HYDROLOGY &WATER RESOURCES ENGINEERING
(CE503PC)
COURSE PLANNER

I. COURSEOVERVIEW:

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 floodcontrol

II. PREREQUISITE(S):

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

III. COURSEOBJECTIVES:

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 flowseparation
iii. Evaluate the unit, S, SUH and synthetichydrograph.
iv. Design the discharge of floodfrequency
v. Apply the concept of ground water and itsoccurrence

IV. COURSEOUTCOMES:

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 abasin.
2. Understand the infiltration methods, evaporation andevapotranspiration apply hydrograph base flow concept,
3. Understand the concept of ground water and itsoccurrence. Know the about the complete concept of welldevelopment.
4. Know the importance of irrigation, types andmethods.
5. Analyze soil-water plant relationship, duty & delta and factors affectingthem. Analyze the design of canals by using differentmethods

V. HOW PROGRAM OUTCOMES AREASSESSED:

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 theconsequent responsibilities relevant to the professional engineering practice.	--	--
PO7	Environment and sustainability: Understand theimpact of the professional engineering solutions in societal and environmental contexts, and demonstratethe 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 –NotApplicable S–Supportive H - HighlyRelated

VI. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

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 willhave 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 toolusage.	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: Concepts of Hydrologic cycle, Global Water Budget, Applications in Engineering. Sources of data.

Precipitation

Forms of precipitation, characteristics of precipitation in India, measurement of precipitation: Recording and non-recording types, rain gauge network: mean precipitation over an area: Arithmetic, Theissen's and Isohyetal methods, Missing Rainfall Data – Estimation, Consistency of Rainfall records, depth area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

UNIT - II

Abstractions from precipitation

evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations: Penman and Blaney & Criddle Methods, potential evapotranspiration over India, actual evapotranspiration, , interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

RunoffComponents of Runoff, Factors affecting runoff, Basin yield, SCS-CN method of estimating runoff, Flow duration curves, Mass curve of runoff – Analysis.

UNIT - III

Hydrographs

Hydrograph –Distribution of Runoff – Hydrograph Analysis Flood Hydrograph – Effective Rainfall – Base Flow- Base Flow Separation - Direct Runoff Hydrograph Unit pulse and Unit step function - Unit Hydrograph, definition, limitations and applications of Unit hydrograph, derivation of Unit Hydrograph from Direct Runoff Hydrograph and vice versa - S-hydrograph, Synthetic Unit Hydrograph.

UNIT - IV

Groundwater Hydrology Occurrence, movement and distribution of groundwater, aquifers – types, Specific Yield, Permeability, Storage coefficient, Transmissibility, Darcy's Law. Well Hydraulics - Steady radial flow into well for confined and unconfined aquifers, Recuperation tests. Well constants.

Crop Water Requirements – Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

UNIT - V

Canal Systems: Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Regime channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals-Types of lining-Advantages and disadvantages. Drainage of irrigated lands- necessity, methods.

SUGGESTED BOOKS:

TEXTBOOKS:

1. Engineering hydrology by jayaram Reddy,Laxmi Publications pvt.Ltd.,NewDelhi
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, PHIpublications.
2. Irrigation and water Resources & Water power by P.N.Modi,Standard BookHouse.
3. Water Resources Engineering-I by Dr.G.Venkata Ramana,Acadamic PublishingCompany
4. Irrigation and water Management by Dr.Majumdar,Printice Hall ofIndia.
5. Irrigation and Hydraulic Structures by S.K.Garg
6. Applied hydrology by Ven Te Chow, David R.Mays Tata Mc GrawHill.
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:

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, sodicsoils.

