

# Techno India NJR Institute of Technology



## Course File

### Water Resources Engineering (5CE4-05)

For Techno India NJR Institute of Technology  
पंकज पौरवाल  
Dr. Pankaj Kumar Perwal  
(Principal)

Jitendra Choubisa  
(Assistant Professor)  
Department of CE



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## Syllabus

3<sup>rd</sup> Year - V Semester: B.Tech. (Civil Engineering)

### SCE4-05: WATER RESOURCE ENGINEERING

Credit: 2

Max. Marks: 100(IA:20, ETE:80)

2L+0T+0P

End Term Exam: 2 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	<b>Introduction:</b> Definitions, functions and advantages of irrigation, present status of irrigation in India, classification for agriculture, soil moisture and crop water relations, Irrigation water quality. Consumptive use of water, principal Indian crop seasons and water requirements.	5
3	<b>Canal Irrigation:</b> Types of canals, design of channels, regime and semi theoretical approaches (Kennedy's Theory, Lacey's Theory) <b>Diversion Head works:</b> Design for surface and subsurface flows, Bligh's and Khosla's methods.	6
4	<b>Embankment Dams:</b> Suitable sites, causes of failures, stability and seepage analysis, flow net, principles of design of earth dams. <b>Gravity Dams:</b> Force acting on a gravity dam, stability requirements.	5
5	<b>Well Irrigation:</b> Open wells and tube wells, types of tube wells, duty of tube well water. <b>Cross-Drainage Structure:</b> Necessity of Cross-drainage structures, their types and selection, comparative merits and demerits.	5
6	<b>Hydrology:</b> Definition, Hydrologic cycle, measurement of rainfall, Flood hydrograph, Rainfall analysis, Infiltration, Run off, Unit hydrograph and its determination.	6
		<b>28</b>

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Office of Dean Academic Affairs  
Rajasthan Technical University, Kota

## Course Overview:

Water resources engineering is the quantitative study of the hydrologic cycle -- the distribution and circulation of water linking the earth's atmosphere, land and oceans. Surface runoff is measured as the difference between precipitation and abstractions, such as infiltration (which replenishes groundwater flow), surface storage and evaporation. Applications include the management of the urban water supply, the design of urban storm-sewer systems, and flood forecasting. Hydraulic engineering consists of the application of fluid mechanics to water flowing in an isolated environment (pipe, pump) or in an open channel (river, lake, and ocean). Civil engineers are primarily concerned with open channel flow, which is governed by the interdependent interaction between the water and the channel.

After studying Water Engineering, graduates can work as a Water Resource Engineer, Environmental Engineer, Hydrologist/ Hydrological Engineer, Sustainability Engineer/ Sustainable Energy Technologist, Environmental Protection Specialist, etc and can earn around INR 4 LPA to INR 6 LPA. Their salary will increase gradually as per the experience they gather throughout the duration of B.Tech Water Resource Engineering course.

## Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Comprehension	Students will be able to Understand the basics of Hydrograph, rainfall analysis and its distribution.
2	Analysis	Student will learn to analyse the rainfall patterns and can evaluate the same with probabilistic methods.
3	Synthesis	Students be able to design the channels on the basis of Kennedy's theory and Lacey's theory.
4	Synthesis	Students will be able to generate designs and layout of canal according to the use.
5	Synthesis	Students be able to differentiate between types of canals and canal headworks.

## Prerequisites:

- Students with basic knowledge of mathematical geometry can understand the topics clearly.
- Students with understanding of basic physics principle can grasp the topics of this course.
- Students with a basic calculation methodologies can perform surveying calculations.

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## Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
	CO. NO.	Domain Specific (PSO)					Domain Independent (PO)					
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	2	2	1	1	1	2	3
CO2	3	2	2	3	2	1	2	1	1	1	1	1
CO3	3	2	2	2	2	1	1	1	2	1	1	2

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

## Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	1	<b>INTRODUCTION:</b> Objective, scope and outcome of the course
2	2	<b>INTRODUCTION: DEFINITIONS,</b> functions and advantages of irrigation, Present status of irrigation in India
3	2	Classification for agriculture, soil moisture and crop water relations
4	2	Irrigation water quality. Consumptive use of water
5	2	Principal Indian crop seasons and water requirements
6	3	<b>CANAL IRRIGATION:</b> Types of canals, design of channels
7	3	Regime and semi theoretical approaches (Kennedy's Theory, Lacey's Theory)
8	3	Diversion Head works: Design for surface and subsurface flows
9	3	Bligh's and Khosla's methods
10	4	<b>EMBANKMENT DAMS:</b> Suitable sites
11	4	Causes of failures, stability and seepage analysis
12	4	Flow net, principles of design of earth dams
13	4	Gravity Dams: Force acting on a gravity dam, stability requirements
14	5	<b>WELL IRRIGATION:</b> Open wells and tube wells
15	5	Types of tube wells, duty of tube well water
16	5	Cross-Drainage Structure: Necessity of Cross drainage structures, their types and
17	5	Comparative merits and demerits
18	6	<b>HYDROLOGY:</b> Definition, hydrologic cycle

