

CLASS TEST ON CE 4121

Design an irrigation channel to carry 50 cumecs of discharge, the channel is to be laid at a slope of 1 in 4000. The critical velocity ratio for the soil is 1.1. Assume Kutter's rugosity coefficient as 0.023 and use Kennedy's method.

CLASS TEST ON CE 4121, IRRIGATION AND FLOOD ENGG. TIME: 20mins. Full mark : 20

Q.1(a) Name the methods of distribution of water adopted for the following crops and described the method with sketches. (i) Potato (b) Orchard © Paddy.

(b) Furrows 90m long and spaced 75cm apart are irrigated by an initial furrow stream of 2 litre/sec. The initial furrow stream reached the lower end of the field in 50 mins. The size of the stream was then reduced to 0.5 litre/sec. The cut back stream continued for 1 hour. Estimate the average depth of irrigation.

Q.2(a) What do mean by quality of irrigation water? How salinity concentration of water is measured? What is SAR ? Classsify SAR.

(b) What is crop coefficient ? How it is determined? Describe water balance method for determining consumptive use of crop.

TEST ON CE 4121, IRRIGATION AND FLOOD ENGG. TIME: 30mins. Full mark : 20

- Q.1(a) Define irrigation engineering. Discuss briefly the necessities of Irrigation.
- (b) After how many days will you supply water soil (clay loam) in order to ensure efficient irrigation of the following crop, if field capacity of soil=27%, permanent wilting point =14%, density of soil=1.5gm/cc, effective depth of root zone=75cm and daily consumptive use of water for the given crop=11mm.
- Q.2(a) What are the functions of irrigation water?
- (b) What are the parameters needed to meet the water requirement of a crop? Express mathematically the water requirement of crop.
- © The gross command area of an irrigation project is 50,000 ha. Out of this about 5,000 ha have been utilized for construction of dwellings, roads, bridges etc. The area to be cultivated during robi season is 25000 ha during kharil season is 24000 ha. The duty of canal water for robi crops is 5,000 ha per cumec and for kharit crops is 3,000 ha per cumec. Find the design discharge for the canal after giving 10% allowance for peak discharge and loss of water in transit. What would be the intensity of irrigation?

Irrigation and Flood Engineering, CE 4121, CLASS TEST- 1

Q1. What return period you would adopt in the design of a culvert on a drain if you are allowed to accept 5% risk of flooding in the 25 years of expected life of the culvert. *Ans* (08)

Q2. From the analysis of available data on annual flood peaks of a small stream for a period of 35 years, the 50 year and 100 year flood have been estimated to be  $660 \text{ m}^3/\text{sec}$  and  $740 \text{ m}^3/\text{sec}$  using Gumbel's method. Estimate the 200 year flood for the stream. Given,  $\bar{y}_n = 0.54034$  and  $\sigma_n = 1.12847$ . (12)

~~820 m<sup>3</sup>/s~~  
820 m<sup>3</sup>/s

Class test on CE 421, Full marks: 20 and Time: 30 mins.

Q.1(a) What is irrigation efficiency? Describe consumptive use efficiency. (b) The base period, intensity of irrigation and duty of various crops under a canal system are given as follows. Find the reservoir capacity if the canal losses are 20% and reservoir losses are 20%..  
crop : wheat, sugar cane, cotton, rice, vegetable. Base period in days: 120, 300, 200, 120, 120.  
Duty at field in hectare /cumec : 1000, 800, 1400, 900, 700. Area under the crop in hectare : 4800, 5600, 2400, 3200 and 1400.

Q.2(a) A water course commands an irrigated area of 600 hectares. Intensity of irrigation of rice in this area is 60%. the transplantation of rice crop takes 12 days and total depth of water required by the crop on the field during transplantation period is 50 cm. the useful rainfall during the transplantation period is 10 cm, find the duty of water for the crop on the field during transplantation period at the head of the field, and also at the head of the distributary. Loss is 20% in the water course.

(b) Name the method of irrigation of water adopted for the following crop, and describe the method with sketches. i. Maize ii. Orchard iii. Paddy

Class Test No. 1

CE 4121

Full Marks: 20

Time: 25 minutes.

1. Write short notes on Storm Surge. 3
2. What are the Human Related Causes of flood in Bangladesh? 5
3. Write down the aims of Watershed management. 4
4. A channel has a bottom width of 200m, depth 6m and side slopes 1:1.5, if the depth is increased to 9m by dredging, determine the percentage increase in velocity of flow in the channel. For the same increase in cross sectional area if the channel is widened (instead of deepening), what is the percentage in the velocity of flow? 8

Class Test No. 2

CE 4121

Full Marks: 20

Time: 20 minutes.

1. Write short notes on True Regime. 5
2. Design an irrigation channel to carry  $14 \text{ m}^3/\text{sec}$  of discharge. The channel is to be laid at a slope 1 in 5000. The critical velocity ratio for the soil is 1. Use Kutters Rugosity coefficient as 0.0225 and side slope 0.5 H : 1 V. 15

Class test on CE 421, Full marks: 20 and Time: 30 mins.

**Q.1(a)** Describe water classification and its availability in the soil. Give necessary diagram.

**(b)** After how many days will you supply water to soil in order to ensure efficient irrigation of the given crop, if field capacity of soil is 27%, permanent wilting point is 14%, density of soil is  $1.5 \text{ gm/cm}^3$ , effective depth of root zone is 75cm, daily consumptive use of water for the given crop is 11 mm.

**Q.2(a)** Describe water holding capacity of soil? why loam soil is a ideal soil for irrigation.

**(b)** A loam soil has field capacity of 22% and wilting coefficient of 10%. The dry weight of soil is  $1.5 \text{ gm/cm}^3$ . If the root zone depth is 70 cm, determine the storage capacity of the soil.. Irrigation water is applied when moisture content falls to 14%. If the water application efficiency is 75%, determine the water depth required to be applied in the field.

**CE 4121**  
**Irrigation and Flood Engineering**

**Full Marks: 72**

**Time: 3 Hours**

- N.B.:-**
- (i) Answer SIX questions, taking THREE from each section.
  - (ii) Figure in the margin indicates full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data missing.

