WATER RESOURCES ENGINEERING

Subject Code: **CE503PC**
Regulations: R**16 -** JNTUH
Class : III Year B.Tech CE I Semester

Department of Civil Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

WATER RESOURCES ENGINEERING (CE503PC)
COURSE PLANNER

I. COURSE OVERVIEW:

This course address the concept of present science of the practice of irrigation engineering which comprising partially all the modern developments which occurs in irrigation purpose. In this mainly the units are taken as metric unit which covers the total area which need for irrigation. In this we can know about water requirement of crops by hydrology, ground water, reservoir water and rain water storing. By this water recourses engineering we can know about design of irrigation structures and planning of reservoir as for flood control

II. PREREQUISITE(S):

Level	Credits	Periods/Week	Prerequisites
UG	4	5	Fluid mechanics.

III. COURSE OBJECTIVES:

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

i. Apply concepts of hydrologic cycle and precipitation and its applications
ii. Learn how to measure base flow and find the analysis of base flow separation
iii. Evaluate the unit, S, SUH and synthetic hydrograph.
iv. Design the discharge of flood frequency
v. Apply the concept of ground water and its occurrence

IV. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. Analyze the importance of hydrology, able to calculate the average rainfall over a basin.
2. Understand the infiltration methods, evaporation nd evapotranspiration.
3. pply hydrograph base flow concept,
4. Understand hydrograph methods, the types of hydrograph and their applications.
5. Understand the concept of ground water and its occurrence.
6. Know the about the complete concept of well development.
7. Know the importance of irrigation, types and methods.
8. Analyze soil-water plant relationship, duty & delta and factors affecting them.
9. Analyze the design of canals by using different methods

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes	Level	Proficiency assessed by

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	S	Assignments, Tutorials.
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	H	Assignments, Tutorials, Exams.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and	H	Assignments, Tutorials, Exams
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of	--	--
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	--	Assignments, Exams
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	--	--
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	--	--
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Assignments, Exams.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	H	Assignments and Exams
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	H	Assignments and Exams

PO11	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	H	Assignments and Exams
PO12	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	--	--

N – Not Applicable S – Supportive H - Highly Related

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program specific outcomes		Level	Proficiency Assessed By
PSO1	**ENGINEERING KNOWLEDGE:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	H	Assignments, Tutorials, Exams
PSO2	**BROADNESS AND DIVERSITY:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	H	Projects
PSO3	**SELF-LEARNING AND SERVICE:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	S	Guest Lectures

VII. SYLLABUS:

COURSE CONTENTS – AS PER JNTUH SYLLABUS

UNIT – I

Introduction to engineering hydrology and its applications, Hydrologic cycle, types and forms of precipitation rainfall measurement, Types of rain gauges, computation of average rainfall over a basin, processing of rainfall data, adjustment of record, Rainfall Double Mass Curve, Runoff, factors affecting runoff, runoff over a catchment, Rainfall Double Mass Curve Runoff, factors affecting runoff, Factors affecting Runoff, runoff over a catchment, Empirical and rational Formulae

Abstraction from rainfall, evaporation, Factors effecting evaporation, measurement of evaporation, Evapotranspiration, Penman and Blaney & Criddle Methods, Infiltration, factors effecting infiltration, Measurement of infiltration, Infiltration indices

UNIT – II

Distribution of Runoff, Hydrograph Analysis, Flood Hydrograph, Effective rainfall, Base flow, Base flow separation, Direct Runoff Hydrograph, unit Hydrograph; Definition and limitations of applications of unit Hydrograph, Derivation of unit Hydrograph from Direct Runoff Hydrograph and vice versa-S-Hydrograph, Synthetic Unit Hydrograph

UNIT – III

Ground Water Occurrence, Types of aquifers, aquifer parameters, Porosity, Specific yield, Permeability, Transmissivity and storage coefficient, Darcy's law, Radial flow to wells in confined and unconfined aquifers, Types of wells, well construction, well development

UNIT – IV

Necessity and Importance of Irrigation, Advantages and ill effects of Irrigation, Types of Irrigation, Methods of application of Irrigation water, Indian agricultural soils, methods of improving soil fertility-Crop Rotation, Preparation of land for Irrigation, Standards of quality for Irrigation water