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19	6	Measurement of rainfall, Flood hydrograph
20	6	Flood hydrograph
21	6	Rainfall analysis, Infiltration
22	6	Run off
22	6	Unit hydrograph and its determination
23	6	Unit hydrograph and its determination
24		Revision to coursework
25		Revision to coursework
26		Revision to coursework
27		Revision to coursework
28		Revision to coursework

### TEXT/REFERENCE BOOKS

1. Irrigation Water Power and Water Resource Engineering by KR Arora, Standard Publishers and Distributors, Delhi.
2. Water Resource Engineering by Modi, Standard Publishers.
3. Irrigation and Water Power Engineering by BC Punmia & B B Lal, Laxmi Publication (P) Ltd.
4. Irrigation Engineering by G.L. Asawa, New Age International Publishers, New Delhi.

### Course Level Problems (Test Items):

CO.NO.	Problem description
1	A. Explain the types of canal system used in irrigation. B. Discuss the importance of hydrological cycle. C. Explain the use of rain gauges.
2	A. Write and explain principles of infiltration and runoff B. Explain the methods of irrigation.
3	A. Explain the types of irrigation systems used in India B. State the types of canal headworks.

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## **Assessment Methodology:**

1. Practical exam in lab where they have to analyze the problem statement. (Once in a week)
2. Assignments one from each unit.
3. Midterm subjective paper based on topics as mentioned in the modules. (Twice during the semester)
4. Final paper at the end of the semester subjective.

## **TEACHING AND LEARNING RESOURCES UNIT-WISE**

All the Water resources engineering notes/study material can be found on below link:

<https://engineeringonline.ucr.edu/blog/what-is-water-resources-engineering/>

<https://nptel.ac.in/courses/105/104/105104103/>

<https://www.youtube.com/watch?v=GjwrU4hYpCE&list=PLbMVogVj5nJRIPjxn3dPWPwOeKC927qZf>

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**Techno India NJR Institute of Technology**  
**Academic Administration of Techno NJR Institute**  
**Syllabus Deployment**

Name of Faculty	: Mr. Jitendra Choubisa	Subject Code: 5CE4-05
Subject	: Water Resources Engineering	
Department	: Civil Engineering	Sem: V
Total No. of Lectures Planned: 28		

**COURSE OUTCOMES HERE (3 OUTCOMES)**

At the end of this course students will be able to:

CO1. Calculate the components of hydrological cycle.

CO2. Apply the basis knowledge in design dam.

CO3. Do flood frequency analysis and flood routine.

Lecture No.	Unit	Topic
1	1	<b>INTRODUCTION:</b> Objective, scope and outcome of the course
2	2	<b>INTRODUCTION: DEFINITIONS,</b> functions and advantages of irrigation, Present status of irrigation in India
3	2	Classification for agriculture, soil moisture and crop water relations
4	2	Irrigation water quality. Consumptive use of water
5	2	Principal Indian crop seasons and water requirements
6	3	<b>CANAL IRRIGATION:</b> Types of canals, design of channels
7	3	Regime and semi theoretical approaches (Kennedy's Theory, Lacey's Theory)
8	3	Diversion Head works: Design for surface and subsurface flows
9	3	Bligh's and Khosla's methods
10	4	<b>EMBANKMENT DAMS:</b> Suitable sites
11	4	Causes of failure of embankment dams and seepage analysis
12	4	Flow net, principles of design of earth dams

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13	4	Gravity Dams: Force acting on a gravity dam, stability requirements
14	5	<b>WELL IRRIGATION:</b> Open wells and tube wells
15	5	Types of tube wells, duty of tube well water
16	5	Cross-Drainage Structure: Necessity of Cross drainage structures, their types and selection
17	5	Comparative merits and demerits
18	6	<b>HYDROLOGY:</b> Definition, Hydrologic cycle
19	6	Measurement of rainfall, Flood hydrograph
20	6	Flood hydrograph
21	6	Rainfall analysis, Infiltration
22	6	Run off
22	6	Unit hydrograph and its determination
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# Techno India NJR Institute of Technology

## Academic Administration of Techno NJR Institute

### Syllabus Deployment

Name of Faculty : Mr. Jitendra Choubisa Subject Code: 5CE4-23  
Subject : Water Resource Engineering Design  
Department : Civil Engineering Sem: V  
Total No. of Lectures Planned: 10

#### COURSE OUTCOMES HERE (3 OUTCOMES)

At the end of this course students will be able to:

CO1. Able to impart a knowledge of Design & Analysis of water harvesting and conservation structure.

