structure. [7+1]

   b) What are slit ejectors and slit excluders in irrigation system? Write their design principles. [4]
6. a) Explain with sketch how spur assist in river control work. [3]

   b) Design the length, radius of curved head, length and thickness of launching apron of a guide bund to train a river with the following data. [5]

Design Flood Discharge : 4500 cumecs
HFL : 154.00 m
Bed Level of river : 150.00 m
Av. dia. of river bed material : 0.1 mm

7. a) Explain the working principle of non-modular and semi modular outlet. What are the requirements of a good module? [2+2]

b) Design the crest and cistern of a vertical drop structure for the data given below. [8]

Discharge =4.5 cumec, Bed level u/s = 105.00, side slope of channel = 1:1, bed level d/s = 103.5, FSL u/s = 106.5, Bed width u/s and d/s = 3.0m , Top width of crest = 0.75m (for initial assumption), Cd = 0.41

8. Following data are obtained at the crossing of a canal and drainage. [10]

Canal Data

Discharge : 50cumec, Full supply depth : 1.6m, Bed width : 35m, Bed level : 210.3m, Side slope : 1.5H:1V

Drainage Data

Discharge : 400 cumec, HFL : 211.0m, Bed level : 208.5m, General ground level: 210.5m

Design the drainage waterway, canal waterway and find the bed levels and FSL at four different sections of the canal Trough.

9. Explain in details the procedures of designing drainage canals in irrigated paddy fields. [10]

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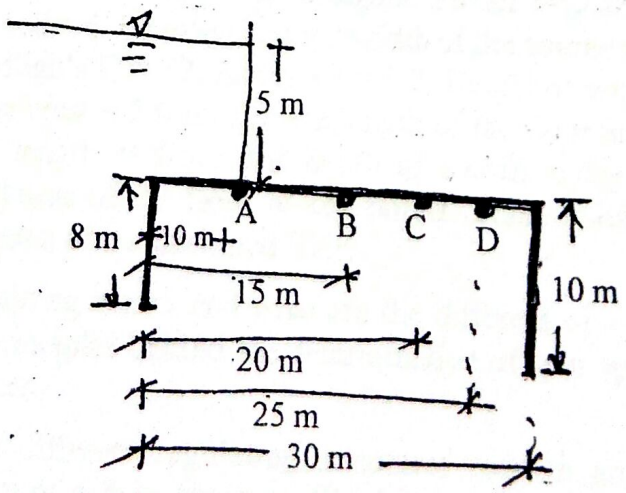
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. A farmer with his 40 m × 40 m plot plans to irrigate his field using 4 sprinklers having a throw distance as 10 m and each placed 20 m apart. Prepare a sketch of wetting pattern of these sprinklers. Write your comments on the moisture pattern and suggest measure to improve it if required. [5]
2. a) How to determine the design capacity of a canal. [3]
   b) With the following data: FC = 35%, PWP = 12% root depth = 70 cm, Soil density= 1.4 gm/cc, ET_c = 9 mm/day, RAM = 70% AMC, application efficiency = 85%, conveyance loss and distribution loss 20% where the abbreviations have their usual meanings. Calculate: (i) Available moisture content (ii) Readily available moisture content (iii) Depth of irrigation at the outlet of the field (iv) Irrigation interval and (v) Depth of irrigation water required at the headwork. [5]
3. Drawing a neat sketch, show the major components of an irrigation system from headworks to command area. [5]
4. a) A canal is to be designed to carry a discharge of 32 cumecs. The beds slope is kept 1 in 1500. The soil is course alluvium having a grain size of 30 mm. Assuming the canal is trapezoidal and to be unlined with unprotected banks. Determine a suitable section for the canal. Assume $\phi = 37°$ [5]
   b) Using Lacey's regime equations prove that $R = 1.35\ (q^2/f)^{1/3}$. Where, R = hydraulic mean radius, q = discharge per unit wetted perimeter and f = silt factor. [5]
5. a) Drawing a neat sketch of an irrigation headworks, draw a longitudinal section through a head regulator showing upstream floor, regulator gates; energy dissipaters and protection works. [3+3]
   b) A section of a hydraulic structure is shown in figure below, calculate the average hydraulic gradient. Also find the uplift pressures at points A, B, C, and D. Find the thickness of the floor at these points. Take G = 2.24 [6]