Soil - water -plant relationship, Vertical distribution of soil moisture, Soil moisture constants, soil moisture constants, Soil moisture tension, consumptive use, Duty and Delta, factors affecting duty, Design discharge for a water course, Depth and frequency of Irrigation, Irrigation efficiencies and water logging,

UNIT-V

Classification of canals, Design of Irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting, IS standards for a canal design, Canal lining

Design discharge over a catchment, computation of design discharge- rational formulae, SCS curve number method, Flood frequency analysis, Stream Gauging-Measurement and estimation of stream flow

SUGGESTED BOOKS:

TEXTBOOKS:

1. Engineering hydrology by jayaram Reddy,Laxmi Publications pvt.Ltd.,New Delhi

2. Irrigation and water power engineering by Punmia, Lal (2010),Laxmi publications Pvt. Ltd., New Delhi,

REFERENCE BOOKS:

1. Elementary hydrology by V.P.Singh, PHI publications.

2. Irrigation and water Resources & Water power by P.N.Modi,Standard Book House.

3. Water Resources Engineering-I by Dr.G.Venkata Ramana,Acadamic Publishing Company

4. Irrigation and water Management by Dr.Majumdar,Printice Hall of India.

5. Irrigation and Hydraulic Structures by S.K. Garg

6. Applied hydrology by Ven Te Chow, David R.Mays Tata Mc Graw Hill.

7. Introduction to hydrology by Warren Viessvann,Jr ,Garyl.Lewis,PHI.

NPTEL WEB COURSE:

nptel.ac.in/downloads/105105110/

NPTEL VIDEO COURSE:

nptel.ac.in/downloads/105105110/ #

GATE SYLLABUS:

Hydrology: Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

Irrigation: Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

IES SYLLABUS:

Water resources of the globe: Multipurpose uses of Water: Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yields, ground water yield and well hydraulics; Water logging, drainage design; Irrigation revenue; Design of rigid boundary canals, Lacey's and Tractive force concepts in canal design, lining of canals; Sediment transport in canals; Non-Overflow and overflow sections of gravity dams and their design, Energy dissipaters and tail water rating; Design of headwork's, distribution works, falls, cross-drainage works, outlets; River training

VIII. COURSE PLAN:

Lecture No	Week	Unit	Topics to be covered	Learning Objective	References
1.	1	1	Introduction to engineering hydrology and its applications, Hydrologic cycle.	Understand the applications of Engg. Hydrology and its cycle.	T2:24.6 T2:24.7 T2:24.8
2.	1	1	Types and forms of precipitation.	Derive the kinds and forms of precipitation.	T7:12.14
3.	1	1			
4.	1	1	Rainfall measurement, types of rain gauges, Computation of average rainfall over a basin.	Understand the rain fall measurement and to know the types of rain gauges.	T4:3.10
5.	2	1			
6.	2	1	Processing of rainfall data. Abstraction from rainfall. Adjustment of record	Explain the processing of rain fall and abstraction of its.	T4:3.11 T4:3.12
7.	2	1			
8.	2	1	Rainfall double mass curve	Evaluate rainfall data in the curve.	T1:16.2
9.	3	1	Runoff - factors affecting runoff.	Understand about Runoff and factors effecting.	T1:16.5
10.	3	1	Runoff over catchment-empirical formulae.	Understand the measurement of runoff	T1:16.6.2
11.	3	1	Rational formulae.	Evaluate the measurement of runoff	T2:26.9
12.	3	1	Evaporation - factors affecting evaporation	Understand about evaporation and its effecting factors.	T2:26.11
13.	4	1	Measurement of evaporation and evaptranspiration.-penman method	Evaluate measurement of evaporation and vaptranspiration.	T1:16.7
14.	4	1			
15.	4	1	Evaptranspiration.- criddle method	Evaluate the measurement evaptrans piration.	T2:26
16.	4	1			
17.	5	1	Infiltration - factors affecting	understand the infiltration	T2:20.4

