L-4/T-1/CE **Date : 15/01/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **WRE 451** (Hydrology, Irrigation and Flood Management)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Define residence time. Give a qualitative comparison between atmospheric moisture and groundwater in terms of residence time. **(5)**

(b) The rainfall values over a catchment in three successive 5-hr intervals are known to be 3, 1 and 7 cm. The ϕ-index for the catchment is estimated to be 0.2 cm/hr. Given below are the ordinates of a 5-hr unit hydrograph: **(15)**

Time(hr)	0	5	10	15	20	25	30	35	40	45	50
Ordinates of 5-hr UH (m^3/s)	0	50	125	185	160	110	60	36	25	12	0

Calculate the resulting storm hydrograph if the initial base flow is 10 m^3/s and increase by 2 m^3/s every 5 hours.

(c) Following are the ordinates of a storm hydrograph of a river draining a catchment area of 50 km^2 due to a 6-hr isolated storm. Derive the ordinates of a 6-hr unit hydrograph for the catchment. **(15)**

Time from start of storm (hr)	0	6	12	18	24	30	36	42	48	54
Discharge (m^3/s)	10	80	105	75	48	32	22	15	10	10

2. (a) Explain why the actual vapor pressure is taken equal to saturation vapor pressure at dew point temperature. **(5)**

(b) Define time of concentration. How is it related to peak discharge from a catchment area? **(5)**

(c) Discuss in brief the logic behind forming polygons in Thiessen Polygon Method. **(5)**

(d) Classify and explain streams according to annual hydrograph. **(5)**

(e) In a 140-min storm, the following intensities of rainfall were observed in successive 20-min intervals: 3.3, 3.6, 9.0, 6.6, 0.6, 0.9 and 6.0 cm/hr. Assume the ϕ-index value to be 3.0 cm/hr, compute (i) total volume of runoff, (ii) total volume of infiltration, and (iii) time of rainfall excess. The catchment area is 2 km^2. **(15)**

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3. (a) Briefly explain the three mechanisms of air mass lifting. **(5)**

(b) The relative humidity and saturation vapor pressure are computed to be 70% and 2400 Pa respectively. Assuming standard air pressure, find out the following: **(15)**

(i) air temperature, (ii) actual vapor pressure at air temperature, (iii) dew point temperature, (iv) specific humidity, and (v) density of moist air.

(c) Calculate precipitable water for surface temperature of 10 °C in first 1 km of saturated atmospheric column if the surface pressure = 101.3 kPa and lapse rate = 6.5 °C/km. Also compute precipitable water for surface temperature of 25 °C in first 1 km of similar column and calculate the percent increase or decrease from the previously computed value. Assume any reasonable value for missing data. **(15)**

4. (a) Write down the factors that affect infiltration capacity and explain in brief. **(5)**

(b) The design precipitation intensity for a storm with a T-year return period with slope of 0.00425 and maximum length of travel of water of 1100 m for the catchment is 3 in/hr. Estimate the design return period (T). Also estimate the design precipitation volume (m^3) as well. Also find out the design peak discharge (m^3/s) using rational method for the catchment. The area of the catchment in 2 km^2 and runoff coefficient is 0.5. Use the IDF curves (Fig. 1) and Kirpich formula for your estimation. **(15)**

(c) Four rain gages located within a rectangular area with four corners at (0,0), (0,13), (14,13) and (14,0) have the following coordinates and recorded rainfalls: **(15)**

Raingage location	Rainfall (mm)
(2, 9)	20
(7, 11)	25
(12, 10)	30
(6, 2)	40

All coordinates are expressed in kilometers. Compute the average rainfall in the area by Thiessen polygon method.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define irrigation, and write down the advantages and disadvantages of irrigation. **(5)**

(b) Briefly explain the concept of multipurpose project and write down the consideration for developing any water resources project as a multipurpose project. **(10)**

Contd P/3

(c) Classify irrigation development with respect to procurement process and coverage. **(5)**

(d) What is national water policy? Write down its main elements. **(7)**

(e) Briefly explain the social and environmental aspects of irrigation and FCD. **(8)**

6. (a) What do you understand by consumptive use of water? Write down the factors affecting CU or ET and the methods for direct measurement of ET. **(7)**

(b) What are the considerations for using surface water and groundwater for irrigation? **(7)**

(c) What is meant by C2-S2 water? Discuss its usefulness for irrigating fine textured soils. **(6)**

(d) Determine the volume of water required to be diverted from the head works to irrigate area of 5000 ha using the data given in the table below: Assume 80% as the effective precipitation to take care of the consumptive use of the crop. Also assume 50% efficiency of water in the field and 75% as the conveyance efficiency of canal. **(15)**

Month	Temp (°F)	% hrs of sunshine	Rainfall (mm)	Crop factor, k
June	70.8	9.9	75	0.80
July	74.4	10.2	108	0.85
August	72.8	9.6	130	0.85
September	71.6	8.4	115	0.85
October	69.3	7.86	105	0.65
November	55.2	7.25	25	0.65
December	47.1	6.42	0	0.60
January	48.8	8.62	0	0.60
February	53.9	9.95	0	0.65
March	60.0	8.84	0	0.70
April	62.5	8.86	0	0.70
May	67.4	9.84	0	0.75

Use Blaney-Criddle Formula.