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. COURSEPLAN:

Lecture No.	Topics to be covered	Link for PPT	Link for PDF	Link for Small Projects/ Numericals(if any)	Course learning outcomes	Teaching Methodology
	UNIT I					
1	Concepts of Hydrologic cycle, Global water budget	https://www.slideshare.net/nandapalit/hydrologic-cycle-33994221	https://nptel.ac.in/content/storage2/courses/105101010/downloads/Lecture14.pdf	**Small Projects/ Numericals(if any) Link**	understand hydrologic cycle and global water availability	Lecture,PPT, Diagrams
2	Application in Engineering, Sources of data	https://www.slideshare.net/nandapalit/hydrologic-cycle-33994222		**Small Projects/ Numericals(if any) Link**	How to collect and capture data from svarious sources and internet	Use of internet, methods of data collection
3	Forms of precipitation, Characteristics of precipitation	https://www.slideshare.net/ThusharaKApm/rainfall-ppt		**Small Projects/ Numericals(if any) Link**	Different forms of precipitation, understanding how they formed under different climatological conditions	Class romm, PPT,chalk and board
4	Measurment of precipitation, Recording and Non recording rain gauges,rain gauge network	https://www.slideshare.net/parimaljha90/precipitation-unit-2		**Small Projects/ Numericals(if any) Link**	understand how rainfall is measured, AWS, network of rain gauge	Class room, PPT, case studies
5	Mean precipitation over an area, Arithmetic, Thisen Polygan and Isohytel methods	https://www.slideshare.net/parimaljha90/precipitation-unit-3		**Case study from AWS station**	Understand how to compute average rainfall using different methods	Class room, PPT, case studies
6	Estimation, consistency of rainfall records,depth area -duration relationships, maximum	https://www.caee.utexas.edu/prof/maidment/CE365KSpr15/Visual/DesignStorms.pptx		**Small Projects/ Numericals(if any) Link**	to understand frequency,depth, duration and their influence on Runoff	Class room, and case studies

	intensity/depth duration frequency relationship					
7	Probable maximum precipitation(PMP),Rainfall data in India	https://www.caee.utexas.edu/prof/maidment/CE365KSpr15/Visual/DesignStorms.pptx		**Small Projects/ Numericals(if any) Link**	Importance of probable maximum precipitation on floods	Case studies,PPT and internet
	UNIT II					
8	Evaporation process, Evaporimeters, Analytical methods of evaporation estimation	https://www.slideshare.net/muhammadsultanpervez7/evaporation-and-transpiration-for-hydrology-subject	http://eagri.org/eagri50/AENG252/pdf/lec10.pdf	**Small Projects/ Numericals(if any) Link**	Understanding Evaporation, Process, formulae,Hoe to reduce evaporation	Case studies,PPT and internet
9	Reservoir evaporation and methods for its reduction, Evapotranspiration			**Small Projects/ Numericals(if any) Link**		
10	Measurement of evapotranspiration,Evapotranspiration equations, Penman and Blaney cradle methods,			**Small Projects/ Numericals(if any) Link**		
11	Potential evaporation over India,Actual evapotranspiration,interception,depression storage			**Small Projects/ Numericals(if any) Link**		
12	Infiltration, Infiltration capacity,measurement of infiltration	https://www.slideshare.net/parimaljha90/unit-3-infiltration	http://www.seu.ac.lk/ft/lm/FT0099/Hydrology/4.0%20Infiltration.pdf	**Small Projects/ Numericals(if any) Link**	Infiltration and its effect on runoff, factors affecting infiltration	
13	modelling infiltration capacity,clasif	https://www.slideshare.net/parimaljha90/unit-	http://www.seu.ac.lk/ft/lm/FT0099/Hydrology/4.0%20Infiltration	**Small Projects/ Numericals(if any) Link**		

	ication of infiltration capacities,Infiltration indices	3-infiltration	.pdf			
14	Components of Runoff,Fctors affecting Runoff, Basin yield,	https://www.slideshare.net/bala1957/runoff	https://nptel.ac.in/content/storage2/courses/105105110/pdf/m2l03.pdf	**Small Projects/ Numericals(if any) Link**	Processes of runoff.Factors affecting runoff.	
15	SCS-CN methods of estimating runoff Floew duration curves, Mass curve of runoff-Analysis					
	Unit III					
16	Hydrograph-Distribution of Runoff-Hydrograph analysis-Flood Hydrograph	https://slideplayer.com/slide/12393933/	https://www.researchgate.net/publication/344596311_Unit_Hydrograph_Concepts_Estimation_Methods_and_Applications_in_Hydrological_Sciences	**Assignments,problems and exercises**	Understanding what is hhydrograph, unit hydrograph, derivation, S-hydrograph and synthetic hydrograph	Cae study, worked examples, exercises,PPT etc
17	Effective rainfall-Base flow-Base flow seperation					
18	Direct runoff hydrograph unit pulse and unit step function					
19	Unit hydrograph,definition,limitations and applications of hydrograph,					
20	Derivation of unit hydrograph from direct runoff					