**SECTION-A**

- Q.1(a) What are the different forms of soil water? Show them in case of sandy loam and silty loam soil by sketches. 3.00
- (b) Define irrigation as science and as well as engineering. What purposes are served by the application of water to the soil? Discuss. 4.00
- (c) To mature 5000 hectare of Robi Crops an irrigation canal was run as follows: 5.00

| Month                            | Oct. | Nov. | Dec. | Jan. | Feb. |
|----------------------------------|------|------|------|------|------|
| No. of running days              | 14   | 28   | 21   | 21   | 14   |
| Discharge in m <sup>3</sup> /sec | 2.00 | 2.50 | 2.25 | 2.25 | 2.00 |

Calculate overall duty and depth of water used.

- Q.2(a) Define potential evapo-transpiration. How crop co-efficient can be determined? Write the limitations of Blaney-Criddle method of determining consumptive use. 4.00
- (b) Write short notes on the following: (i) Lysimeter method of determining Cu (ii) Furrow method of irrigation (iii) Contour farming method of irrigation. 3.00
- (c) Determine reservoir capacity for the following data: Command area of a project = 40,000 hectares, canal losses = 10%, reservoir losses = 10%, base period, outlet factor and intensity of irrigation are given in the following table. 5.00

| Crop      | Base period in days | Outlet factor hectare/cumec | Intensity of irrigation in % |
|-----------|---------------------|-----------------------------|------------------------------|
| Cotton    | 180                 | 1500                        | 10                           |
| Wheat     | 120                 | 1800                        | 20                           |
| Sugarcane | 360                 | 1700                        | 20                           |
| Rice      | 120                 | 700                         | 15                           |
| Vegetable | 120                 | 700                         | 15                           |

- Q.3(a) Describe water holding capacity of different soil. Write the qualities of a loam soil. 3.00
- (b) Describe direct irrigation and irrigation by reservoir scheme. Give necessary sketches. 3.00
- (c) Find the discharge capacity of a sprinkler irrigation system from the following data: (i) Crop = wheat. (ii) Depth of irrigation to be applied = 05 cm. (iii) Peak water requirement = 0.625 cm/day, (iv) Area = 7.5 hectares (250 m x 300 m), (v) Overall irrigation efficiency = 80%, (vi) Operating hours = 20 hrs/day. 4.00
- (d) What are the different manual water lifting devices? Describe any one of them. 2.00

- Q.4(a) Distinguish between saline and alkaline soil. How you will reclaim saline and alkaline soil? 3.00
- (b) What do you mean by SAR? Classify SAR briefly. 4.00
- (c) What are the different irrigation project in Bangladesh? What are the different surveys involved in irrigation planning and designing. 5.00

**SECTION-B**

- Q.5(a) Write the various methods for estimating design flood discharge from a certain catchment. Discuss any one of them in details. 3.50
- (b) Write short notes on the following: (i) Flood plain zoning (ii) Flood forecasting and warning system (iii) Emergency evacuation. 4.00
- (c) What return period would you adopt in the design of a culvert on a drain if you are allowed to accept 5% risk of flooding in the 25 years of expected life of the culvert? 4.50
- Q.6(a) What do you mean by the term flood management? Discuss the direct and indirect benefits of flood management. 4.00
- (b) Differentiate between flood risk and flood vulnerability. 2.00

- (c) From the analysis of available data on the annual flood peaks of a small stream for a period of 35 years, the 50 year and 100 year flood have been estimated to be  $660 \text{ m}^3/\text{sec}$  and  $740 \text{ m}^3/\text{sec}$ . Estimate the 200 year flood for the stream by using Gumbel's method. Given that,  $\bar{y}_n = 0.54034$  and  $\sigma_n = 1.12847$ . 6.00
- Q.7(a) Define berm. Write down the different purposes of providing berm in the irrigation canal. 3.50
- (b) Write short notes on the following: (i) Borrow pit (ii) Spoil bank (iii) Counter berm 4.50
- (c) Define balancing depth. Calculate the balancing depth for a channel section having a bed width of 18 m and side slopes of 1H:1V in cutting and 2H:1V in filling the banks. The bank embankments are kept 3 m higher than the berm level and crest width of the banks is kept as 2 m. 4.00
- Q.8(a) Define regime channel. Write down the importance of sediment transport. 2.50
- (b) Differentiate between Lacey's theory and Kennedy's theory. S&L 2.50
- (c) State and briefly explain the Kennedy's silt theory. 2.50
- (d) Design an irrigation channel to carry 50 Cumecs of discharge, the channel is to be laid at a slope of 1 in 4000. The critical velocity ratio for the soil is 1.1. Assume Kutter's rugosity coefficient as 0.023 and use Kennedy's method. 4.50

Heaven's Light is Our Guide  
 DEPARTMENT OF CIVIL ENGINEERING  
 RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 B.Sc. Engineering FOURTH Year GDE Semester Examination, 2017  
 CE 4121  
 Irrigation and Flood Engineering

Full marks: 72

Time: 3 Hours

- N.B:- (i) Answer any SIX questions, taking THREE from each section.  
 (ii) Figures in the margin indicate full marks.  
 (iii) Use separate answer script for each section.  
 (iv) Assume reasonable value for any data missing.

