

Programme Name/s	: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/
Programme Code	: CE/ CR/ CS/ LE
Semester	: Fifth
Course Title	: WATER RESOURCE ENGINEERING
Course Code	: 315314

I. RATIONALE

Water is essential resource for all the living thing on earth, making its conservation crucial. With increasing demand and unpredictable rainfall in India, efficient water management system is more important than ever. Irrigation structures like dams, diversion headworks, canals play a key role in this effort. Water Resource Engineering deals in the planning, designing, constructing, and executing these hydraulic structures which are used to used to store, distribute and conserve the water sources. The primary goal of water resources engineering is to control and regulate water for various purposes including flood control, irrigation, hydroelectric power development etc. This course will enable the students to use and apply the basic principles and practices related to irrigation engineering and utilisation of supplied water at field.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Suggest the relevant irrigation systems for the given site conditions.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Evaluate the hydrological parameters of the given site.
- CO2 - Compute the Canal capacity for the crop water requirement of the given command area.
- CO3 - Suggest the suitable type of dam for the given site condition.
- CO4 - Execute the Minor and Micro Irrigation Schemes.
- CO5 - Propose the type of Diversion Headwork in the irrigation scheme.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks	
				Actual Contact Hrs./Week			SLH	NLH			Theory	Based on LL & TL				Based on SL						
				CL	TL	LL						Practical										
												FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min													
315314	WATER RESOURCE ENGINEERING	WRE	DSC	4	-	2	-	6	2	3	30	70	100	40	50	20	25@	10	-	-	175	