	hydrographs and vice versa					
21	S-hydrograph, Synthetic Unit hydrograph					
		I MID EXAMINATIONS				
	Unit IV					
22	Occurrence,movement and of distribution of groundwater,aquifers-types	https://www.slideshare.net/RambabuPalaka/groundwater-hydrology-79854852	https://www.researchgate.net/publication/321145446_GROUNDWATER_HYDROLOGY_AN_OVERVIEW	**Examples, exercises from real time data**	Understanding what is groundwater, its occurrence and movement, laws governing groundwate flow, aquifer properties	Class room, PPT, internet, case studies, exercises
23	specific yield,permeability, storage coefficient, trasmissivity, Darcys law					
24	Well hydraulics,steady radial flow in to wells for confined and unconfined aquifers					
25	Recuperation tests, well constants					
26	Water requirements of crops-crops and crop seasons of India	https://www.slideshare.net/babukakumanu/crop-water-requirement-72681897	http://www.fao.org/3/s8376e/s8376e.pdf	**Examples, exercises from real time data**	Understanding water requirement, duty and delta, quality of water, soil water relationship	class room,PPT,case studies and problems
27	Cropping pattern, duty and delta,					
28	Quality of irrigation water, Soil water relationships, Root zone soil water,					

	infiltration					
29	Consumptive use, Irrigation requirement, frequency of irrigation					
30	methods of applying water to the fields	https://slideplayer.com/slide/12412255/	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_017641.pdf	**Examples, exercises from real time data**	know about adiffernt methods of water application, sprinkler and drip irrigation	Class room, PPt, examples and exercises
31	Surface, subsurface,sprinkler and trickel and drip irigation					
	Unit V					
32	Canal systems,alignment of canals,canal losses	https://www.slideshare.net/LATIFHYDERWadho/lacey-regime-theory-irrigation-engineering	https://nitsri.ac.in/Department/Civil%20Engineering/CIV_604_IHS-6th_CIVIL-Chapter-3_Notes.pdf	**Practical design of existing canals and water logging projects like SRSP**	understanding canals, classifications, canal design,equations governing canal design, water logging, steps to prevent water logging	
33	Estimation of design discharge,design of channels, rigid boundary channels,alluviam channels,Regime channels					
34	Kennedys and Laceys theory of regime channels					
35	Canal outlets, non modular, semi modular and modular outlets					
36	water logging,causes, effects and remedial measures					

37	lining of canals, types of lining, advantaged and dis advantages					
38	Drainage of of irrigated lands,necessit h and methods					
		II Mid examinations				

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENTOF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Objectiv es	**Program Outcomes**												**Program Specific**		
	P O1	**PO 2**	**PO 3**	**PO 4**	**P O5**	**P O 6**	**P O 7**	**P O 8**	**P O 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
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

I. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENTOF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

II. QUESTIONS

UNIT-I

SHORT QUESTIONS

S.No	Question	Blooms Taxonomy Level	Course Outcome
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, mostof 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 Level**	**Course Outcome**
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 tothe
   a) west ofwesternghats (b) east of westernghats
   (c) west ofeasternghats (d) south ofHimalayas.
2. Double mass curve technique isused
   (a) to prepare the rainfall hyetograph from the rainfall masscurve
   (b) to prepare the rainfall mass curve from the rainfallhyetograph
   (c) to check the consistency of record at a suspected raingaugestation
   (d) in developing isohyetalmaps.
3. TheThiessenweightsof4raingaugesA,B,CandDcoveringariverbasinare0.15,0.25, 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 bemaximum?
   (a) fresh powder snow (b) virgin snow (c) coarse snow (d) packed snow in glaciers.
5. According to Dalton's law, evaporation is proportionalto
   (a) the vapour pressuregradient
   (b) the difference between the saturation vapour pressure at 100 ^{0}C and the actualvapour pressure
   (c) the difference between the actual vapour pressure and the saturation vapour pressure at 0^{0}C
   (d) the difference between the saturation vapour pressure at a given temperature andthe saturation vapour pressure at 0 ^{0}C.
6. The salinity in water
   (a) reducesthe evaporation (b) does not affectevaporation
   (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 requirementof
   a) rabiorkharif b) rabi and kharif orsugarcane
   c) rabi and sugarcane or kharifandsugarcane d) rabi or kharif orsugarcane
8. The amount of irrigation water required to meet the evapotranspiration needs of thecrop