SECTION-A

- Q.1(a) What are the scope of irrigation? Describe briefly the scope of irrigation. 4.00  
 (b) What are the purposes served by irrigation water? Write briefly. 3.00  
 (c) To mature 5000 hectare of Rabi crops an irrigation canal was run as follows: 5.00

| Month                            | October | November | December | January | February |
|----------------------------------|---------|----------|----------|---------|----------|
| No of running days               | 14      | 28       | 21       | 21      | 14       |
| Discharge in m <sup>3</sup> /sec | 2.00    | 2.50     | 2.25     | 2.25    | 2.00     |

Calculate overall duty and depth of water used

- Q.2(a) Write short notes on the following: 3.00  
 (i) Duty of water (ii) Moisture holding capacity and (iii) Wilting Point.  
 (b) What do you understand by potential evapotranspiration? How does it differ from duty of water? Discuss. 4.00  
 (c) The gross area of an irrigation project is 50,000 hectare out of this about 500 hectare have been utilized for construction of dwelling, roads, bridges etc. The area is to be estimated during Rabi crops (ie. winter season) is 25000 hectare and during Kharif crops (ie. summer season) is 24000 hectare. The duty of canal water for Rabi crops is 5000 hectare per cumec and for Kharif crop is 3000 hectare per cumec. Find the discharge for canal after giving 10% allowance for peak discharge and loss of water in transit. What would be the annual intensity of irrigation? 5.00
- Q.3(a) Define NIR and CIR. 2.00  
 (b) What are the different forms of soil moisture? Show with diagram and describe them briefly. 3.00  
 (c) What do you mean by Duty? Enumerate the different ways by which duty can be improved. 3.00  
 (d) Find the field capacity of a soil for the following data: 4.00  
 Root zone depth = 2 m, Existing water content = 5%, Dry density of soil = 1.5 g/cm<sup>3</sup>, water applied to the soil = 500 m<sup>3</sup>, water lost due to evaporation and deep percolation = 10% and Area of plot = 1000 m<sup>2</sup>.
- Q.4(a) What do you mean by water logging? Discuss how water logged land becomes infertile 4.00  
 (b) What is saline and alkaline soil? What is the chemical added to the soil accomplish the exchange of sodium for other ions. 4.00  
 (c) What are the steps essential for land reclamation? For (i) Temporary control of salt (ii) Permanent reclamation of saline and alkaline land. 4.00

SECTION-B

- Q.5(a) Define flood. Describe the classification of flood. 3.00  
 (b) Distinguish between (i) Structural and Non-structural measure (ii) Borrow pit and Spoil Bank (iii) Berm and counter berm. 6.00  
 (c) Calculate the balancing depth for a channel section having a bed width equal to 18 m and side slopes of 1.5 H:1V in cutting and 2H:1V in filling. The bank embankments are kept 3 m higher than the berm level and crest width of banks is kept as 2 m. 3.00
- Q.6(a) Differentiate between Kennedy's theory and Lacey's theory. 3.00  
 (b) State and explain Kennedy's theory. Describe the design procedure of regime channel by adopting Kennedy's theory. 4.00  
 (c) Design a regime channel for a discharge of 50 cumecs and silt factor 1.1. Use Lacey's theory. 5.00
- Q.7(a) Explain the term 'Flood Management'. Describe the options for flood management. 4.00  
 (b) Write short notes on Flood forecasting and warning system. 3.00  
 (c) From the analysis of available data an annual flood peaks of a small stream for a period of 35 years, the 50 years and 100 years flood have been estimated to be 660 m<sup>3</sup>/sec, and 740 m<sup>3</sup>/sec. Using Gumbel's method, estimate the 200 years flood for the stream. Given  $n=35$  years,  $\bar{y}_n = 0.5403$  and  $\sigma_n = 1.12847$  5.00
- Q.8 (a) Differentiate between Flood Risk and flood vulnerability. 2.00  
 (b) What are the different methods of irrigations water assessment? Discuss any one among them. 3.00  
 (c) What are the methods that are used to estimate design flood? Describe rational method. 3.00  
 (d) Critically explain flood control economics. Describe the costs that are included in flood management. 4.00

Full Marks: 70

Time: 3 Hours

- N.B.:-
- (i) Answer SIX questions, taking THREE from each section. ---
  - (ii) Figure in the margin indicates full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data missing.

27  
**SECTION-A**

- Q.1(a) Define irrigation as science as well as engineering. What purposes are served by the application of water to the soil? 3.67 2
- (b) Write direct and indirect benefits of irrigation. 3.00 2
- (c) A loam soil has field capacity 25% and permanent wilting percentage 10%. The dry unit wt. of soil is  $14.72 \text{ kN/m}^3$  ( $1500 \text{ kg/m}^3$ ). If the depth of root zone is 0.75 m, determine the storage capacity of the soil. Irrigation water is applied when moisture content drops to 14%. If water application efficiency is 75%, determine the water depth required to be applied in the field. (5.00) 5+
- Q.2(a) Write short notes on (i) Water storage, efficiency, (ii) Net irrigation requirement (iii) Leaching requirement. 3.00 2
- (b) What is SAR? Discuss the effect of salts on plant growth. 4.67 3
- (c) The depths of penetration along the length of a border strip at points 30 m apart were probed. Their observed values are 1.9, 1.8, 1.5, 1.4, 1.3, and 1.2 meters. Compute the water distribution efficiency. (4.00) 4+
- Q.3(a) Define potential evapotranspiration. Do you agree that evapotranspiration and consumptive use are same if yes give reasons? 3.67
- (b) What are the different methods for determining consumptive use of crop? Describe the method of field experimental plots. 4.00
- (c) Determine consumptive use requirement for a certain crop with climate data given below. Also calculate field irrigation requirement if the water uses efficiency is 75%. Use Blaney Criddle method. 4.00

| Month     | Mean Monthly temp °C | Monthly % of day time hr. of the yr. | Monthly consumptive use co-eff. | Mean Monthly eff. rainfall |
|-----------|----------------------|--------------------------------------|---------------------------------|----------------------------|
| April     | 25                   | 8.6                                  | 0.60                            | -                          |
| May       | 27                   | 9.29                                 | 0.65                            | -                          |
| June      | 28                   | 9.18                                 | 0.70                            | 52.30                      |
| July      | 29                   | 9.39                                 | 0.75                            | 74.60                      |
| August    | 29                   | 9.04                                 | 0.75                            | 62.80                      |
| September | 27                   | 8.31                                 | 0.65                            | 31.20                      |
| October   | 24                   | 8.10                                 | 0.60                            | 25.30                      |

- Q.4(a) Define water logging. Write various measures for controlling water logging. 3.67 2
- (b) What are the manner according to which water is applied in the field? Write the objectives of irrigation depends in selecting the methods of irrigation. 3.00 2
- (c) Write the advantages of furrow irrigation. Determine the system capacity for a sprinkler irrigation system to irrigate 15 hectares of maize crop. The moisture use rate is 5 cm/day. Moisture replaced in soil at each irrigation is 60 mm. Irrigation efficiency is 70 percent. Irrigation period is 10 days in a 12 days interval. The system to be operated for 20 hours per day. (5.00) 1.5