CO2. Able to impart a knowledge of Design & Analysis of river training & bank protection works

CO3. To understand an estimation and analysis of run off, unit hydrograph, flood hydrograph

Lecture No.	Practical	Topic
1	1	Irrigation water quality. Consumptive use of water
2	2	Irrigation water quality. Consumptive use of water
3	3	Design for surface and subsurface flows
4	4	Design for surface and subsurface flows
5	5	Kennedy's Theory, Lacey's Theory)
6	6	stability and seepage analysis
7	7	stability and seepage analysis
8	8	Gravity Dams: Force acting on a gravity dam, stability requirements
9	9	Gravity Dams: Force acting on a gravity dam, stability requirements
10	10	Infiltration, Run off

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<b>7E7061</b>	Roll No. _____	Total No of Pages: <b>4</b>
	<b>7E7061</b> <b>B. Tech. VII Sem. (Main) Exam., Nov.-Dec.-2016</b> <b>Civil Engineering</b> <b>7CE1A Water Resources Engineering - I</b>	

Time: 3 Hours

Maximum Marks: 80

Min. Passing Marks Main: 26

Min. Passing Marks Back: 24

Instructions to Candidates:

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)

1. NIL

2. NIL

### UNIT - I

Q.1 (a) Define the following terms: [8]

- (i) Water conveyance efficiency
- (ii) Consumptive irrigation requirements
- (iii) Irrigation efficiencies
- (iv) Consumptive use of water

(b) The base period, intensity of irrigation and duty of various crop under a canal system are given in the table below. Find the reservoir capacity if the canal losses are 15% and the reservoir losses are 11%. [8]

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Crops	Base period (days)	Duty at the field (ha/cumecs)	Area under the crop (hectares)
Wheat	120	1600	4400
Sugar cane	340	900	5800
Cotton	180	1400	2400
Rice	120	900	3200
Vegetables	120	700	1400

**OR**

- Q.1 (a) Define irrigation. Discuss in brief the benefits and ill effects of irrigation. [8]
- (b) Write short notes on the following: [8]
- Contour farming
  - Border strip method
  - Free flooding
  - Zig – Zag method

**UNIT – II**

- Q.2 (a) Design an irrigation channel to carry a discharge of  $50\text{m}^3/\text{s}$  by Kennedy's theory. Assume  $m = 1.0$ ,  $N = 0.025$  and slope of channel as 1 in 5000. [8]
- (b) What are Lacey's basic regime equations? Starting from these equations, derive the equations for: [8]
- Wetted perimeter
  - Hydraulic radius
  - Bed slope.

**OR**

- Q.2 (a) Write short notes on the following:- [8]
- Role of command area development
  - Estimation of channel losses
  - Khasra bandi and Jamabandi
  - Silt control in canals

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- (b) Compare Kennedy's and Lacey's silt theories. Why is Lacey's conception superior to that of Kennedy's? [8]

### UNIT - III

- Q.3 (a) Describe the functions of a distributor head regulator and cross regulator. [8]  
(b) What do you understand by non - modular, semi - modular and rigid module outlets? [8]

OR

- Q.3 (a) What is an outlet? Define proportionality and sensitivity of outlet. Find a relationship between sensitivity and flexibility of an outlet. [8]  
(b) Describe the objectives of river training and also describe various types of river training works. [8]

### UNIT - IV

- Q.4 (a) Describe the various measures for prevention of water logging. [8]  
(b) Describe various types of lining. [8]

OR

- Q.4 (a) What are saline, saline - alkali and alkali soils? Explain how you will reclaim each one of these soils? [8]  
(b) Design a trapezoidal shaped concrete lined channel to carry a discharge of 100 cumecs at a slope of 25cm/km. The side slopes of channel are 1.5:1. The value of  $N$  may be taken as 0.016. Assume the limiting velocity as 1.5m/sec. [8]