6. Write various methods of river trainings. Discuss with necessary sketch, the types of spurs used for river training works. [3+5]

7. a) Making a suitable sketch compute the minimum water level required in the distributary to convey a flow as 50 lps through a -10 m long, free-discharging pipe outlet (n = 0.016) of 20 cm dia to a water course with FSL at 100.0m – [1+4]

   b) Drawing a definition sketch, design a vertical drop in a 10 m wide canal (side slope 1:1) discharging a flow as 20 m^3/s. The canal bed level upstream and downstream is 102 m and 100 m respectively, whereas the FSL upstream and downstream is 105 m and 130 mm respectively. Determine design level, length of cistern and upstream floor length using Bligh's safe hydraulic gradient as 1/8. [1+6]

8. a) What are the various types of cross drainage works? Draw the section of canal syphon. [2+2]

   b) Design a suitable cross drainage (water way, bed levels of different section and design of transitions) works if the following data at the crossing of a canal and drainage are given. [6]

   Canal

   Q = 40 m^3/s, Bed width = 30 m, FSD of canal = 1.6 m, Bed level = 206.4 m, Side slope = 1 ½ H:1V

   Drainage

   Q = 45 m^3/s, HFL = 207 m, Bed level = 204.5 m, General ground level = 206.50 m

9. Explain all steps required to arrive design discharge of a drainage canal in irrigated paddy field. [10]

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Justify the need of irrigation development in Nepal. Define cropping intensity and irrigation intensity. [3+2]
2. The base period, intensity of irrigation and duty of various crops under a canal irrigation system are given in the table below. Find the reservoir capacity if the canal losses are 18% and reservoir losses are 14%. [8]

Crop	Base periods (days)	Duty at the field (Ha/Cumecs)	Area under the crop (hectares)
Rice	120	850	3000
Wheat	120	1700	4500
Sugarcane	360	750	5400
Vegetables	120	650	1200
Cotton	200	1300	2200

3. Draw a typical cross section of a canal in partial cutting and partial filling and label at least five different canal elements on it. [5]
4. a) Sides of an irrigation canal with the following design parameters are well protected. What will be the stable depth and bed width of such a canal? [6]

   $Q = 5\ m^3/s$, $d_{50} = 3$ cm, $i = 1$ in 500

   b) The slope of a channel in alluvium in 1/6000. Find the channel section and the maximum discharge which can be allowed to flow in it. Take $f = 1.0$. [5]
5. A diversion weir with a vertical drop to be designed for an irrigation system has the following data: Design flood = 4000 m^3/s; Natural width of the source river = 300 m; Bed material = Coarse sand, Bligh's C = 12; Lacey's f = 1.2; Height of weir above low water = 3.0 m; Top width of the crest = 2.0 m. Fix the length of the floor according to Bligh's principle and design the length of floor and depth of cutoffs using Khosla's seepage theory. Compute the thickness of the floor at key points. Make suitable assumptions if necessary. Draw a neat sketch of the designed weir. [12]
6. What is meant by river training works and what are the different objectives served by it. What are the underlying principles behind the determination of spur spacing. Draw L and X - section of a typical spur. [1+2+3+2]
7. Describe the functions of different regulating structures used in an irrigation system. Design the crest and cistern of a drop structure (Sarda type) for a discharge of 9 cumecs and a drop height of 1.2 m: FSL u/s and d/s = 105.7 m and 104.5 m; Bed Level u/s and d/s = 104.2 m and 103.0 m; Bed Width u/s and d/s = 8 m; Side Slope of Channel = 1:1. [5+8]

8. Determine bed and water levels at four critical locations of the canal water way at transition of Syphonic Aqueduct designed with the following data. [8]

Canal

Full supply discharge = 40 m^3/s
Full supply level = 151.8 m
Side slope = 1.5:1
Depth of water = 1.5 m
Bed level = 150.00 m
Bed width = 32 m

Drainage

Maximum flood discharge = 520 m^3/s
High flood level = 150.6 m
Bed level = 148.2 m
Normal ground level = 150.00 m