7. (a) What is meant by surface and subsurface irrigation; and what are their types? Discuss briefly the various techniques used for distributing water in the firm. **(15)**

(b) Define and explain the following terms: (i) Available moisture (ii) Field capacity (iii) Crop factor. **(6)**

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Contd... Q. No. 7

(c) Wheat is to be grown in a field having a field capacity equal to 27% and the permanent wilting point is 13%. Find the storage capacity in 80 cm depth of the soil, if the dry unit weight of the soil is 14.72 KN/m^3. If irrigation water is to be supplied when the average soil moisture falls to 18%. Find the water depth required to be supplied to the field if the field application efficiency is 80%. What is the amount of water needed at the canal outlet if the water lost in the water-courses and the field channels is 15% of the outlet discharge? **(8)**

(d) Write short note on Trickle irrigation. **(6)**

8. (a) Write down the causes and ill effects of flood. **(5)**

(b) What are the major types of flood in Bangladesh? Briefly explain the measures that can be taken for flood mitigation. **(7)**

(c) Mention the main reasons for the failure of any flood management policy and enlist the possible impacts on water resources system of Bangladesh. **(15)**

(d) What are the precautions for the use of saline water in irrigation? **(8)**

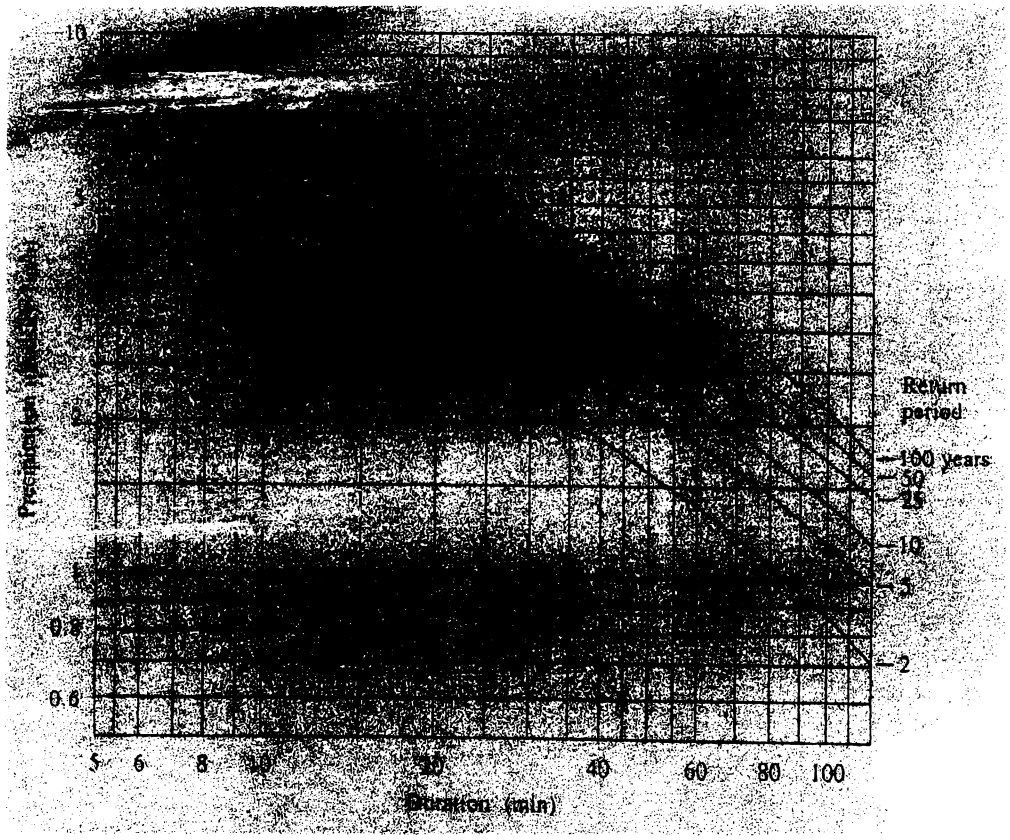

Fig. 1. IDF Curves [for Q. No. 4(b)]

L-4/T-1/CE **Date : 28/09/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2011-2012

Sub : **WRE 401** (Irrigation and Flood Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What do you mean by soil moisture suction? Briefly describe the working principle and limitations of a tensiometer. **(2+8=10)**

(b) Distinguish between the terms: **(3×3=9)**

(i) Hydraulic head and hydraulic gradient

(ii) Infiltration rate and cumulative infiltration

(iii) Check flooding and basin flooding.

(c) A sandy loam soil has available water holding capacity of 130 mm/m. The root depth of the crop is 70 cm and the allowable depletion of water is 55%. The daily water use by the crop is 9 mm/day. Determine the frequency and net depth of irrigation. **(6)**

(d) Explain how the soil structure influences irrigation? **(5)**

(e) Explain why the infiltration rate is higher at the beginning of irrigation and approaches to a constant value with time. **(5)**

2. (a) Explain briefly the meteorological factors that influence Evapotranspiration. **(6)**

(b) Rice is grown in an irrigation scheme of 25 ha area. The monthly reference crop evapotranspiration, effective rainfall and K_c values are given below. The seepage and percolation loss from the rice field is estimated to be 8 mm/day; application efficiency and conveyance efficiency are 85% and 65% respectively. For the month of March, calculate net irrigation requirement (mm/day), field irrigation requirement (mm/day) and discharge capacity (l/s) of a pump assuming that irrigation water supply is available for 15 hours a day. **(14)**

Month	December	January	February	March	April
ET_0, mm/d	2.9	3.3	5.5	7.2	6.7
R_e, mm/d	0	0	0.5	1.0	1.2
K_c	1.0	1.0	1.2	1.3	1.1