### UNIT - V

- Q.5 (a) Describe various types of rain gauges for the measurement of rainfall with simple sketches. [8]  
(b) What is transpiration? What are the factors that affect transpiration? How would you measure the infiltration capacity? [8]

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**OR**

Q.5 (a) Find the ordinates of a storm hydrograph resulting from a storm with rainfall of 2, 6.75 and 3.75cm during subsequent 3 hours intervals. The ordinates of 3-hour unit hydrograph are given in table:-

Time (Hrs.)	3	6	9	12	15	18	21	24	3	6	9	12	15	18	21	24
Discharge (cumecs)	0	110	365	500	390	310	250	235	175	130	95	65	40	22	10	0

Assume an initial loss of 5 mm infiltration index of 2.5 mm/hour and base flow of 10 cumecs. [8]

(b) Write short notes on Hydrologic Cycle and factors affecting runoff. [8]

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	<b>7E7061</b> <b>B. Tech. VII Sem. (Main / Back) Exam., Nov. – Dec. - 2018</b> <b>Civil Engineering</b> <b>7CE1A Water Resources Engineering - I</b>	

Time: 3 Hours

Maximum Marks: 80  
Min. Passing Marks: 26*Instructions to Candidates:*

Attempt any **five** questions, selecting **one** question from each unit. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)

1. NIL2. NIL**UNIT- I**

Q.1 (a) Write short notes on the following-

[8]

- (i) Comparison of sprinkler and drip irrigation
- (ii) Quality standard for irrigation water

(b) A watercourse has a culturable command area of 1100 hectares. The intensity of irrigation for crop A is 40% and for crop B is 30%, both crops being Rabi crops. Crop A has a Kor period of 20 days and crop B has a Kor period of 15 days. Calculate the outlet discharge of the water course if the Kor depth for crop A is 10 cm and for crop B is 16 cm.

[8]

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- OR**
- Q.1 (a) What is subsurface irrigation? Differentiate between the natural subsurface irrigation and the artificial subsurface irrigation. [8]
- (b) Define the following terms- [8]
- (i) Frequency of irrigation
  - (ii) Crop rotation
  - (iii) Irrigation efficiencies
  - (iv) Consumptive use of water

**UNIT- II**

- Q.2 (a) Discuss the factors governing the selection of alignment of main canal and its distributaries. [8]
- (b) What are Lacey's basic regime equations? Starting from these equations, derive the equations for- [8]
- (i) Wetted perimeter
  - (ii) Hydraulic radius
  - (iii) Bed slope

**OR**

- Q.2 (a) Write short notes on the following- [8]
- (i) Role of command area development
  - (ii) Estimation of channel losses
  - (iii) Rotational delivery
  - (iv) Silt control in canals
- (b) Compare the Kennedy's and Lacey's theories for the design of alluvial channels. [8]
- What are the drawbacks of both theories?

UNIT- III

- Q.3 (a) What are the basic principles of regulation of a canal system? Describe the methods of regulation of a canal system. [8]
- (b) Define flexibility, setting, sensitivity, efficiency, proportionality, modular limits of a canal outlet. [8]

OR

- Q.3 (a) What do you understand by river training works? Draw neat sketches of Guide banks and Spurs. Also explain their functions. [8]
- (b) What do you understand by critical tractive force? Explain initial and final regime condition of channels. Also discuss the mechanics involved in sediment transport. [8]

UNIT- IV

- Q.4 (a) What are saline, saline-alkali and alkali soils and explain how you will reclaim each one of these soils? [8]
- (b) Differentiate between an open well and a tube well. What are the advantages of tube wells over open wells? [8]

OR

- Q.4 (a) Explain the advantages and disadvantages of canal lining. [8]
- (b) Design a trapezoidal shaped concrete lined channel to carry a discharge of 120 cumecs at a slope of 20 cm/km. The side slopes of the channel are 1.5:1. The value of N may be taken as 0.014. Assume limiting velocity as 1.5m/s. [8]

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UNIT- V

- Q.5 (a) What is Hydrological cycle? Give brief description of different components of hydrological cycle. [8]
- (b) Describe run-off. Differentiate between direct run-off and base flow. What are various components of run-off? [8]

OR

- Q.5 (a) Draw a neat diagram of Symon's rain gauge, clearly showing all its dimensions. How will you select a site for rain gauge station? [8]
- (b) What is a unit hydrograph? What are the basic propositions and limitations of the unit hydrograph theory? [8]

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**UNIT- II**

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- (b) What are Lacey's basic regime equations? Starting from these equations, derive the equations for- [8]
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UNIT- V

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