18.	5	1	infiltration, measurement of infiltration, infiltration indices.	and its factors effecting and able to measure the filtration	
19.	5	2	Distribution of runoff-Hydrograph analysis flood hydrograph.	Define hydrograph analysis and flood hydrograph	T2:23.4
20.	5	2			
21.	6	2	Effective rainfall base Flow separation-direct	Evaluate the measurement of steam and rainfall	T2:20.9 T2:20.10
22.	6	2			
23.	6	2	Unit hydrograph, Definition, and limitations of applications of Unit hydrograph	Define unit hydrograph and its limitations, applications	T4:5.13 T2:34.2
24.	6	2			
25.	7	2	Derivation of Unit Hydrograph, S hydrograph, Synethic unit hydrograph.	Derive the Unit hydrographs -UH, influence UH Derivation of Unit Hydrograph, S hydrograph, SUH.	T2:21.1-21.2
26.	7	2			
27.	7	2	Ground water - Occurrence, types of aquifers.	Define about Ground water Occurrence, types of aquifers.	T:21.3-T:21.4
28.	7	3	Aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient, types of wells.	understand the parameters of aquifer, and types of wells	T2:21.5-21.6
29.	8	3			
30.	8	3	Darcy's law, radial flow to wells in confined and unconfined aquifers..	understand the Darcy's law, radial flow of well in types of aquifers	T4:7.1-7.3
31.	8	3			
32.	8	3	Types of wells, well construction and development	Define well construction and development	T3:27.2
33.	9	3			
34.	9	4	Necessity and Importance of Irrigation, advantages and ill effects of Irrigation.	Understand irrigation and its Necessity, Importance, advantages, ill effects.	T3:27.9
35.	9	4			
36.	9	4	types of Irrigation, methods of application of Irrigation water	Define types of Irrigation, methods and its application.	T3:27.9
37.	10	4			
38.	10	4	Indian agricultural soils, methods of improving soil fertility.	understand the Indian agricultural soils, methods of improving soil fertility	T3:27.10
39.	10	4			
40.	10	4	Soil-water plant relationship	understand Soil-water plant relationship	T3:27.11
41.	11	4	Vertical distribution of soil moisture, Soil moisture constants.	Understand the vertical distribution of soil moisture and its constants.	T3:27.12
42.	11	4			
43.	11	4	Soil moisture tension, consumptive use	Define soil moisture tension, consumptive use.	T4:10.7
44.	11	4			
45.	12	4	Duty and delta, Factors affecting duty.	understand about Duty and delta and factors affecting duty	T4:10.8 T4:10.9
46.	12	4			
47.	12	4	Factors affecting duty, Irrigation efficiencies. Water logging	calculate factors affecting duty and to know the	T4:10.10
48.	12	4			

				Irrigation efficiencies	
49.	13	5	Balancing depth of cutting ,IS Standard for canal design canal lining	Understand the balancing depth and cutting	T5:13.9
50.	13	5			
51.	13	5	Design discharge over a catchment, Computation	understand the design of discharge - rational formula	T4:9.8 T4:9.9
52.	13	5			
53.	14	5	SCS Curve number method, flood frequency analysis –introductory part only	Understand SCS method, flood frequency analysis,	T4:9.10
54.	14	5			
55.	14	5	Stream gauging-measurement and estimation of stream flow	Evaluate the measurement of steam and rainfall	T3:27.12
56.	14	5			
57.	15	5	Duty and delta, Factors affecting duty.	understand about Duty and delta and factors affecting duty	T4:10.8 T4:10.9
58.	15	5			
59.	15	5	Factors affecting duty, Irrigation efficiencies. Water logging	calculate factors affecting duty and to know the Irrigation efficiencies	T4:10.10
60.	15	5			
61.	16	5	Classification of canals, Design of irrigation by Kennedy's and lacey's theories	Design the irrigation canals	T5:13.8
62.	16	5			
63.	16	5	Duty and delta, Factors affecting duty.	understand about Duty and delta and factors affecting	T4:10.8 T4:10.9
64.	16	5			

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	S	S	S	S	S	S	H	S	S	H	S	S	S	S
II	H	S	S	S	S	S	H	S	H	S	S	S	S	S	H
III	H	S	S	S	S	S	H	S	H	S	S	S	S	S	H
IV	H	S	H	H	S	H	S	H	S	H	H	S	H	S	H
V	H	S	H	S	S	S	H	H	S	H	S	S	S	H	H