(c) Discuss briefly with a sketch the non-weighing percolation type lysimeter method to determine consumptive use of a crop. **(6)**

(d) Distinguish between the terms: **(3×3=9)**

(i) Furrow irrigation and sub irrigation

(ii) Weir type escape and sluice type escape

(iii) Aqueduct and syphon aqueduct

Contd P/2

3. (a) Write down the conditions favoring the adoption of sprinkler irrigation. Also state its limitations. **(4+3=7)**

(b) Estimate the vapor pressure deficit in the month of April for the following monthly average climatic data for 25 years record at a climatic station. The altitude of the station is 25 m above MSL. **(7)**

Daily (average) maximum temperature = 34.39 °C
Daily (average) minimum temperature = 21.32 °C
Maximum relative humidity = 89.42%
Minimum relative humidity = 38.35%

Given that,

$$e^{o}(T) = 0.611 \exp\left[\frac{17.27\,T}{T + 237.3}\right]$$

(c) Show in a diagram the different components of diversion head works. Also write down the functions of the following components/structures: **(9)**

(i) Under-sluice
(ii) River training works
(iii) Cross regulator.

(d) Write down the purposes of measuring irrigation water. Briefly describe and give advantages and disadvantages of a constant head orifice. **(12)**

4. (a) Define "flexibility" and "sensitivity" as applied to irrigation outlets and derive a relationship between them. **(9)**

(b) A direct driven centrifugal pump lifts 150 m^3 of water per hour against a total static head of 12 m. The head loss in the suction and discharge pipe may be assumed to be 2.5 m and 6.5 m respectively. Compute the cost of electrical energy in the month of July if the pump is operated 15 hours a day and electrical cost is Tk. 5 per unit. Assume the efficiencies of the pump and motor are 75% and 90% respectively. **(8)**

(c) Describe with a sketch the working principle of a centrifugal pump. Give a comparison between a volute type centrifugal pump and a vertical turbine pump. **(10)**

(d) State the rules for setting and operating weirs to measure irrigation water. **(8)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define irrigation. What are the objectives of irrigation? **(5)**

(b) What do you understand by 'mixed cropping'? Under what conditions it is favorable. Why mixed cropping is not generally acceptable? **(6)**

(c) Write short notes on (i) counter berm (ii) borrow pit (iii) non-silting and non-scouring velocity. **(9)**

Contd P/3

(d) A reservoir is proposed to be constructed for a gross command area of 1.5×10^5 hectares of which 80% is cultivable irrigable. Following data are given: **(15)**

Crop	Delta (cm)	Intensity of irrigation (%)	Kor-depth (cm)	Kor-period (day)
Paddy	120	40	19	21
Wheat	40	20	13.5	28
Sugarcane	90	15	16.5	12

(i) Work out the storage required for the reservoir, assuming canal losses at 20% of the head discharge, and reservoir evaporation and dead storage losses at 15% of gross capacity.
(ii) For the above crop pattern, determine the channel capacity in the head reaches, assuming a time factor equal to 0.80.

6. (a) Discuss the general causes of flood in Bangladesh. **(15)**
(b) What is waterlogging in irrigation? Discuss the causes of waterlogging. What reclamation methods may be adopted for a waterlogged area? **(12)**
(c) Classify the irrigation water based on the electrical conductivity and sodium hazards and state the suitability of these classes with respect to soils and crops. **(8)**

7. (a) Briefly describe the types of flood that are common in Bangladesh. **(7)**
(b) Define: (i) base period (ii) duty (iii) kor watering (iv) intensity of irrigation (v) time factor (vi) alluvial canal. **(9)**
(c) What is leaching? How leaching requirement is determined? **(4)**
(d) Design an irrigation canal having double tile lining (n = 0.014) and laid at a longitudinal stope of 1 in 1100. The design discharge is 30 m^3/s and the side slope is 1H : 1V. Use Kennedy's method assuming the maximum permissible velocity as 2.50 m/s. **(15)**

8. (a) Briefly explain with necessary sketches, the engineering measures adopted for the protection of flood prone areas. **(15)**
(b) Draw the layout of a typical canal irrigation system. **(4)**
(c) Is groundwater irrigation advantageous than surface water irrigation? Justify your answer. **(6)**
(d) A sample of water from a well showed that it has an electrical conductivity of 800 micro-mho/cm and a density of 0.99 g/cm^3. A field with a bulk density of soil of 1.50 g/cm^3 and saturation point of 40 percent will be irrigated. Determine the depth of irrigation that may turn the 35 cm depth of soil saline ignoring the precipitation and leaching of salts that may occur. What is the classification of this water if the concentration of Mg. Ca and Na are 2, 10 and 30 milli-equivalent/litre, respectively? **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2009-2010

Sub : **WRE 401** (Irrigation and Flood Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Write Short notes on: **(10)**

   (i) Leaching

   (ii) Sodium Absorption Ratio (SAR)

   (iii) Duty and Delta

   (iv) Canal seepage loss.