29.5

SECTION-B

- 11
- Q.5(a) Explain the following terms with connected sediment transport phenomenon: (i) Suspended load 3.00 3  
(ii) Lacey's silt factor (iii) Threshold motion of the sediment.
- (b) Derive an expression for the average tractive force per unit of wetted area that is generated in a trapezoidal channel section of given R and S. 3.67 3.5
- (c) Design a channel using Lacey's theory to carry a discharge of 100 cumecs. Assume silt factor as 1.00. 5.00 5
- Q.6(a) State and explain Kennedy's theory. Describe the design procedure of regime channel by adopting Kennedy's theory. 3.67
- (b) "Channel improvement by deepening is preferred to widening" Explain briefly. 3.00
- (c) An irrigation channel having full supply level of 4 m above the existing ground level is provided with banks 3 m wide at top. The side slopes are 2H:1V and the slope of hydraulic gradient line through the base bank soil is 5H:1V. Assuming a free board of 1 m, a counter berm of 7 m wide and 2 m height is provided. Justify the suitability of counter berm for the safety of the canal banks. 5.00
- Q.7(a) Define flood. What are the causes of flood? 3.00 2
- (b) What do you mean by flood management? Mention the different option for flood management. 3.00 2
- (c) Write short notes on (i) Polder (ii) Dyke (iii) Flood bypass. 3.00 2
- (d) Differentiate between Risk and Vulnerability. 2.67 2
- Q.8(a) Write short notes on: (i) Maximum probable flood (ii) Design flood (iii) Return period. 3.00 3
- (b) Determine the percentage chance that a 25 year storm may occur  
(i) In the next 10 years  
(ii) In the next year itself  
(iii) May not occur in another 15 years. 3.00 2
- (c) From the analysis of available data on annual flood peaks of a small stream for a period of 35 years, the 50 years and 100 years flood have been estimated to be 660 m<sup>3</sup>/s and 740 m<sup>3</sup>/s using Gumbel's method. Estimate 200 year flood for the stream. Given for a record length of n = 35 years,  $\bar{y} = 0.54034$  and  $\sigma_{11} = 1.12847$ . 5.67 + 0.5

- N.B:- (i) Answer any SIX questions, taking THREE from each section.  
 (ii) Figure in the margin indicate full marks.  
 (iii) Use separate answer script for each section.  
 (iv) Assume reasonable value for any data missing.

SECTION-A

- Q.1 (a) What are the benefits and harmful effects of Irrigation? 3.00  
 (b) Write the advantages and disadvantages of lift and gravity Irrigation. 3.00  
 (c) Describe direct irrigation and irrigation reservoir scheme. Give necessary sketches. 2.67  
 (d) What are the indogenous methods of water lifting? Describe any one of them with sketches. 3.00  
 Q.2 (a) What are the different forms of soil water? Show them in case of sandy loam and silty loam soil with a diagram. 3.67  
 (b) What is duty of irrigation water? What points do you consider while determining the duty of irrigation water? 3.00  
 (c) To mature 5000 hectare of Robi crops, an irrigation canal was run as follows: 5.00
- | Month                            | Oct. | Nov. | Dec. | Jan. | Feb. |
|----------------------------------|------|------|------|------|------|
| No. of running days              | 14   | 28   | 21   | 21   | 14   |
| Discharge in m <sup>3</sup> /sec | 2.00 | 2.50 | 2.25 | 2.25 | 2.00 |
- Calculate overall duty and depth of water used.  
 Q.3 (a) How quality of irrigation water is analyzed? Give the classification of irrigation water and explain them. 2.00  
 (b) Distinguish between saline and alkaline soil and discuss how you will reclaim them? 2.67  
 (c) A stream of 125 lit/sec was delivered from a canal and 70 lit/sec were delivered to the field. An area of 1.6 hectare was irrigated in 8 hrs. The effective depth of root zone was 1.7 m. Runoff loss in the field was 420 cumec. The depth of water percolation varied linearly from 1.7 m at the head end to 1.3 m at the tail end of the field. Available moisture holding capacity of the soil is 20 cm depth of the soil. Determine water conveyance, applications, storage and distribution efficiency. The irrigation was started at a moisture extraction level of 50% of the available moisture. 5.00  
 (d) What do you know about water logging? Write the reasons for water logging. 2.00  
 Q.4 (a) Name the methods of distribution of irrigation water adopted for the following crops and describe them with sketches. 3.00  
 (i) Potato (ii) Orchard (iii) Paddy (in plane terrain).  
 (b) What methods of irrigation water distribution will you select where irrigation water is saline, scarcity of water is there and in hill tracts? Describe them briefly and give necessary sketches. 3.67  
 (c) Determine reservoir capacity for the following data: command area of a project = 40,000 hectares, canal losses = 10%, reservoir losses = 10%. Base period, outlet factor and intensity of irrigation are given in the following table: 5.00

| Crop       | Base period (days) | Outlet factor ha/cumec | Intensity of irrigation (%) |
|------------|--------------------|------------------------|-----------------------------|
| Cotton     | 180                | 1500                   | 10                          |
| Wheat      | 120                | 1800                   | 20                          |
| Sugarcane  | 360                | 1700                   | 20                          |
| Rice       | 120                | 700                    | 15                          |
| Vegetables | 120                | 700                    | 15                          |