QUESTION BANK
UNIT-I
SHORT QUESTIONS

S.No	Question	Blooms Taxonomy	Course Outcome

		Level	
1.	Draw the hydrological cycle?	Understand	1
2.	What are the reasons for error in measurement of precipitation?	Understand	1
3.	Define Readily available soil moisture?	Understand	1
4.	How can we reduce the water usage?	Understand & Remember	1
5.	What do mean by term 'HYDROLOGY'	Remember	1
6.	Write the applications of hydrology.	Understand	1
7.	Name the types of rain-gauges?	Understand	1
8.	Define Runoff? What are the types of Runoff?	Understand & Remember	2
9.	Name the methods used for measuring evapotranspiration.	Understand	2
10.	What are infiltration indices?	Remember	2

LONG QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Explain the methods of estimating missing rainfall data at a station in a basin.	Remember &Understand	1
2.	Explain step by step procedure you would adopt to prepare the depth- area duration curves for a particular storm for a basin having a number of rain-gauges, most of which are recording.	Remember & Understand	1
3.	Discuss the analysis of rainfall data with respect to time, space, frequency and intensity.	Remember & Understand	1
4.	Explain the balanced equation for precipitation.	Remember	1
5.	Describe with the help of sketch various forms of soil moisture. Which of these soil moistures is mainly available for utilization by the plants?	Remember	1
6.	Evaporation is indirectly a cooling process. Justify the statement. Discuss the factors affecting evaporation.	Remember & Understand	2
7.	Discuss the various factors affecting evapotranspiration.	Remember & Understand	2
8.	Distinguish between the potential evapotranspiration and the actual evapo-transpiration.	Remember & Understand	2
9.	Bring out the difference between evaporation, transpiration, evapotranspiration and consumptive use.	Remember & Understand	2
10.	Explain energy budget method of computing lake evaporation. What are its limitations?	Remember & Understand	2

UNIT-II

SHORT QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome

1.	Explain hydrograph analysis?	Understand	4
2.	What do you mean by base flow?	Understand	3
3.	What do you understand about flood hydrograph?	Understand	3
4.	Define return period and exceedence probability?	Understand	4
5.	Define Unit hydrograph?	Understand & Remember	4
6.	What is recession time?	Remember	3
7.	Write Dicken's formula for flood discharge.	Understand & Remember	4
8.	What is flood frequency?	Remember	4
9.	What is basin lag?show in the graph?	Understand & Remember	4
10.	What are ungauged rivers?	Remember	3

LONG QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Define unit hydrograph. What are the assumptions underlying the unit hydrograph theory.	Understand	4
2.	What does the word unit refer to in the unit hydrograph? Explain with sketches what do you understand by the principle of linearity and principle of time invariance in the unit hydrograph theory?	Understand	4
3.	Describe how recession constants of direct runoff and base flow curves are obtained from a semi log arithmetic plot.	Understand	4
4.	Describe with the help of neat sketches any three methods of separation of base flow from the hydrograph of runoff (i.e. stream flow hydrograph) indicating the situation under which you advocate them	Understand	4
5.	How is runoff estimated using Strange's tables and Barlow's tables	Understand & Remember	4
6.	What are the various components of runoff? Describe how each component is derived in the runoff process.	Understand	3
7.	State the significance of inflection point on recession side of the hydrograph. Also explain the different factors that effect the shape of the hydrograph.	Remember	3
8.	Describe the method of deriving unit hydrograph from complex storms .	Remember	4
9.	The peak discharge and time to peak in a 3 h unit hydrograph derived for a basin of area 250 km2 with L = 30 km and Lc = 14 km are 50m3 /s and 9 h respectively. Assuming that Snyder's synthetic unit hydrograph applies determine the coefficient Ct and Cp. Determine the 2 h unit hydrograph for the upper 180 km2 of the same	Understand	3

	watershed which has L= 20km and Lc = 11.8 km.		
10.	Define unit hydrograph. What are the assumptions underlying the unit hydrograph theory.	Understand	4