   (b) A watercourse commands an irrigation area of 800 hectares. The intensity of irrigation of rice in this area is 60%. The transplantation of rice crop takes 15 days and a total depth of water required by the crop is 60 cm on the field during the transplantation period, given that the rain falling on the field during this period is 15 cm. (i) Find the duty of irrigation water for the crop on the field during transplantation; (ii) Find the duty at the head of distributory; assuming losses of water to be 15% in the water courses and (iii) Calculate the discharge required in the water course. **(15)**

   (c) Discuss critically the quality standards required for irrigation water. **(5)**

   (d) With a neat sketch show the layout of irrigation canal network. **(5)**

2. (a) What is waterlogging? Explain the basic causes of waterlogging and discuss the various factors responsible for it. **(10)**

   (b) What are the advantages and disadvantages of subsurface drainage system? **(5)**

   (c) Describe : (i) Salt balance equation (ii) leaching requirement **(10)**

   (d) An irrigated area has to be provided with the drains so that the water table lies at least 2 m below the ground surface. The drains are spaced at 20 m c/c and are placed 2.5 m below the ground surface. Find the maximum rate of flow in each of the drains if they are 200 m in length each. Depth of the impervious stratum below ground surface is 5 m. and $K = 10^{-4}$ cm/sec. **(10)**

3. (a) Discuss the major causes of flood in Bangladesh. **(5)**

   (b) Discuss the engineering measures for flood control by improving the conveyance of the natural drainage system. **(10)**

   (c) Design a trapezoidal concrete lined channel to carry a discharge of 350 cumac at a slope of 10 cm/km. The side slope of the channel is 1.5 : 1. The value of n for lining material is 0.013. Assume the limiting B/y ratio to be 5. Where, B = Bottom Width of the channel. and y = depth of the flow. **(15)**

Contd P/2

(d) How can the irrigation water be scientifically managed and help in improving water logging problem? **(5)**

4. (a) Differentiate among the following terms (i) Initial berm, fully formed berm and back berm

(ii) Initial regime, final regime and true regime channel. **(10)**

(b) Design an irrigation canal using Lacey theory for the data given below. **(10)**

Discharg, Q = 50 cumec, grain size d_{so} = 0.15 mm.

(c) Write short notes on (i) Aluvial and non aluvial canal; (ii) Gross and culturable command area; (iii) Kor depth and Kor period. **(10)**

(d) Draw neat sketch of the different types of subsurface drainage layout. **(5)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Define and show in a diagram the different classes of soil water and also indicate their availability to plants and drainage characteristics. **(9)**

(b) What do you mean by soil-moisture tension? Explain why a combination of a tensiometer and a resistance block is necessary to measure moisture content in most soils. **(2+5=7)**

(c) Explain why a sandy soil requires more frequent irrigation than a clayey soil under similar climatic conditions. **(5)**

(d) Gravimetric samples prior to irrigation in a 1.5 ha field yields the following results. The field capacity of the soil is 16% and the root zone depth is 1.2 m. Determine the time required to irrigate the field using a stream of 35 l/s assuming application losses of 30%. **(14)**

Sampling depth (cm)	Sample volume (cm^3)	Wt. of moist sample (gm)	Dry wt. of moist sample (gm)
0-30	150.0	215.5	194.8
30-60	152.0	227.5	205.2
60-90	146.0	230.5	208.5
90-120	145.0	235.3	210.3

6. (a) Write short notes on: **(9)**

(i) Soil moisture stress

(ii) Irrigation scheduling

(iii) Pump characteristic curves

(b) Briefly describe the non-weighing constant water table type lysimeter to determine the consumptive use of a crop in the field and state its limitations. **(5+2=7)**

(c) Describe with a sketch the working principle of a vertical turbine pump. **(7)**

Contd P/3

(d) Wheat is to be grown at a place, the useful data of which are given below. Determine the consumptive use of field irrigation requirement if the water application efficiency is 75%. Make use of Blaney-Criddle equation and a crop factor = 0.8. **(12)**

Month	Mean temperature, t°c	Percent day-time, hr	Effective rainfall (cm)
November	18.0	7.30	1.7
December	16.0	7.15	1.1
January	14.0	7.20	2.5
February	15.0	7.40	2.3

7. (a) State the salient points of difference between **(6)**
   (i) sprinkler irrigation and trickle irrigation
   (ii) check flooding and basin flooding.

   (b) What are the special site conditions that favor sub irrigation? State the advantages and limitations of this method. **(5+2+2=9)**

   (c) A stream of 105 l/s was delivered to a field of 2.0 ha for 8 hours. The depth of root zone was 1.20 m and runoff averaged 50 l/s for 4 hours. Available water holding capacity of the soil is 15 cm/m and management allowable depletion is 55%. The average depth of penetration of water in each 0.25 ha segment of the field was 0.82 m, 0.98 m, 1.10 m, 1.02 m, 0.90 m, 0.85 m, 1.07 m and 1.05 m. Calculate water application, water-storage and water-distribution efficiencies. **(15)**

   (d) "Furrow irrigation is associated with salt accumulation in the ridges" - Explain. **(5)**

8. (a) Distinguish between **(9)**
   (i) Aqueduct and syphon aqueduct
   (ii) Weir and barrage
   (iii) Total static head and total pumping head.