SECTION-B

- Q.5 (a) What is the basis for design of regime channels? 3.00  
 (b) Compare briefly the silt theories of Kennedy and Lacey. Write the purposes that are served by fully formed berms. 6.00  
 (c) The following data refer to an irrigation canal: Bed width = 1.0 m, Side slopes = 2H:1V (in filling) and 1H:1V (in cutting), Top width of embankment on either side of canal = 3 m, Fully supply depth = 5 m, free board = 1 m. Determine the balancing depth. Draw a neat cross-section of the canal illustrating the various dimensions and the levels. 2.67  
 Q.6 (a) Distinguish between (i) Suspended load and bed load, (ii) Initial regime and final regime, (iii) Berm and counter berm, (iv) Borrow pit and spoil bank. 6.00  
 (b) An area of 50 x 10<sup>3</sup> ha has to be irrigated by a canal for growing wheat, water requirement for which is 10 cm per month. Design and draw a suitable canal section with the data given below: Mean slope of the ground = 1 in 3500, Manning's roughness coefficient, n = 0.025, Side slopes = 1:1, use Kennedy's formula. 5.67  
 Q.7 (a) Define flood. Describe natural and human related causes of flood in Bangladesh. 4.00  
 (b) Define flood management. Write short notes on the following flood management measures with suitable figures: (i) Storage reservoirs (ii) Watershed management (iii) Flood plain zoning (iv) Floodways. 4.00  
 (c) Critically explain flood control economics. Describe the costs that are included in flood management. 3.67  
 Q.8 (a) Write short notes on: (i) Maximum probable flood (ii) Design flood (iii) Return period. 3.00  
 (b) What are the methods that are used to estimate design flood? Describe rational method for estimation of design flood. 2.67  
 (c) "Channel improvement by deepening is preferred to widening". Explain briefly. 2.00  
 (d) The analysis of a 30 year flood data at a point on a river yielded  $x = 1200$  m<sup>3</sup>/sec and  $S_x = 650$  m<sup>3</sup>/sec. For what discharge would you design the structure at this point to provide 95% assurance that the structure would not fail in the next 100 years? The values of  $y_n$  and  $\sigma_n$  for a record length of n years are given below: 4.00

| n   | $y_n$   | $\sigma_n$ |
|-----|---------|------------|
| 30  | 0.53622 | 1.11238    |
| 35  | 0.54034 | 1.12817    |
| 50  | 0.54851 | 1.16066    |
| 100 | 0.56002 | 1.20649    |

**CE 421**  
**Irrigation and Flood Engineering**

Full marks: 70

Time: 3 Hours

- N.B:-
- (i) Answer any SIX questions, taking THREE from each section.
  - (ii) Figure in the margin indicate full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data missing.

**SECTION-A**

- Q.1 (a) Write scopes of irrigation. Describe engineering scope of irrigation. 3.00
- (b) Loam is the ideal soil for irrigation-why? Discuss the statement. 3.00
- (c) What are the purposes served by irrigation water? Write briefly. 2.00
- (d) Find Field Capacity of a soil for the following data: 3.00  
Depth of root zone = 2 m, Existing water content = 5%, Dry density of soil =  $1500 \text{ kg/m}^3$ , Water applied to the soil =  $600 \text{ m}^3$ , Water lost due to evaporation and deep percolation = 10%, and Area of land irrigated =  $900 \text{ m}^2$ .
- Q.2 (a) What are the different forms of soil moisture? Show with diagram and describe them briefly. 3.00
- (b) What do you know by Duty of water? How duty of water can be improved, describe briefly. 2.00
- (c) What do you mean by optimum utilization of irrigation water and water distribution efficiency? 2.00
- (d) The given area of an irrigation project is 50,000 hectre. Out of this about 5,000 hectre have been utilized for construction of dwellings, roads, bridges etc. The area to be cultivated during robi (in winter season) is 25,000 ha and during kharif (in summer season) is 24,000 hectre. The duty of land water for robi crops is 5,000 hectre per cumec and for kharif crop is 3,000 hectre per cumec. Find the design discharge for canal after giving 10% allowance for peak discharge and loss water in transit. What would be the annual intensity of irrigation? 4.00
- Q.3 (a) What is furrow irrigation? Show with diagram and write its advantages and disadvantages. 2.00
- (b) What are water lifting devices for low lift and without using any power or machineries. Describe any one devices with diagram. 3.00
- (c) Describe trickle method of irrigation. What are the advantages and disadvantages of using this method in Bangladesh. 3.00
- (d) Depth of penetration along the length of a border stop at point 30 m apart are proved. Their observed values are 1.9, 1.8, 1.5, 1.4, 1.3 and 1.2 meters. Compute water distribution efficiency and comment on the results. 3.00
- Q.4 (a) What is meant by water logging? What are the causes of water logging? What steps will you take to improve an already water logged tract? 3.00
- (b) What do you mean by  $C_2$ - $S_2$  water? Discuss its usefulness for irrigating fine textured soil. 3.00
- (c) What is meant by saline and alkaline soil? How you will proceed to reclaim saline land. 2.00
- (d) Estimate the leaching requirement when EC of saturation extract of the soil is  $11 \text{ mmol/cm}$  at 25% reduction in the yield of cotton. EC of irrigation water is  $1.5 \text{ mmol/cm}$ . 3.00

**SECTION-B**

- Q.5 (a) State and explain Kennedy's theory. Describe the design procedure of regime channel by adopting Kennedy's theory. 4.00
- (b) "Channel improvement by deepening is preferred to widening"- explain by comparing two channel sections after improvement. 3.00
- (c) An irrigation channel having a full supply level of 4 m above the existing ground level is provided with banks 3 m wide at top. The side slopes are 2H:1V; and the slope of hydraulic gradient line through the bank soil is 5H:1V. Assuming a free board of 1 m, a counter berm of 7 m wide and 2 m height is provided. Justify the suitability of counter berm for the safety of the channel banks. 4.00