UNIT-III

SHORT QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Define specific retention?	Understand	5
2.	Define Permeability?	Understand	5
3.	Define transmissibility?	Understand	5
4.	Define Storage coefficient?	Understand &Remember	6
5.	What are the types of wells?	Understand &Remember	6
6.	Define aquifuge and give the examples.	Understand	5
7.	What are the parameters considered in aquifer .name them.	Understand &Remember	5
8.	What do you mean by unconfined aquifer?	Remember	5
9.	What do mean by radial flow .give an example	Understand & Remember	5
10.	Which type of flow is generally considered in the aquifer.justify.	Understand& Remember	5

LONG QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Distinguish between Groundwater and Perched groundwater.	Understand	5
2.	Distinguish between Open wells and tube wells.	Understand	6
3.	Distinguish between Water table and artesian aquifers.	Understand	5
4.	Distinguish between Confined aquifer and water table aquifer	Understand	5
5.	Distinguish between Permeability and transmissibility.	Understand	5
6.	Differentiate between shallow dug wells and deep dug wells. How the dug well is constructed?	Understand	6
7.	Enumerate the methods which are used for determining the yield of dug wells. Discuss briefly any one of these methods.	Understand	6
8.	Distinguish with sketches if necessary, the difference between unconfined and confined aquifer	Understand	5
9.	Derive a formula for discharge of a well in a homogeneous unconfined aquifer assuming equilibrium flow condition. State the assumptions on which the formula is based.	Understand	5

10.	Distinguish between: Vadose zone and phreatic zone	Understand & Remember	5

UNIT-IV

SHORT QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Define Irrigation?	Understand	7
2.	What are the different types of soils?	Understand	8
3.	What do you understand about full supply coefficient?	Understand	7
4.	What are the ill effects of irrigation?	Understand	7
5.	What standards required for Irrigation water?	Understand	7
6.	What do mean by artificial irrigation .give an example	Remember	7
7.	What do mean by natural irrigation .give an example	Remember	7
8.	What is consumptive use?	Understand	7
9.	When do you consider the land for the crop rotation?	Understand	7
10.	What is the formula used for finding depth of irrigation?	Understand	7

LONG QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Discuss various methods of irrigation and state the advantages of each method.	Understand	7
2.	Describe the step by step procedure for preparation of land for irrigation	Understand & Remember	7
3.	Discuss in brief, various methods of surface irrigation.	Understand & Remember	7
4.	What is meant by C2-S2 water?. Discuss its usefulness for irrigating fine textured soils.	Understand	8
5.	Explain in detail about the iIl-effects of irrigation	Understand	7
6.	What is meant by flow duty and quantity duty?	Remember	8
7.	Define the terms Duty, Delta and base period and also derive the relation between them..	Understand	8
8.	(a) Why soil is necessary for plant life. Explain the classification of soils based on geological process of formation.	Understand	8
9.	Write down the classification of irrigation water based on sodium absorption ratio and its suitability for irrigation.	Understand	7
10.	What is meant by duty and delta of canal water? Derive a relation between duty and delta for a given base period.	Understand	8

UNIT-V

SHORT QUESTIONS

S.No	Question	Blooms Taxonomy	Course Outcome

		Level	
1.	What are the merits of Lacey's theory?	Remember & Understand	9
2.	Why do we need to provide side slopes for canals?	Understand	9
3.	What do you understand about SCS curve?	Understand & Remember	9
4.	What is meant by depression storage?	Remember	9
5.	What do you know about Gumbels method of flood frequency analysis?	Remember & Understand	9
6.	What is lacey's theory?	Remember & Understand	9
7.	What do you mean by canal?	Remember	9
8.	What do you mean by reservoir?	Remember	9
9.	What are the types of canals?	Understand	9
10.	What is flood frequency?	Understand	9

LONG QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Why is Lacey's conception is superior to that of Kennedy's?	Understand	9
2.	What do you understand by Initial and final regime of channels?	Remember	9
3.	When do you classify the channel as having attained regime condition?	Understand	9
4.	Describe briefly the observations of Lacey on the regime of river.	Remember	9
5.	What is the necessity of drainage below the lining? Discuss the various drainage and pressure release arrangements.	Remember	9
6.	Using Lacey's basic regime equations derive an expression for Lacey's scour depth.	Understand & Remember	9
7.	What is meant by scour? What precautions do you take against it during the design of weirs?	Remember	9
8.	Explain the mid-section method of computing the discharge in a stream.	Remember	9
9.	Design a trapezoidal shaped concrete lined channel to carry a discharge of 100 cumecs at a slope of 25 cm/km. The side slopes of the channel are 1.5:1. The value of N may be taken as 0.016. Assume the limiting velocity as 1.5m/sec.	Understand & Remember	9
10.	What is Khosla's safe exit gradient?	Understand & Remember	9