during its full growth iscalled

a) effective rainfall b) consumptiveuse

c) consumptive irrigation requirement d) net irrigation requirement

9. Hydrograph is the graphical representationof

a) runoffandtime b) surface runoff andtime

c) ground water flowand time d) rainfall andtime

10. Infiltration rate isalways

a) more than theinfiltrationcapacity b) less than the infiltrationcapacity

c) equal to or less than the infiltrationcapacity

d) equal to or more than the infiltrationcapacity

UNIT II

1. Infiltration is thea

a) movement of water throughthe soil b) absorption of water by soilsurface

c) both (a)and(b) d) none of theabove

2. If the intensity of rainfall is more than the infiltration capacity of soil, then the infiltration rate willbe

a) equal to rate of rainfall b) equal to infiltrationcapacity

c) more than rate of rainfall d) more than infiltration capacity

3. Cyclonic precipitation is caused by lifting of an air mass dueto

a) pressuredifference b) temperaturedifference

c) natural topographical barriers d) all of the above

4. Which of the following is a non-recordingraingauge?

a) tipping bucket type raingauge b) Simon'sraingauge

c) Steven's weighing type raingauge d) floating type raingauge

5. A raingauge should preferably befixed

a) near the building b) under the tree c) in anopenspace d) in a closedspace

6.Hydrograph is a graphdrawnbetween_and_____.

7.Hyetograph is a graphdrawnbetween_____and_____.

8.Direct runoff hydrograph= _____-_____.

9.FloodHydrograph_____+_____.

10. Base flow is alsocalledas_____.

UNIT III

1.The depth of flow at which specific energy is minimum iscalled

a) Normaldepth b)alternatedepth c)criticaldepth d) none

2.In MLT system the dimension for specific volume wouldbe

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 energyis

a) Kineticenergyonly b) kinetic energy &pressure energy

c) pressureenergyonly d) none ofthese

4. When surface of transpiration is submerged under water, then potential evapotranspirationis
   a) much morethanevapotranspiration b) much less thanevapotranspiration
   c) equalto evapotranspiration d) equal to or less thanevapotranspiration
5. Unit of runoff in M.K.S. systemis
   a) cubicmetre/sec b)metre/sec c) cubicmetre
   d) square metre
6. Transmissivity is also calledas_____.
7. Aquitard is a geographicformationhaving_____.
8. Types ofaquifers are_____and_____.
9. Aquifuge is a geographicformationhaving_____.
10. Aquiclude is a geographicformationhaving_____.

UNIT IV

1. An artesian aquifer is the onewhere
   a) water surface under the ground is at atmosphericpressure
   b) water is under pressure between two imperviousstrata
   c) water table serves as upper surface of zone of saturation d) none of theabove
2. A deepwell
   a) is always deeper than ashallow well b) has more discharge than a shallowwell
   c) is weaker structurally than ashallow well d) both (a) and(b)
3. A multipurpose reservoir is the one whichis
   a) designed for one purpose but serves more than onepurpose
   b) planned and constructed to servevariouspurposes c) both (a) and(b)
   d) none of the above
4. The useful storage is the volume of water stored in the reservoirbetween
   a) minimum pool level and maximum poollevel
   b) minimum pool level and normal poollevel
   c) normal pool level and maximumpoollevel d) river bed and minimum poollevel
5. The water stored in the reservoir below the minimum pool level iscalled
   a) useful storage b)deadstorage c) valley storage d) surchargestorage
6. Water logging of the ground surface occurs dueto_____
7. Delta isgivenas _____.
8. Duty and Delta arerelatedas _____.
9. Depth of irrigationis the_____.
10. Croprotationmeans_____.