9. List out the main effects and preventive measures of water logging. Estimate the rate of internal drainage discharge in lps/ha from bunded rice fields of Terai area. The 3-day design rainfall of 10 years frequency in that area has been estimated as 400 mm. Make suitable assumptions for removing excess water from the field of Terai. [4+6]

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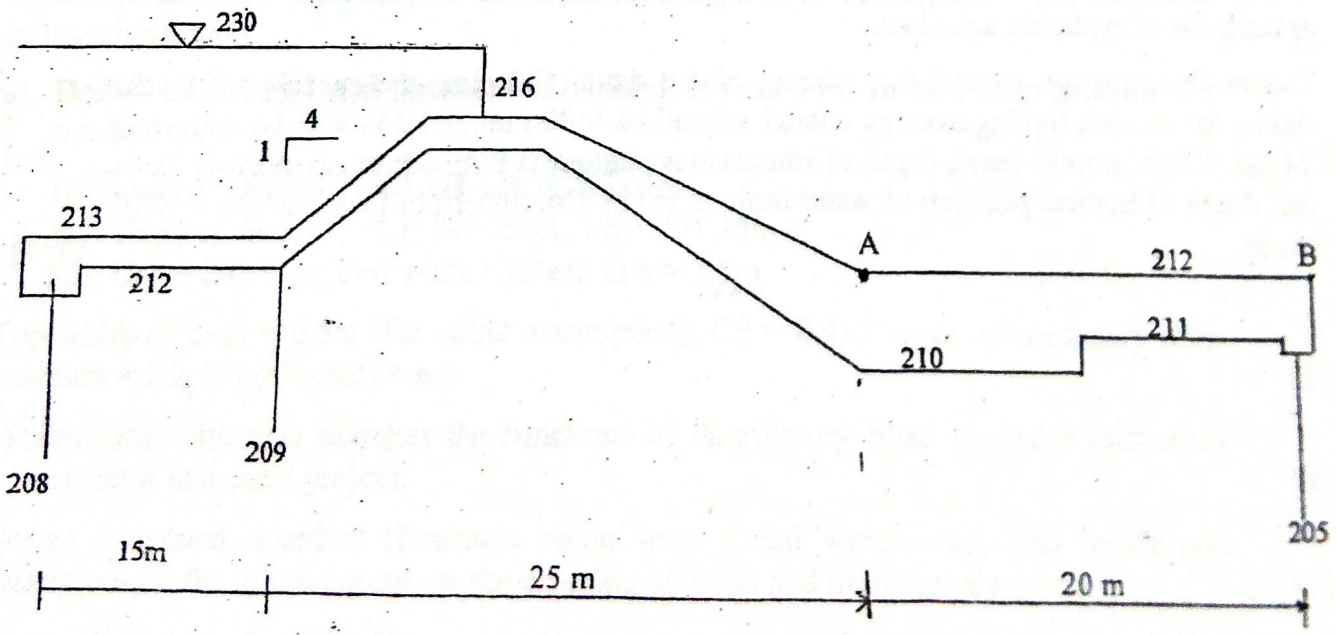
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the advantages and disadvantages of sprinkler and drip irrigation. [5]
2. Compute the flow discharge needed for a canal to irrigate dry season crops in 30000 ha and wet season crops in 40000 ha. Kor period and kor depth for dry and wet season crops are 6 weeks and 14.8 cm and 4 weeks and 11.5 cm respectively. [8]
3. Explain briefly with contours (topographic) the classification of canals based on alignments. [5]
4. a) What are Lacey's basic regime equations? Starting from these equations, derive the equation for wetted perimeter. [3+2]
   b) Design an unlined channel in alluvial soil by the tractive force approach for a discharge of 50 cumecs from the following data. [5]
      i) Bed slope = 1/5000
      ii) Side slopes = 0.5 : 1
      iii) Manning's N = 0.022
      iv) Permissible tractive stress = 0.0025 KN/m^2
5. Find whether the section provided is safe against uplift at A and B. [12]



6. Design the length, radius of curved head, length and thickness of gabion slope pitching and gabion launching apron of a guide bund to train a river with the following data. [8]