XI. OBJECTIVE QUESTIONS: JNTUH

UNIT I

1. Rain shadow region in India is found to the
   a) west of western ghats (b) east of western ghats
   (c) west of eastern ghats (d) south of Himalayas.
2. Double mass curve technique is used
   (a) to prepare the rainfall hyetograph from the rainfall mass curve
   (b) to prepare the rainfall mass curve from the rainfall hyetograph
   (c) to check the consistency of record at a suspected raingauge station
   (d) in developing isohyetal maps.
3. The Thiessen weights of 4 raingauges A, B, C and D covering a river basin are 0.15, 0.25, 0.30 and 0.30 respectively. If the average depth of rainfall for the basin is 5 cm, and the rainfalls recorded at B, C and D are 5 cm. 4 cm and 5 cm respectively. What is the rainfall at A? (a) 5 cm (b) 6 cm (c) 7 cm (d) 8 cm.
4. In which of the following the snow density would be maximum?
   (a) fresh powder snow (b) virgin snow (c) coarse snow (d) packed snow in glaciers.
5. According to Dalton's law, evaporation is proportional to
   (a) the vapour pressure gradient
   (b) the difference between the saturation vapour pressure at 100^0C and the actual vapour pressure
   (c) the difference between the actual vapour pressure and the saturation vapour pressure at 0^0C
   (d) the difference between the saturation vapour pressure at a given temperature and the saturation vapour pressure at 0^0C.
6. The salinity in water
   (a) reduces the evaporation (b) does not affect evaporation
   (c) increases the evaporation (d) difficult to say.
7. For supplying water to rabi crop, kharif crop and sugarcane, the channel is designed for a capacity equal to the greater of the water requirement of
   a) rabi or kharif b) rabi and kharif or sugarcane
   c) rabi and sugarcane or kharif and sugarcane d) rabi or kharif or sugarcane
8. The amount of irrigation water required to meet the evapotranspiration needs of the crop during its full growth is called
   a) effective rainfall b) consumptive use
   c) consumptive irrigation requirement d) net irrigation requirement
9. Hydrograph is the graphical representation of
   a) runoff and time b) surface runoff and time
   c) ground water flow and time d) rainfall and time
10. Infiltration rate is always
    a) more than the infiltration capacity b) less than the infiltration capacity
    c) equal to or less than the infiltration capacity
    d) equal to or more than the infiltration capacity

UNIT II

1. Infiltration is the a
   a) movement of water through the soil b) absorption of water by soil surface
   c) both (a) and (b) d) none of the above

2. If the intensity of rainfall is more than the infiltration capacity of soil, then the infiltration rate will be
   a) equal to rate of rainfall b) equal to infiltration capacity
   c) more than rate of rainfall d) more than infiltration capacity
3. Cyclonic precipitation is caused by lifting of an air mass due to
   a) pressure difference b) temperature difference
   c) natural topographical barriers d) all of the above
4. Which of the following is a non-recording raingauge?
   a) tipping bucket type raingauge b) Simon's raingauge
   c) Steven's weighing type raingauge d) floating type raingauge
5. A raingauge should preferably be fixed
   a) near the building b) under the tree c) in an open space d) in a closed space
6. Hydrograph is a graph drawn between _____ and _____.
7. Hyetograph is a graph drawn between _____ and _____.
8. Direct runoff hydrograph = _____ -_____.
9. Flood Hydrograph _____ +_____.
10. Base flow is also called as_____.