   (b) Show in a sketch the layout of diversion head works. State the requirements of a good module in an irrigation project. **(4+5=9)**

   (c) State the rules for setting and operating weirs in irrigation canal. **(6)**

   (d) A pump is to be installed in a well to irrigate rice grown over 25 ha of land. The peak irrigation requirement is 15 mm/day and the total static head is 12 m. The efficiencies of the pump and motor are 70% and 90% respectively. The pump is operated for 16 hours a day. Determine (i) the power requirement in kW and (ii) the cost of electricity in a month if the power cost is Tk. 5.00 per unit. **(11)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2008-2009

Sub : **WRE 401** (Irrigation and Flood Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) What are the main elements of National Water Policy of Bangladesh. **(5)**

   (b) Write short notes on (i) Leaching (ii) Environmental considerations of irrigation project (iii) Disadvantages of irrigation. **(10)**

   (c) Explain how the salinity concentration of the soil solution can be measured? Discuss the quality of irrigation water based on the salt concentration in water. **(10)**

   (d) Design an earth canal section using Kennedy's Theory for the data given below : **(10)**

   Canal discharge = 4000 cusec
   Canal bed slope = 1 in 5250
   Critical velocity ratio = 1.085
   Manning's n = 0.021

2. (a) With neat sketch show the layout of canal system. **(5)**

   (b) Explain various types of canal seepage losses. Mention the factors affecting seepage losses. **(10)**

   (c) Differentiate among the following terms **(10)**

   (i) Initial berm, Fully formed berm and Back berm
   (ii) Initial regime, Final regime and True regime channel.

   (d) The electrical conductivity of an irrigation water is 2000 ppm. Also, the electrical conductivity of the saturated extract of a soil is 10,000 micro-mhos/cm, that reduces the yield of that field by 25%. A crop planted on that soil is desired to be irrigated at 70% available soil water. The water holding capacity of that soil is 30 cm per meter depth of soil. The root zone depth of the crop is 90 cm. Calculate the irrigation requirement of that crop. **(10)**

3. (a) Mention the major causes of flood in Bangladesh. **(5)**

   (b) Discuss the engineering measures for flood control by improving the conveyance of the natural drainage system. **(10)**

   (c) Discuss the curative measures of waterlogging. **(10)**

   (d) Briefly describe the distribution system for canal irrigation. **(10)**

Contd P/2

WRE 401

4. (a) What are the advantages of a fully formed berm. **(5)**

(b) Name various land reclamation methods. Describe the method of leaching. **(10)**

(c) Briefly describe following flood fighting measures : **(10)**

(i) Ringing of sand boils

(ii) Heightening to stop overtopping

(iii) Closure of crevasses and breaches

(d) In a command area, the monthly water requirements Q for various crops are given below. Determine the channel capacity for design. Assume the reasonable value of any data you need. **(10)**

Month	Water requirement in ha-m					
	Paddy	Ground nut	Sugar cane	Chillies	Cotton	Maize
	30,000 ha	5,000 ha	10,000 ha	4,000 ha	8,000 ha	5,000 ha
March	---	---	4,000	---	---	---
April	---	---	5,000	---	---	---
May	---	---	7,500	---	---	---
June	5,200	---	3,500	---	---	---
July	1,700	---	1,200	---	---	---
August	2,000	---	900	---	---	---
September	2,200	---	500	102	---	---
October	8,200	---	4,500	960	640	250
November	5,150	520	5,500	805	1,130	1,120
December	---	840	2,600	620	2,732	1,770
January	---	1,320	3,000	306	3,152	1,300
February	---	710	3,500	---	2,102	---

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

Assume reasonable value of any data.

5. (a) What do you mean by soil moisture tension? Briefly describe the working principle and disadvantages of a tensiometer. **(2+10=12)**

(b) What are the factors affecting infiltration characteristics of soil? **(4)**

(c) Distinguish between : **(2×5=10)**

(i) Available water and hygroscopic water

(ii) Furrow irrigation and sub-surface irrigation

(d) A sandy loam soil holds water at 140 mm/m depth between Field capacity and Permanent wilting point. The root depth of the crop is 30 cm and the allowable depletion of water is 35%. The water use by the crop is 5 mm/day. There is no rainfall and ground water contribution. Determine **(9)**

(i) allowable depletion depth between irrigations

(ii) frequency of irrigation

(iii) net application depth of water

6. (a) What are the factors affecting Evapotranspiration? **(6)**

(b) Discuss the soil moisture depletion method to determine consumptive use of a crop. **(6)**

(c) Write short notes on : **(3×3=9)**

(i) Effective rainfall

(ii) Soil moisture characteristic curve

(iii) Pumping head

(d) A stream of 135 litres per second was diverted from a canal and 100 litres per second were delivered to the field. An area of 1.6 hectares was irrigated in eight hours. The effective depth of root zone was 1.8 m. The runoff loss in the field was 432 m^3. The depth of water penetration varied linearly from 1.8 m at the head end of the field to 1.2 m at the tail end. Available moisture holding capacity of the soil is 20 cm/m depth of soil. Irrigation was started at a moisture extraction level of 50% of the available moisture. Determine : (i) Water conveyance efficiency, (ii) Water application efficiency, (iii) Water storage efficiency and (iv) Water distribution efficiency. **(14)**

7. (a) Describe the working principle of a centrifugal pump with a sketch. Give a comparison between a volute type centrifugal pump and a turbine pump. **(9+5=14)**

(b) Write short notes on : **(2×3=6)**

(i) Aqueduct

(ii) Syphon

(c) What are the conditions favoring the adoption of sprinkler irrigation? **(5)**

(d) A pump lifts 93,600 litres of water per hour against a total head of 21 metres. Compute the water horse power. If the pump has an efficiency of 72%, what size prime mover is required to operate the pump. If a direct drive electric motor, having an efficiency of 80%, is used to operate the pump, compute the cost of electrical energy in a month of 30 days. The pump is operated for 12 hours daily for 30 days. The cost of electrical energy is 3.00 Tk. per unit. **(10)**

Contd P/4

WRE 401

8. (a) What do you mean by canal regulation? State the purposes of irrigation water measurement. **(2+3=5)**