Design Floor Discharge	: 3000 cumecs
River Bed Level	: 240.0 m
HFL	: 245.0 m
Average dia. of river bed material	: 0.1 mm

7. Find the thickness of downstream impervious floor for a fall having following data: [12]

a) Discharge $\frac{u/s}{d/s} = \frac{10 \text{ cumecs}}{10 \text{ cumecs}}$

b) Full supply level $\frac{u/s}{d/s} = \frac{201.50}{200.25}$

c) Drop = 1.25 m

d) Bed level $\frac{u/s}{d/s} = \frac{200.00}{198.75}$

e) Bed width $\frac{u/s}{d/s} = \frac{9.0\text{m}}{9.0\text{m}}$

f) Full supply depth $\frac{u/s}{d/s} = \frac{1.50\text{m}}{1.50\text{m}}$

g) Bligh's creep coeff. = 8

8. Following data are obtained at the crossing of a canal and drainage. [10]

Canal Data

Discharge : 36 cumecs, Full supply depth : 1.5 m, Bed width : 28 m, Bed level : 210.4 m, Side slope : 1.5 H : 1 V

Drainage Data

Discharge : 400 cumecs, HFL : 211.0 m, Bed width : 14 m, Bed level : 208.6 m, General ground level : 210.5 m

Determine bed and water level at four critical locations of the canal waterway at transitions of syphonic aqueduct.

9. Derive the equation to find the spacing of tile drain. Calculate the spacing of the tile drains for an area having average annual rainfall of 1600 mm, if 1.5% is to be drained in 24 hrs. From ground level, depth of impervious stratum is 9 m, depth of drains is 2.0 m and depth of highest position of water table is 1.0 m. Coefficient of permeability = 0.001 cm/se. [5+5]

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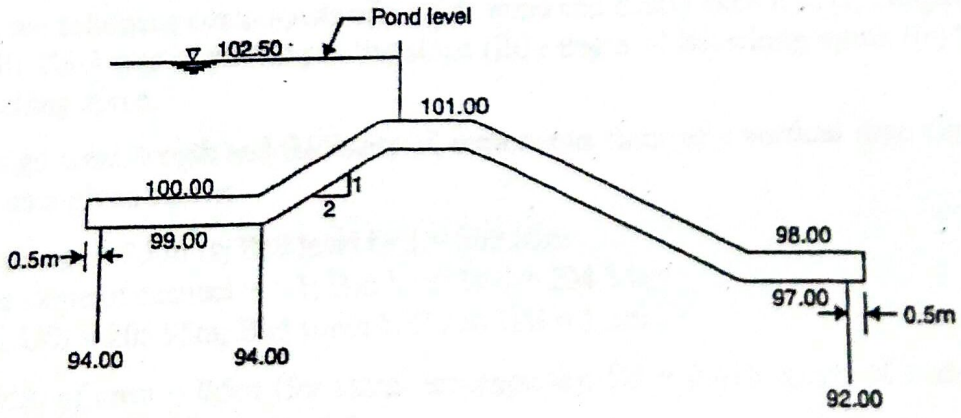
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Writing various methods of surface irrigation, discuss the suitability of drip and sprinkler irrigation. [5]
2. A minor commands 400 ha of irrigable area. It is proposed to consider wheat crop in the whole command area. The kor period for the wheat is considered 3 weeks. The kor depth has been assessed to be 10 cm. In this period 2.75 cm of rainfall is normally expected with such an intensity that 50% of this could be taken as superfluous (surface runoff). Considering 10% conveyance loss find out (a) duty of the canal water at the field head and (b) discharge of the minor at upstream head. [8]
3. Explain the components of a canal irrigation system. [5]
4. A stable channel is to be designed for a discharge of 40 m^3/s and the silt factor of unity. Calculate the dimensions of the channel using Lacey's regime equations. What would be the bed-width of this channel if it were to be designed on the basis of Kennedy's method with critical velocity ratio equal to unity and the ratio of bed-width to depth of flow the same as obtained from Lacey's method. [4+6]
5. Sketch the hydraulic gradient line for the weir profile, shown below, considering the case of no flow at pond level. Slope correlation for the slope (2:1) is 6.5 percent. Also compute the value of the exit gradient. [12]