UNIT V

1. Horizontal acceleration due to earthquake results in
   a) hydrodynamicpressure b) inertia force into the body of thedam
   c) both (a)and (b) d) none of theabove
2. The major resisting force in a gravity damis
   a) water pressure b) wavepressure c) self-weight of dam d) upliftpressure

3. When the reservoir is full, the maximum compressive force in a gravity dam isproduced
   a) at the toe b) attheheel c) within the middle third of base d) at centre of base
4. Presence of tail water in a gravitydam
   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 upstreamslope

b) depends on downstream apron interference and downstreamsubmergence

6. Kennedy's and Lacey's theories areusedfor_____.
7. Canals aredividedinto_____and_____.
8. Alluvial channel is achannel having _____.
9. In Rational method discharge can befound using _____.
10. Frequency of rainfall is alsocalledas_____.
11. No. of years within which a given storm occurs is called as.

XII. GATEQUESTIONS:

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 knownas
   (A)waterconveyanceefficiency (B) water applicationefficiency
   (C)wateruse efficiency
   (D) none of the above
5. A 70% index of wetnessmeans
   (A) rain excessof30% (B) rain deficiency of 30% (C) rain deficiency of70%
   (D) none of the above
6. The value of sodium absorption ratio for high sodium water lies between
   (A) 0to10 (B)10to18 (C) 18 to 26 (D) 26 to34
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) 837hectares/m^3/sec (C) 972hectares/m^3/sec
   (D) 1172 hectares/m^3/sec
8. Optimum depth of kor wearing for riceis
   (A)135mm (B)165mm (C)190mm (D) 215 mm
9. The "outlet discharge factor" is the duty at the headof
   (A) maincanal (B) branch canal (C)watercourse (D)distributory
10. Which of the following is a non-recording rainguage?
    (A) tipping bucket typerainguage (B) Simon'srainguage
    (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 passesthrough
   a. Sandysoil b. Coarse aggregate soil c. Clay soil d. Fine silt andclay
2. Select the correct answer using the code givenbelow

a. 1 and3 b.3only c. 1and2 d. 3 and4

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 catchmentis:
   a.6.0cm b.7.5cm c.2.3cm d. 2.8cm
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 20years.
   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 thefollowing?
   a. Normalratiomethod b. Mass curvemethod
   c. Double-masscurvemethod d. Depth duration frequencycurve
6. Pick up the correct equation from thefollowing
   a. Run off = Surface run off + Ground waterflow
   b. Run off = Surface run off - Ground water flow
   c. Run off = Surface run off / Ground waterflow
   d. Run off = Surface run off x Ground waterflow.
7. In India, rain fall is generally recordedat
   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 itsoriginal
   a. depth is more than critical depth b. depth is less than the criticaldepth
   c. depth is equal tocriticaldepth d. none ofthese.
9. For computing the run off volumes of large areas, number of infiltrations usedare
   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 knownas
    a. Meinzer's formula b. Slichter's formula c. Darcy's formula d. Hazen'sformula.

XIII. WEBSITES:

1. www.wikipedia.org/water_resources_engineering
2. www.civil.tamu.edu/areas/water resources (Texas A&M University)
3. www.waterresources-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. EXPERTDETAILS:

1. Dr.J. Purushotham (Irrigation and DesignExpert)
2. J. Raja Rao (Irrigation and water resourcesexpert)
3. B.P.Venkateshwarlu (Irrigationexpert)
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 andmanagement
2. Water resources and hydrologyjournals
3. Journal of Indian water resourcessociety

INTERNATIONAL:

1. International Journal of water resources and environmentalengineering
2. Journal of water resources planning andmanagement
3. Inetrnational Journal of water(IJW)
4. Civil engineeringjournals.

XVI. LIST OF TOPICS FOR STUDENTSEMINARS:

1. Infiltration, factors effectinginfiltration.
2. Types ofirrigation.
3. Hydrographs.
4. Ground water occurrence.

XVII. CASE STUDIES / SMALLPROJECTS:

1. Study on rainfall runoff data for givenregion.
2. Determination of IDF equation for a given region using 30-50 years rainfalldata.
3. Case study on sprinklerirrigation.
4. Rainfall runoff modeling using SCS curve numbertechnique.
5. Designing of unlined canal using Kennedy'smethod.
6. Designing of lined canal using Lacey'smethod