(b) Write down the main functions of the following structures : **(3×3=9)**

(i) Under-sluices (ii) Guide bank and (iii) Marginal bund

(c) Distinguish between **(3×4=12)**

(i) Head regulator and cross regulator

(ii) Weir type escape and sluice type escape

(iii) Flexible module and rigid module

(d) A weir type outlet is to be placed in a trapezoidal channel of an irrigation project. The outlet has a 'Setting' such that its 'Flexibility' is equal to 1. Determine the depth below water surface at which the outlet is to be located. **(9)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2007-2008

Sub : **WRE 401** (Irrigation and Flood Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume any reasonable value if missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Define flood. Write the different types of flood and their causes in Bangladesh. **(9)**

(b) What are the differences between vertical turbine pump and centrifugal pump? **(6)**

(c) A distributary canal takes off from a branch canal having canal bed level at 204.0 m and full supply level at 205.8 m. The gross command area at the head of the distributary is 30000 hectares and after each km it is reduced by 5,000 hectares. Out of this command area the culturable area is only 75%. The intensity of irrigation for the Rabi and Kharif seasons is 32% and 14% respectively. Design suitable channel sections for the first 1 km of this distributary canal, assuming the following data. **(20)**

(i) Total losses below km 3 = 0.44 cumec.

(ii) Channel losses occur @ 2 cumec/million square meter of wetted perimeter.

(iii) Kor period for Rabi (wheat) = 4 weeks

(iv) Kor depth for Rabi = 14 cm

(v) Kor period for Kharif (rice) = 2.5 weeks

(vi) Kor depth for Kharif = 20 cm

(vii) Manning's n = 0.0255

(viii) Critical velocity ratio = 0.95

The ground levels at every 200 meters, along the line of the proposed alignment, have been obtained and tabulated below.

distance from head in meter	reduced level in meters
0	205.20
200	205.30
400	205.25
600	205.00
800	204.90
1000	204.30
1200	204.30

WRE 401 (CE)

2. (a) What is consumptive use? Define reference crop evapotranspiration. How is it related to crop evapotranspiration? **(6)**

(b) What are the structural measures for flood control in Bangladesh? Describe them briefly. Which one do you think is the most appropriate measure among them and why? **(16)**

(c) Command area of a project is 120 hectares. Net irrigable area is 78% of command area. Field capacity, permanent wilting point and density of soil are 30%, 12% and 1.2 gm/cc respectively. The effective depth of root zone of given crop is 60 cm and daily consumptive use of that crop is 13 mm. Determine how many days can the crops utilize water if moisture content of soil is 29%. **(13)**

3. (a) Write the assumptions of FAO Penman-Monteith equation for estimating evapotranspiration. Calculate solar radiation from the given data. **(12)**

(i) extraterrestrial radiation = 41.07 MJm^{-2} day^{-1}

(ii) sunset hour angle = 120°

(iii) monthly average sunshine duration = 8.5 h/day

$$N = \frac{24}{\pi}\omega_s$$

$$R_s = \left(a_s + b_s \frac{n}{N}\right) R_a$$

symbols represent usual meanings.

(b) Write short notes on (i) canal escapes and (ii) glacis fall. **(6)**

(c) Design a regime channel for a discharge of 150 cumecs and silt factor 1.1, using Lacey's theory. **(17)**

4. (a) Show in sketch a typical layout of diversion head works. Write the functions of each components briefly. **(15)**

(b) Assume the following situations for a small watershed in Rangpur. The six-month seasonal precipitation is 170 cm, runoff is 50 cm and the change in ground water storage is 45 cm. What is the monthly evapotranspiration rate? **(7)**

(c) A pump is installed to irrigate 25 hectare area. Peak irrigation requirement is 18 mm/day. It is estimated that total static head is 23 m, loss is 2.5 m and efficiencies of pump and motor are 70% and 80% respectively. Determine the cost of electricity if pump is operated for 10 hours in a day and unit cost is Tk. 5.5/kw-h. **(13)**

WRE 401 (CE)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Write short notes on (i) Return flow (ii) National water policy (iii) Different types of irrigation projects. **(15)**

   (b) What are the considerations for development of any water resources project? Explain. **(12)**

   (c) Discuss the shape of yield-water application curve. **(8)**

6. (a) Classify irrigation water according to salinity and sodium hazards. Also remark on the use of each class of water. **(15)**

   (b) Discuss the different methods of evaluating relative proportions of sodium to other cations in irrigation water. **(8)**

   (c) A sample of water from a well showed that it has an electrical conductivity of 2 mmhos/cm and a density of 1 g/cm^3. A field with a bulk density of soil of 1.58 g/cm^3 and saturation point of 38 percent will be irrigated. Work out the depth of irrigation that may turn the 30 cm depth of soil saline ignoring the precipitation and leaching of salts that may occur. Given that soil will become saline when EC becomes greater than 4 mmhos/cm. **(12)**

7. (a) The data obtained from a test cylinder is given in the Table 1. Plot accumulated infiltration, average infiltration, and instantaneous infiltration rates respectively against time scale on appropriate graph paper. **(20)**

   (b) Explain the use of electro-resistance blocks and tensiometer to measure soil moisture. Discuss their relative drawbacks as well. **(15)**

8. (a) What is waterlogging and what are its ill-effects? **(10)**

   (b) What are the preventive measures against waterlogging? **(5)**

   (c) Briefly describe with sketches the various types of surface irrigation methods. Also give suitability, advantages, disadvantages and limitations of each type. **(12)**

   (d) Determine the field capacity of a soil for the following data: **(8)**

   (i) Depth of root zone = 1.8 m

   (ii) Existing moisture = 8%

   (iii) Dry density of soil = 1450 kg/m^3

   (iv) Quantity of water applied in soil = 650 m^3

   (v) Water lost due to deep percolation and evaporation = 10%

   (vi) Area to be irrigated = 1000 m^2.