6. The launching apron of a guide bank is laid in a width equal to 1.8 times the depth of scour below original bed. If a scour slope of 3:1 is to be maintained with thickness 1.5 t, find the thickness of apron before it get launched. Draw neat sketch of designed structure. [8]
7. a) Write down the functions of head-regulator and cross-regulator. [4]
   b) Why is the provision of drop structures required in an canal irrigation system. Explain with appropriate sketches. [4]
   c) Mention various types of canal outlet and describe in brief. What is flexibility of outlet? [4]

8. a) Following data are obtained at the crossing of a canal and a drainage. [6]

Canal data:

$Q = 20\ m^3/s$, depth of water = 1.5 m and FSL = 151.50 m, Bed width = 12 m, side slope (H:V) = (1.5:1)

Drainage data:

$Q = 200\ m^3/s$, HFL = 150.7 m, Bed level = 148.5 m and Ground level = 150.0 m

Design the following components of siphon aqueduct.

i) Drainage waterway
ii) Canal waterway
iii) Transition
iv) Uplift

b) Explain different types of cross-drainage structure with necessary sketch. [4]

9. Determine the drainage rate in l/s/ha required to meet the following conditions for healthy growth of rice paddies in bonded filed in Terai of Nepal. [10]

Initial water level in field = 50 mm
Maximum water level is 400 mm which may persist for up to one day.
Depth in excess of 250 mm may persist for up to 2 days.
No rain follows the design rainfall for several days.
Neglect ET and deep percolation losses.
Design 3 day rainfall is 400 mm.

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07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Irrigation and Drainage Engineering *(CE654)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Write down sowing time, harvesting time and average delta of five principal crops of hills of Nepal. [5]
2. a) Write down the steps for calculating irrigation requirement for Rice crop. [5]

   b) The field capacity of soil is 60%, permanent wilting point is 25%, Density of soil is 1.2gm/cc, effective root depth is 120cm, ET crop is 9mm/day. Calculate the irrigation interval if the readily available moisture is 85% of available soil moisture capacity. [3]
3. Neatly draw the component of canal and explain it. [5]
4. Explain sediment transport and tractive force approach in canal design. [10]
5. Draw a neat sketch of the general layout of a diversion head works and cross sections of under sluices, canal head regulator and weir with all details. [3+3+3+3]
6. Following hydraulic data near a proposed bridge site are obtained.

   Maximum discharge = 4000m^3/s
   Higest flood level = 205.0m
   River bed level = 200.00m
   Average diameter of river bed meterial = 0.1mm

   Design the following components of a guide bund and neatly sketch it. (i) Length of guide bund (ii) Thickness of pitching of the slope (iii) Length of launching apron (iv) thickness of launching apron. [8]
7. a) Design crest, length and thickness of impervious floor of a vertical drop structure for the data given below:

   Discharge = 1.8m^3/s; Bed level U/S = 205.05m
   Side slope of channel = 1:1; Bed level D/S = 204.35m
   FSL U/S = 205.95m; Bed width U/S and D/S = 1.5m

   Top width of crest = 0.5m (for initial assumption); Cd = 0.415 sp.gr. of masonary drop structure = 2.2; Bligh's coeff = 6.0. [8]

   b) Describe with neat sketches the functions of distributory head regulator and cross regulator in a canal project. [4]
8. Design a syphon aqueduct (Drainage water way, Canal water way, Bed levels and Transitions) if the following data at the crossing of canal and drainage are given. [10]
   - Discharge of canal = 50 cumecs
   - Bed width of canal = 32m

- Full supply depth of canal = 1.80m
- Canal bed level = 200.0m
- Side slopes of canal = (1.5H:1V)
- High flood discharge of drainage = 400 cumecs
- High flood level of drainage = 200.60m
- Bed level of drainage = 198.0m
- General ground level = 200.20m

9. Design a surface drainage for a field of 40ha area in Terai with following data. Design maximum yearly precipitation for three consecutive days = 50mm, longitudinal slope of channel 1:400, Manning roughness coefficient 0.025, Maximum water level is 300mm which may persist for up to one day and depends in excess of 200mm may persist for up to 3 days. Assume other suitable values if necessary. [10]

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