UNIT III

1. The depth of flow at which specific energy is minimum is called
   a) Normal depth b) alternate depth c) critical depth d) none
2. In MLT system the dimension for specific volume would be
   a) L3 b) L-3 c) ML-3 d) M-1L3
3. A Turbine is called reaction turbine, if at the inlet of the turbine the total energy is
   a) Kinetic energy only b) kinetic energy & pressure energy
   c) pressure energy only d) none of these
4. When surface of transpiration is submerged under water, then potential evapotranspiration is
   a) much more than evapotranspiration b) much less than evapotranspiration
   c) equal to evapotranspiration d) equal to or less than evapotranspiration
5. Unit of runoff in M.K.S. system is
   a) cubic metre/sec b) metre/sec c) cubic metre
   d) square metre
6. Transmissivity is also called as _____.
7. Aquitard is a geographic formation having_____.
8. Types of aquifers are_____ and_____.
9. Aquifuge is a geographic formation having_____.
10. Aquiclude is a geographic formation having_____.

UNIT IV

1. An artesian aquifer is the one where
   a) water surface under the ground is at atmospheric pressure
   b) water is under pressure between two impervious strata
   c) water table serves as upper surface of zone of saturation d) none of the above
2. A deep well

a) is always deeper than a shallow well b) has more discharge than a shallow well
c) is weaker structurally than a shallow well d) both (a) and (b)

3. A multipurpose reservoir is the one which is
   a) designed for one purpose but serves more than one purpose
   b) planned and constructed to serve various purposes c) both (a) and (b)
   d) none of the above
4. The useful storage is the volume of water stored in the reservoir between
   a) minimum pool level and maximum pool level
   b) minimum pool level and normal pool level
   c) normal pool level and maximum pool level d) river bed and minimum pool level
5. The water stored in the reservoir below the minimum pool level is called
   a) useful storage b) dead storage c) valley storage d) surcharge storage
6. Water logging of the ground surface occurs due to _____
7. Delta is given as _____.
8. Duty and Delta are related as _____.
9. Depth of irrigation is the _____.
10. Crop rotation means _____.

UNIT V

1. Horizontal acceleration due to earthquake results in
   a) hydrodynamic pressure b) inertia force into the body of the dam
   c) both (a) and (b) d) none of the above
2. The major resisting force in a gravity dam is
   a) water pressure b) wave pressure c) self-weight of dam d) uplift pressure
3. When the reservoir is full, the maximum compressive force in a gravity dam is produced
   a) at the toe b) at the heel c) within the middle third of base d) at centre of base

4.Presence of tail water in a gravity dam
   i) increases the principal stress ii) decreases the principal stress
   iii) increases the shear stress iv) decreases the shear stress

5.Coefficient of discharge of an ogee spillway
   a) depends on depth of approach and upstream slope
   b) depends on downstream apron interference and downstream submergence

6. Kennedy's and Lacey's theories are used for _____.
7. Canals are divided into _____ and_____.
8. Alluvial channel is a channel having _____.
9. In Rational method discharge can be found using _____.
10. Frequency of rainfall is also called as _____.
11. No. of years within which a given storm occurs is called as_____.

XII. GATE QUESTIONS:

1. At a station, Storm I of 5 hour duration with intensity 2 cm/h resulted in a runoff of 4 cm and Storm II of 8hour duration resulted in a runoff of 8.4 cm. Assume that the ϕ-index is the same for both the storms. The ϕ-index (in cm/h) is:
   (A)1.2 (B)1.0 (C)1.6 (D) 1.4
2. The intensity of storm II (in cm/h) is:
   (A)2.00 (B)1.75 (C)1.50 (D)2.25

3. The transplantation of rice requires 10 days and total depth of water required during transplantation is 48 cm. During transplantation, there is an effective rainfall (useful for irrigation) of 8 cm. The duty of irrigation water (in hectares/cumec) is:
   (A)612 (B)216 (C)300 (D)108
4. The ratio of quantity of water stored in the root zone of the crops to the quantity of water actually delivered in the field is known as

(A)water conveyance efficiency (B) water application efficiency
(C)wateruse efficiency
(D) none of the above