- Q.6 (a) Write the name of the methods for the assessment of irrigation water supply. Compare area method with the volumetric method assessment of irrigation water supply. 4.00
- (b) Write short notes on: (i) Berms, (ii) Borrow pits, (iii) Counter berms and (iv) Balancing depth. Give suitable diagrams. 4.00
- (c) Design and draw a suitable regime channel section for a discharge of 55 cumecs and silt factor 1.2, using Lacey's theory. 2.00
- Q.7 (a) What are the causes of flood? Describe them in light of flood in Bangladesh. 2.00
- (b) Describe the importance of sediment transport in designing earthen irrigation canals. 2.00
- (c) Write a short note on flood forecasting and warning system. 2.67
- (d) Given below is the information regarding flood stage, recurrence interval, total damage and cost of project for giving protection against indicated stage. Work out the benefit-cost ratio and net benefit (i.e benefit-cost). What is the peak stage against which you would choose to provide protection? 5.00

| Peak Stage (m) | Total damage under indicated stage (Tk. in millions) | Return Period (yr) | Annual project cost (Tk. in millions) |
|----------------|--|--------------------|---------------------------------------|
| 9              | 0  | 7                  | 0.8                                   |
| 10             | 8  | 10                 | 1.2                                   |
| 11             | 20   | 15                 | 1.6                                   |
| 12             | 40   | 22                 | 2.0                                   |
| 13             | 64   | 30                 | 2.6                                   |
| 14             | 90   | 70                 | 3.2                                   |
| 15             | 120  | 150                | 3.6                                   |
| 16             | 160  | 300                | 4.0                                   |

- Q.8 (a) Explain the direct and indirect benefits of flood management. 2.00
- (b) Write down the procedure to estimate the design flood for any return period using Gumbel's distribution. 2.67
- (c) Describe briefly the structural measures for flood management. 3.00
- (d) Based on analysis of 30 years data on annual floods, which gave a mean of 1200 m<sup>3</sup>/s and standard deviation of 575 m<sup>3</sup>/s, a structure with a useful life period of 50 years was designed for a flood of 3000 m<sup>3</sup>/s. What is the risk involved in the design? Later it was found that there was an error in the computation of statistics and the correct mean and correct standard deviation were estimated as 1075 m<sup>3</sup>/s and 500 m<sup>3</sup>/s respectively. Determine the corresponding reduction in the risk. Use Gumbel's method. Given, for  $n = 30$ ,  $\bar{y}_n = 0.53622$  and  $\sigma_n = 1.11238$ . 4.00
- \*\*\*

08-17-11 (2013)  
 Tuesday  
 10:00 AM to 1:00 PM

Heaven's light is our Guide  
**DEPARTMENT OF CIVIL ENGINEERING**  
**RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY**  
 B.Sc. Engineering **FOURTH** year **SEVENTH SEMESTER** Examination, 2013

**CE 421**  
**Irrigation and Flood Engineering**

**Full Marks: 70**

**Time: 3 Hours**

- N.B.:-**
- (i) Answer **SIX** questions, taking **THREE** from each section.
  - (ii) Figure in the margin indicates full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data not given.

**SECTION-A**

- Q.1(a)** Explain the necessity of irrigation in a tropical country like Bangladesh. Compare inundation irrigation with perennial irrigation. 3.67
- (b)** Write short notes on the following: (i) Field capacity, (ii) Wilting coefficient, and (iii) Moisture holding capacity of a soil. 3.00
- (c)** Determine reservoir capacity for the following data; Command area of a project = 40,000 hectares, Canal losses = 10%, Reservoir losses = 10%. 5.00

Base period, Outlet factor and Intensity of irrigation are given in the following table:

| Crop       | Base period (days) | Outlet factor (ha/Cumec) | Intensity of irrigation (%) |
|------------|--------------------|--------------------------|-----------------------------|
| Sugar cane | 360                | 1700                     | 20                          |
| Cotton     | 180                | 1500                     | 10                          |
| Wheat      | 120                | 1800                     | 20                          |
| Rice       | 120                | 700                      | 15                          |
| Vegetables | 120                | 700                      | 15                          |

- Q.2(a)** What is meant by 'Duty'? Enumerate the different terms by which duty can be improved. 3.67
- (b)** What are the methods used for estimating consumptive use of water for a particular crop at a particular place? Explain in details the one which is most widely used in our country and the reasons for preferring that particular method. 5.00
- (c)** If wheat requires about 9.5 cm of water after every 30 days, and the base period for wheat is 150 days, find out the value of duty and delta for wheat. 3.00

- Q.3(a)** What are the different methods of assessment of irrigation water? Which method do you think best and why? 2.00
- (b)** Write short notes on the following, give suitable sketches with each of them. (i) Berm in the canal, (ii) Balancing depth, (iii) Borrow pit in canal construction. 4.67
- (c)** Determine the uniformity coefficient from the following data obtained from a field test on a square plot bounded by four sprinklers. Sprinkler - 4.365 x 2.381 mm nozzles at 2.8 kg/cm<sup>2</sup>. 5.00

Spacing - 24 m x 24 m, Wind - 3.5 km/hr from South-west, Humidity - 42%. Time of test - 1.0 hour.

|     |     |     |      |     |
|-----|-----|-----|------|-----|
| S   | 8.9 | 7.6 | 6.6  | S   |
| 8.1 | 7.6 | 9.9 | 10.2 | 8.3 |
| 8.9 | 9.1 | 9.1 | 9.4  | 8.9 |
| 9.4 | 7.9 | 9.1 | 8.6  | 9.1 |
| S   | 7.9 | 6.6 | 6.8  | S   |

S indicates location of sprinklers.

- Q.4(a)** Enumerate the conditions which are favorable for the adoption of sprinkler irrigation. 3.00
- (b)** Draw neat sketches to illustrate the following methods: (i) Furrow irrigation, (ii) Free flooding, (iii) Check flooding. State under what circumstances you will recommend their use. 5.67
- (c)** Estimate the leaching requirement when EC of the saturation extract of the soil is 11 mmhos/cm at 25% reduction in the yield of cotton. EC of the irrigation water is 1.5 mmhos/cm. 3.00