WRE 401

Table 1 for Question No. 7(a)

Cylinder No. 3

Time (hr)			Intake (mm)		
Watch	Difference	Cumulative	Depth	Difference	Cumulative
4:15			260		
4:16	1	1	249	11	11
4:18	2	3	242	7	18
4:22	4	7	234	8	26
refill			271		
4:30	8	15	260	11	37
4:48	18	33	246	14	51
refill			270		
5:02	14	47	262	8	59
5:29	27	74	248	14	73
6:00	31	105	238	10	83
refill			280		
6:29	29	134	269	11	94
6:57	28	162	260	9	103
7:23	26	188	253	7	110
7:43	20	208	248	5	115

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2006-2007

Sub : **WRE 401** (Irrigation and Flood Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Prove that for suspended load transport in a channel $\frac{c}{c_a} = e^{-\frac{\omega_0}{\epsilon}(y-a)}$, where the symbols have their usual meaning. **(6)**

(b) Compare the Lacey's theory with Kennedy's theory. **(5)**

(c) An unlined irrigation canal has the following parameters : **(10)**

Depth of flow = 1.03 m

Bottom width = 1.95 m

Side slope = 2.25 : 1

Free board = 0.25 m

Longitudinal slope = 0.0005

and Manning's coefficient = 0.024.

A lined irrigation canal is to be designed with the design discharge of the unlined canal. The properties of the lined canal are

Bottom width = 2.00 m

Side slope = 1.25 : 1

Free board = 0.2 m

Longitudinal slope = 0.0005

Manning's coefficient = 0.014

Compare the velocities and the depth of flow of these canals.

(d) Illustrate the various structural and non-structural measures for flood mitigation. **(7)**

(e) Compare the standard national floor management program with the actual flood management in Bangladesh. **(7)**

2. (a) Differentiate between **(9)**

(i) Straight glacis fall and vertical drop fall

(ii) Head regulator and cross regulator

(iii) Weir type and sluice type escape.

(b) What is meant by flexibility and sensitivity of a module and derive a relationship between them. **(6)**

(c) Draw neat sketches and explain the working principle of **(9)**

(i) Syphon aquaduct

(ii) Syphon

(iii) Constant head orifice.

(d) Estimate the consumptive use of water by citrus crop sown on 21 October and harvested on 25 March, at a location by Blanney-Criddle formula from the following data. Also determine the field irrigation requirement if the water application efficiency is 75%. **(11)**

Month	Mean Monthly air temp °F	Total day light hour of the month	Useful rainfall (cm)
October	78.48	190	3.19
November	74.12	182	2.04
December	65.39	178	1.37
January	62.53	172	1.03
February	70.19	198	0.94
March	72.34	202	2.11

Given that the total day light hours in the successive two years are 2375 hours and 2465 hours.

3. (a) Show in sketch the layout of a diversion headwork and briefly discuss the functions of each component. **(11)**

(b) Distinguish between consumptive use and evapotranspiration. **(6)**

(c) Explain why the irrigation efficiency of 100 percent are not always desirable. **(6)**

(d) The average weather data for a month recorded at a certain place are given below : **(12)**

T_{max} = 36.3°C, T_{min} = 24.7°C

Relative humidity = 56%

Wind sped at 2 m height = 1.18 m/s

Net radiation = 15.16 MJ/m^2-day

Soil heat flux = 0.16 MJ/m^2-day

Slope of the vapour pressure temperature graph = 0.312 kPa/°C

The psychrometric constant = 0.069 kPa/°C

(i) Calculate the evapotranspiration of the reference crop by FAO Penman Monteith equation.

(ii) Calculate the evapotranspiration of the crop if the crop coefficient is 0.89.

(iii) What will be gross irrigation requirement of that month if water application efficiency is 78% and water conveyance efficiency is 72%.

Contd ... P/2

4. (a) Briefly discuss with a sketch the working principle of a centrifugal pump. **(6)**

   (b) Explain in which condition what type of lysimeters will used. **(7)**

   (c) A pump was installed on a well to lift water to irrigate rice crop grown over 12 ha of land. If the peak irrigation requirement is 12.5 mm/day and the lift 11 m, determine (i) the power requirement in KW, (ii) the cost of electricity in a month (July) if the pump is operated for 13 hours a day and the per unit cost is Tk 2.75. Assume that the efficiencies of pump and motor are 75% and 85% respectively. **(6)**

   (d) Calculate the balancing depth for a canal section having a bed width equal to 20 m and side slope of 1.5 : 1 in cutting and 2.5 : 1 in filling. The bank embankments are kept at 4.0 m higher than the ground level (berm level) and crest width of banks is kept as 2.5 m. **(6)**