5. A 70% index of wetness means
   (A)rain excess of 30% (B) rain deficiency of 30% (C) rain deficiency of 70%
   (D) none of the above
6. The value of sodium absorption ratio for high sodium water lies between
   (A) 0 to 10 (B)10 to 18 (C) 18 to 26 (D) 26 to 34
7. The kor depth for rice is 190mm and kor period is 14 days.The outlet factor for this will be
   (A)637 hectares/m^3/sec (B) 837 hectares/m^3/sec (C) 972 hectares/m^3/sec
   (D) 1172 hectares/m^3/sec
8. Optimum depth of kor wearing for rice is
   (A)135 mm (B) 165 mm (C) 190 mm (D) 215 mm
9. The "outlet discharge factor" is the duty at the head of
   (A) main canal (B) branch canal (C) water course (D) distributory
10. Which of the following is a non-recording rainguage ?
    (A)tipping bucket type rain guage (B) Simon's rainguage
    (C) Steven's weighing type rainguage (D) floating type rainguage

iii) IES

1. Which of the following statements is/are correct? Lining of irrigation canals has necessarily to be carried out in the reaches where the channel passes through
   a. Sandy soil b. Coarse aggregate soil c. Clay soil d. Fine silt and clay
2. Select the correct answer using the code given below
   a. 1 and 3 b. 3 only c. 1 and 2 d. 3 and 4
3. A 4 hr storm had 4 cm of rainfall and the resulting direct -ϕrunoff was 20 cm. if the index remains at the same value,the runoff due to 10 cm of rainfall in 8 hrs in the catchment is:
   a. 6.0 cm b. 7.5 cm c. 2.3 cm d. 2.8 cm
4. Form the analysis of rainfall data at a particular station, it was found that a rainfall of 400 mm had a return period of 20 years.
   a. (0.95) b. 1-(0.95) c. 1-(0.05) d. (0.05)
5. Inconsistency of rainfall data can be checked by which one of the following?
   a. Normal ratio method b. Mass curve method
   c. Double-mass curve method d. Depth duration frequency curve
6. Pick up the correct equation from the following
   a. Run off = Surface run off + Ground water flow
   b. Run off = Surface run off - Ground water flow
   c. Run off = Surface run off / Ground water flow
   d. Run off = Surface run off x Ground water flow.
7. In India, rain fall is generally recorded at
   a.8 A.M b. 12 Noon c. 4 P.M d. 8 P.M.

8. A hydraulic jump in a control meter will be formed above the control, if its original
   a. depth is more than critical depth b. depth is less than the critical depth
   c. depth is equal to critical depth d. none of these.
9. For computing the run off volumes of large areas, number of infiltrations used are
   a.2 b.3 c.4 d.5
10. With the usual meanings ofletters, the equation V=400I D210/4 is used for determining the velocity of ground water flow in metres per day. It is known as
   a. Meinzer's formula b. Slichter's formula c. Darcy's formula d. Hazen's formula.

XIII. WEBSITES:

1. www. wikipedia.org/water_resources_engineering
2. www.civil.tamu.edu/areas/water resources (Texas A&M University)
3. www.water resources-ju.org
4. www.jawahar-book-centre.com
5. www.civil.iitb.ac.in
6. www.amazon.com
7. www.e-books delivery.com

XIV. EXPERT DETAILS:

1. Dr.J. Purushotham (Irrigation and Design Expert)
2. J. Raja Rao (Irrigation and water resources expert)
3. B.P.Venkateshwarlu (Irrigation expert)
4. I.S.N.Raju (Irrigation and Designs expert)
5. P Rama Raju (Inter state water resources expert)

XV. JOURNALS:

NATIONAL:

1. Journal of water resources planning and management
2. Water resources and hydrology journals
3. Journal of Indian water resources society

INTERNATIONAL:

1. International Journal of water resources and environmental engineering
2. Journal of water resources planning and management
3. Inetrnational Journal of water (IJW)
4. Civil engineering journals.

XVI. LIST OF TOPICS FOR STUDENT SEMINARS:

1. Infiltration, factors effecting infiltration.
2. Types of irrigation.
3. Hydrographs.
4. Ground water occurrence.

XVII. CASE STUDIES / SMALL PROJECTS:

1. Study on rainfall runoff data for given region.
2. Determination of IDF equation for a given region using 30-50 years rainfall data.
3. Case study on sprinkler irrigation.
4. Rainfall runoff modeling using SCS curve number technique.
5. Designing of unlined canal using Kennedy’s method.
6. Designing of lined canal using Lacey’s method.