**SECTION-B**

- Q.5(a) What are the various methods employed for the management of floods and for reducing the damage caused by them. 4.00
- (b) Explain the direct and indirect tangible losses due to floods. 3.67
- (c) A catchment is divided into five sub-areas as given below: 4.00
- |                              |     |     |     |      |     |
|------------------------------|-----|-----|-----|------|-----|
| Sub-area (km <sup>2</sup> ): | 1.5 | 3.0 | 2.0 | 1.0  | 2.5 |
| Runoff coefficient, c:       | 0.7 | 0.6 | 0.4 | 0.55 | 0.9 |
- Calculate the 25 years flood using the rational method. Assume a concentration time of 35 minutes and use the following intensity-frequency duration function  $I = \frac{75T_r^{0.22}}{(t+12)^{0.85}}$
- Q.6(a) Explain what do you understand by the return period? Give few formula which are used to determine the return period. 3.67
- (b) How do you justify the Gumbels extreme value distribution to describe the annual peak flood discharge? 3.00
- (c) Annual peak flood discharges recorded at a stream gauging site for 19 years during the period 1951 to 1979 in m<sup>3</sup>/s are given below: 3950, 6190, 7660, 4220, 2820, 5600, 7050, 5280, 5200, 4360, 6970, 6240, 4960, 5890, 5980, 3590, 6860, 7210, 5270. Construct the frequency curve and hence find the flood peak with a return period of 50 years and 100 years. 5.00
- Q.7(a) Describe different indirect protection methods used to protect the embankment of a river. 3.00
- (b) Write short notes on: (i) Alluvial canal and non-alluvial canal, (ii) Initial regime and final regime. 3.67
- (c) Design a regime channel for a discharge of 50 cumecs and silt factor 1.1, using Lacey's theory. 5.00
- Q.8(a) What are the causes of flood? Describe them in the light of flood in Bangladesh. 3.00
- (b) Write short note on the following: (i) Flood forecasting and warning, (ii) Flood control by the construction of Levees. 3.00
- (c) Given the following inflow hydrograph to a certain stream channel reach. Calculate outflow by the Muskingum method. 5.67

|                             |    |    |    |    |     |     |     |    |    |    |    |    |    |
|-----------------------------|----|----|----|----|-----|-----|-----|----|----|----|----|----|----|
| Time in hr.                 | 0  | 1  | 2  | 3  | 4   | 5   | 6   | 7  | 8  | 9  | 10 | 11 | 12 |
| Inflow in m <sup>3</sup> /s | 10 | 20 | 40 | 80 | 120 | 150 | 120 | 60 | 50 | 40 | 30 | 20 | 10 |

Assume initial inflow as 10 m<sup>3</sup>/s and K = 4 hr and X = 0.25.

-----O-----

THE END

- N.B.:-
- (i) Answer SIX questions, taking THREE from each section.
  - (ii) Figure in the margin indicates full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data not given.

**SECTION-A**

- Q.1(a) Define irrigation. Describe briefly the scope of irrigation. 3.00
- (2) (b) Compare well irrigation and canal irrigation. 2.67
- (c) Discuss the effect of soil texture and soil structure on the soil moisture content. 3.00
- (d) What is meant by crop-rotation? Write the advantages of crop-rotations. 3.00
- Q.2(a) What are water balance parameters? Describe briefly the water balance formulae for crop water requirement. 3.67
- (b) Write six numbers of factors affecting consumptive use of irrigation water. 3.00
- (c) Following data refers to an agricultural land growing rice:
- (i) Period growth = 16th July to 31st July
  - (ii) USBR class A pan evaporation = 6 mm/day.
  - (iii) Crop coefficient (crop index)  $K = 1.20$
  - (iv) Evaporation loss = 5 mm/day
  - (v) Effective rainfall during the period = 60 mm
- Calculate the value of NIR, FIR and GIR. Assume 20% loss of water in application and 25% in conveyance.
- Q.3(a) According to Dorenbos and Pruitt what are the limitations of Blaney Criddle formula for estimating consumptive use of water? 3.00
- (b) To mature 5000 hectares of Rabi crops an irrigation canal was run as follows: 5.00
- | Month                  | Oct. | Nov. | Dec. | Jan. | Feb. |
|------------------------|------|------|------|------|------|
| Number of running days | 14   | 28   | 21   | 21   | 14   |
| Discharge in $m^3/sec$ | 2.00 | 2.50 | 2.25 | 2.25 | 2.00 |
- Calculate overall duty and depth of water used.
- (c) What are the various methods of assessment of irrigation water? Describe the volumetric method of assessment and write which of the method is most economical and why? 3.67
- Q.4(a) Write short notes on: i) Water storage efficiency ii) Net irrigation requirement iii) Leaching requirement. 3.00
- (2) (b) What is SAR? Discuss the effects of salts on plant growth. 4.67
- (c) The depths of penetrations along the length of a border strip at points 30 m apart were probed. Their observed values are 1.9, 1.8, 1.5, 1.4, 1.3 and 1.2 meters. Compute the water distribution efficiency. 4.00

**SECTION-B**

- Q.5(a) Differentiate between 'Initial regime' and 'Final regime'. 2.00
- (b) Enumerate the two recognized silt theories. Explain how one theory is an improvement over the other. 4.67
- (c) Design an irrigation channel to carry 40 cumecs of discharge, with B/D, i.e. base width to depth ratio as 2.5. The critical velocity ratio is 1.0. Assume Kutter's rugosity coefficient of as 0.023 and use Kennedy's method. 5.00

Q.6(a) Write short notes on the followings:

- R → (i) Flood plain zoning (ii) Flood proofing (iii) Emergency evacuation.

(b) What is meant by 75% dependable value of a random variable? How is it obtained from frequency analysis?

(c) Based on analysis of 30 year data on annual floods, which gives a mean of 1200 m<sup>3</sup>/s and standard deviation of 575 m<sup>3</sup>/s, a structure with useful life period 50 years, was designed for a flood of 3000 m<sup>3</sup>/s, what is the risk involved in the design? Later it was found that there was an error in the computation of statistics and the correct mean and correct standard deviation were estimated as 1075 m<sup>3</sup>/s and 500 m<sup>3</sup>/s respectively. Determine the corresponding reduction in the risk. Use Gumbel method. Given for n = 30,  $\bar{p}_n = 0.53622$ ,  $\sigma_n = 1.11238$ .

Q.7(a) What are the causes of bank recession? What are the different types of bank protection? Briefly explain the indirect bank protection techniques.

(b) Discuss briefly the tangible and intangible benefits of flood.