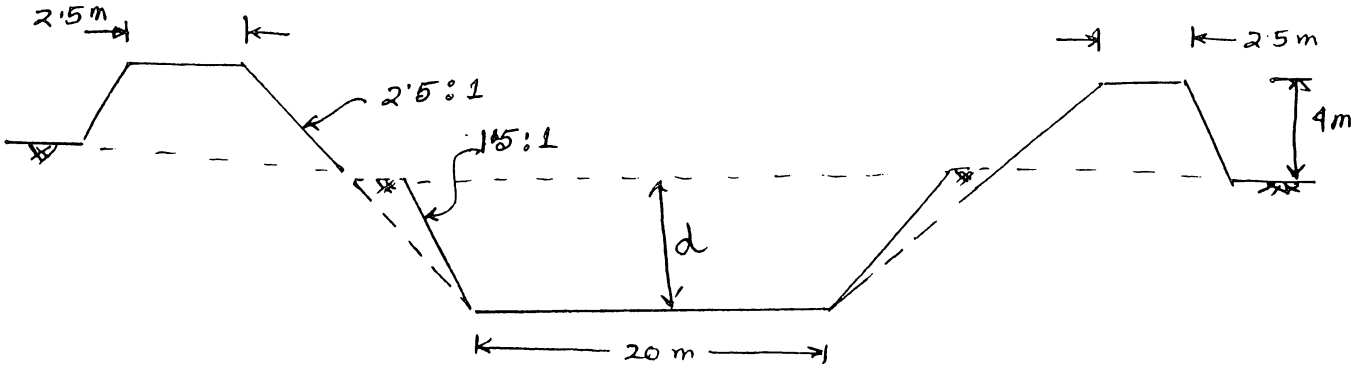

Fig 1 for Q 4(d)

(e) An irrigation canal of 105 l/s was delivering water to a field of 1.75 ha for 6 hours. The depth of root zone is 1.9 m and the runoff loss was estimated as 412 m^3. The depth of penetration of water varied linearly from 1.85 m at the head to 1.25 m at the tail end of the field. The available water holding capacity of the soil is 18 cm/m and irrigation started when 50% of available water was depleted. Determine (i) water application efficiency, (ii) water storage efficiency and (iii) Water distribution efficiency. **(10)**

WRE 401

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

Assume reasonable value of any data if not given.

5. (a) Discuss about the minor and major irrigation system in Bangladesh. **(5)**

   (b) Write short notes on (i) water right (ii) irrigation inputs (iii) general cropping patterns of Bangladesh. **(10)**

   (c) Discuss the principal methods of land reclamation. **(10)**

   (d) Explain the social and environmental aspects of irrigation. **(10)**

6. (a) Discuss how the salinity concentration of the soil solution can be calculated. Also mention the problems of plant growth caused by excess amount of soluble salts present in irrigation water. **(8)**

   (b) Discuss the quality of irrigation water in context to concentration of potentially toxic elements. **(7)**

   (c) Explain the leaching method in details. **(8)**

   (d) A 36 cm depth of soil has a mean bulk density of 1.28 gm/cc and saturation point 47%. Soil salinity is changing due to evaporation of 13.5 cm ground water having an electrical conductivity of 7.5 mill-mhos/cm over a period of 90 days. It is assumed that 36 cm depth of soil will be affected by the rise ion salt concentration. If the irrigation water with density of 1 gm/cc and electrical conductivity of 640 micro-mhos/cm is applied to that soil, calculate the depth of irrigation that will cause equal increase of soil salinity as done by evaporation. **(12)**

7. (a) Briefly describe the working principle and disadvantages of a tensiometer. **(7)**

   (b) Distinguish between the terms **(9)**

   (i) field capacity and allowable depletion

   (ii) apparent specific gravity and real specific gravity

   (iii) hydraulic head and hydraulic gradient.

   (c) Briefly describe with sketches the various types of surface irrigation method. Also give suitability advantages and disadvantages and limitations of each type. **(12)**

   (d) Briefly describe the sub-irrigation system. **(7)**

8. (a) Explain with a sketch why a sandy soil requires more frequent irrigation than a clayey soil under similar climatic condition. **(5)**

   (b) Discuss the curative measures of waterlogging. **(10)**

   (c) Explain why a combination of tensiometer and a resistance block is necessary to measure moisture contents in most soils. **(5)**

   (b) What conditions favour sprinkler irrigation? **(5)**

   (c) Compute the depth and frequency of irrigation required for a certain crop with data given below : **(10)**

   Rootzone depth = 105 cm

   Field capacity = 27%

   Permanent wilting point = 14%

   Apparent specific gravity of soil = 1.6

   Consumptive use = 17 mm/day

   Efficiency of irrigation = 72%

   Assume 55% depletion of available moisture before application of irrigation water.

TABLE 1: **Values of Monthly Crop Coefficient (k) to compute Consumptive use by Blaney-Criddle Formula**

Month	*Sugarcane*	*Rice*	*Maize*	*Cotton*	*Wheat*	*Berseem*	*Vegetables*	*Citrus*
January	0.75	–	–	–	0.50	0.50	0.50	0.50
February	0.80	–	–	–	0.70	0.70	0.55	0.55
March	0.85	–	–	–	0.75	0.80	0.60	0.55
April	0.85	0.85	0.50	0.50	0.70	0.90	0.65	0.60
May	0.90	1.00	0.60	0.60	–	1.00	0.70	0.60
June	0.95	1.15	0.70	0.75	–	–	0.75	0.65
July	1.00	1.30	0.80	0.90	–	–	0.80	0.70
August	1.00	1.25	0.80	0.85	–	–	0.80	0.70
September	0.95	1.10	0.60	0.75	–	0.60	0.70	0.65
October	0.90	0.90	0.50	0.55	0.70	0.65	0.60	0.60
November	0.85	–	–	0.50	0.65	0.70	0.55	0.55
December	0.75	–	–	0.50	0.60	0.60	0.50	0.55

Source: Dastane (1972).