R-483 → (c) An engineer is required to design a drainage system for an airport with an area of 2.5 km<sup>2</sup> for a 50 year return period. The 50 year rainfall intensity in that region is given by  $I = \frac{35}{(t+10)^{0.15}}$  where I is intensity in cm/hr and t is the duration in minutes.

If the concentration time for the area is estimated as 50 minutes, for what discharge the system must be designed?

Q.8(a) Enumerate the name of different institutions responsible for flood management of Bangladesh and briefly discuss their responsibility.

(b) Write a short note on flood forecasting and warning system.

(c) Given below is the information regarding flood stage, recurrence interval, total damage and cost of project for giving protection against indicated stage. Work out the benefit-cost ratio and net benefit (i.e. benefit - cost). What is the peak stage against which you would choose to provide protection?

| Peak stage (m) | Total damage below indicated stage (Tk. in millions) | Return period (years) | Annual cost of project (Tk. in millions) |
|----------------|--|-----------------------|--|
| 9              | 0  | 7                     | 0.8                                      |
| 10             | 8  | 10                    | 1.2                                      |
| 11             | 20   | 15                    | 1.6                                      |
| 12             | 40   | 22                    | 2.0                                      |
| 13             | 64   | 30                    | 2.6                                      |
| 14             | 90   | 70                    | 3.2                                      |
| 15             | 120  | 150                   | 3.6                                      |
| 16             | 160  | 300                   | 4.0                                      |

**CE 421**  
**Irrigation and Flood Engineering**

Full Marks: 70

Time: 3 Hours

- I.B.:**
- (i) Answer SIX questions, taking THREE from each section.
  - (ii) Figure in the margin indicates full marks.
  - (iii) Use separate answer-script for each section.
  - (iv) Assume reasonable value for any missing data.

**SECTION - A**

- Q.1(a) What do you mean by the term Irrigation? Explain the necessity of irrigation in arid country. 3.00
- (b) Well irrigation is an anti-water logging measure. Explain. 3.00
- (c) Lift irrigation is a costly system of irrigation. Explain. Discuss the salient features of lift irrigation. (Compare lift irrigation and gravity irrigation.) 5.67
- Q.2(a) What is meant by interference between tube wells? What is the ideal distance between two adjacent tube wells? 3.00
- (b) How will you determine the yield of tube well? 3.67
- (c) A tube well is driven in a confined aquifer of 30m thickness. The aquifer is 25m below ground level. The static water table is 15m below ground level. The discharge of the tube well is found to be 800 l/m<sup>2</sup>/day. When the drawdown head is 12.25m permeability is 21.5 m/day. Find the diameter of the tube well if radius of influence is 300m. 5.00
- Q.3(a) What is permeability? Why is it necessary that a good irrigation soil be permeable? How is permeability determined? 3.00
- (b) Write brief notes on the following - 3.67
- (i) Soil texture and soil structure
  - (ii) Field capacity
  - (iii) Wilting point
  - (iv) Efficiency
- (c) Compute the depth and necessity of irrigation required for a certain crop with the data given below:  
 Root zone depth = 100 cm, Field capacity = 22%, Wilting point = 12%, Apparent sp. gravity of soil = 1.50 gm/cc,  
 Consumptive use = 25 mm/day, Efficiency of irrigation = 50%.  
 Assume 50% depletion of available moisture before application of irrigation water at field capacity. 5.67
- Q.4(a) The culturable command area for a reservoir is 60,000 hectares. Find out the reservoir capacity if canal losses are 7.5%, reservoir loss 10.50% and other data are given below: 6.00

| Crop      | Base Period (days) | Data (ccm/sec) | Irrigation Intensity (c/e) |
|-----------|--------------------|----------------|----------------------------|
| Rice      | 130                | 1000           | 10                         |
| Wheat     | 120                | 2400           | 15                         |
| Cotton    | 180                | 1800           | 12                         |
| Sugarcane | 360                | 3000           | 18                         |

- (b) Why is it necessary to collect the charges for irrigation water supplied to the cultivator? Explain. 2.67
- (c) What do you mean by Flood Control, Flood Mitigation, Flood Management or Flood Protection? Explain. 3.00

**SECTION - B**

- Q.5(a) What is meant by "Saline" and "Alkaline" soils? How will you proceed to reclaim saline sand? 4.67
- (b) What are the principal causes of water-logging in a canal irrigation tract? 3.00
- (c) A field channel has a culturable command area of 2000 hectares. The intensity of irrigation for gram is 30% and for wheat is 50%. Gram has a crop period of 18 days and Kor depth of 12 cm, while wheat has a Kor period of 15 days and a Kor depth of 15 cm. Calculate the discharge of the field channel. 4.00
- Q.6(a) What is meant by design flood? What is its importance? 3.00
- (b) What are the types of flood? Describe them in the light of flood in Bangladesh. 3.67
- (c) The analysis of a 30 year flood data at a point on a river yielded  $V = 1200$  m<sup>3</sup>/sec and  $S_v = 650$  m<sup>3</sup>/sec. For what discharge would you design the structure at this point to provide 95% assurance that the structure would not fail in the next 50 year? From table of  $n = 30$  years,  $S_{95} = 0.51622$  and  $S_{99} = 1.1218$ . 5.00
- Q.7(a) Briefly discuss about the flood management and mitigation strategies of Bangladesh. 3.00
- (b) Enumerate the name of different institutions responsible for flood management in Bangladesh. Discuss their responsibilities. 3.67
- (c) The unit hydrograph of a basin may be approximated as a triangle with a base period of 48h and a peak discharge of 900 m<sup>3</sup>/s at the end of 12h. The design storm is having a total duration of 12h with rainfall intensities of 2.5 cm/h, 4 cm/h and 3 cm/h in three successive 4h period. Determine the design flood discharge and its time of occurrence. Assume that the basin is completely saturated before the occurrence of design storm. 5.00
- Q.8(a) What are the requirements for the success of an irrigation project? How do you estimate a project planned? 3.00
- (b) Compare briefly the silt theories of Lacey and Kennedy. 3.67
- (c) Design an irrigation channel to carry 10 cumecs at a slope of 1 in 5000 with  $f = 0.0225$  (Manning's) and Kennedy's. 3.00