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Classify the irrigation projects on the basis of given criteria.</p> <p>TLO 1.2 Explain the term “hydrological cycle”.</p> <p>TLO 1.3 Describe the characteristics of Rain gauge station to be installed in the given location.</p> <p>TLO 1.4 Estimate mean rainfall in the given area using the relevant method.</p> <p>TLO 1.5 Explain the factors affecting Runoff for given site condition.</p> <p>TLO 1.6 Determine the Maximum Flood Discharge using the relevant empirical method from the given data.</p>	<p>Unit - I Introduction to Irrigation and Hydrology</p> <p>1.1 Irrigation: Definition, necessity and Classification of Irrigation projects, advantages and ill effects of excess irrigation.</p> <p>1.2 Hydrology: Definition of Hydrological cycle, Rainfall, Evaporation.</p> <p>1.3 Rain Gauge: Symon's rain gauge and automatic rain gauge - Tipping bucket type.</p> <p>1.4 Methods of calculating mean rainfall: Arithmetic mean, Thiessen polygon and Isohyetal method.</p> <p>1.5 Runoff: Definition, factors affecting Runoff (No Numerical questions).</p> <p>1.6 Maximum Flood Discharge measurement: Empirical methods.</p>	<p>Video Demonstrations</p> <p>Lecture Using Chalk-Board</p> <p>Presentations</p> <p>Site/Industry Visit</p> <p>Collaborative learning</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Explain the terms, "Cropping seasons, Crop period, Duty, Delta, base period, Culturable Command Area, Gross Command Area, intensity of irrigation."</p> <p>TLO 2.2 Establish the relationship between duty, delta and base period.</p> <p>TLO 2.3 Compute the crop water requirement and canal capacity from the given data.</p> <p>TLO 2.4 Propose the relevant method of supplying irrigation water in the cropping season.</p> <p>TLO 2.5 Suggest relevant measures of silt control in a given type of dam with justification.</p> <p>TLO 2.6 Compute the control levels for the given reservoir from the given data.</p>	<p>Unit - II Crop water requirement and Reservoir Planning</p> <p>2.1 Crop Water requirement: Cropping seasons, Crop period, Duty, Delta, base period, Culturable Command Area, Gross Command Area, intensity of irrigation, factors affecting duty.</p> <p>2.2 Relation between duty, delta and base period.</p> <p>2.3 Numerical on water requirement and capacity of canal. IKS: Rahat water Irrigation system in India.</p> <p>2.4 Methods of Irrigation: Surface, subsurface and overhead irrigation.</p> <p>2.5 Silting of Reservoir: Rate of silting, factors affecting silting and control measures.</p> <p>2.6 Control levels in reservoir. Numerical on fixing control levels of reservoir.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Collaborative learning</p>
3	<p>TLO 3.1 Classify the dams based on given criteria.</p> <p>TLO 3.2 Draw a labeled cross-sectional sketch of Earthen dam.</p> <p>TLO 3.3 Propose the suitable control measure to reduce the seepage through the foundation and embankment of earthen dam.</p> <p>TLO 3.4 Explain with the sketch the various forces acting on the gravity dam.</p> <p>TLO 3.5 Propose the types of spillways for given type of dam with justification.</p> <p>TLO 3.6 Propose the types of energy dissipaters for the given type of dam with justification.</p>	<p>Unit - III Dams and Spillways</p> <p>3.1 Dam and its classification based on use, materials and hydraulic design.</p> <p>3.2 Earthen Dams: Components with function, typical cross section.</p> <p>3.3 Methods of construction of earthen dam, seepage through embankment and foundation and its control, Types of failure of earthen dam and its preventive measures.</p> <p>3.4 Gravity Dams: Forces acting on dam, typical cross section, drainage gallery.</p> <p>3.5 Spillways: Definition, function, Types. Emergency and service spillway - ogee spillway and discharge over spillway, Spillway gates .</p> <p>3.6 Energy dissipation.</p>	<p>Lecture Using Chalk-Board Model Demonstration Video Demonstrations Presentations Site/Industry Visit Collaborative learning Case Study</p>
4	<p>TLO 4.1 Explain the procedure for construction of given type of Bandhara.</p> <p>TLO 4.2 Propose the suitable location for construction of percolation tank.</p> <p>TLO 4.3 Design the typical layout of Lift Irrigation system in the given situation.</p> <p>TLO 4.4 Design the typical layout of Drip and Sprinkler irrigation for the given condition.</p> <p>TLO 4.5 Suggest the layout for the Well Irrigation scheme in the given site conditions.</p>	<p>Unit - IV Minor and Micro Irrigation</p> <p>4.1 Bandhara irrigation: Introduction, Layout, components, construction.</p> <p>4.2 Percolation Tanks: Selection of site, need, construction.</p> <p>4.3 Lift irrigation scheme: Components and their functions, layout.</p> <p>4.4 Drip and Sprinkler Irrigation: components, layout, suitability.</p> <p>4.5 Well irrigation: Introduction, types, advantages and disadvantages.</p>	<p>Lecture Using Chalk-Board Video Demonstrations Case Study Presentations Site/Industry Visit Collaborative learning</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	<p>TLO 5.1 Classify the weirs based on given conditions.</p> <p>TLO 5.2 Suggest the suitable site for barrage construction.</p> <p>TLO 5.3 Draw a labeled sketch of the given type of diversion headwork.</p> <p>TLO 5.4 Classify the canal on the basis of alignment and position in the given canal network.</p> <p>TLO 5.5 Suggest the relevant type of construction material used for lining of given canal.</p> <p>TLO 5.6 Propose the relevant type of Cross Drainage work in given site condition.</p> <p>TLO 5.7 Propose the relevant types of regulators used for specific purpose in canal irrigation system</p>	<p>Unit - V Diversion Headwork and Canals</p> <p>5.1 Weirs: Introduction, components, classification. K.T. weir : components and construction.</p> <p>5.2 Barrages : Introduction, components and their functions, location.</p> <p>5.3 Diversion headwork : Layout, components and their function.</p> <p>5.4 Canals: Definition, classification according to alignment and position in the canal network, cross section of canal in embankment and cutting, partial embankment and cutting.</p> <p>5.5 Canal lining: Purpose, construction material used, advantages.</p> <p>5.6 Cross Drainage works: Aqueduct, siphon aqueduct, super passage, level crossing.</p> <p>5.7 Canal regulators: Head regulator, Cross regulator, escape, falls and outlets.</p>	<p>Lecture Using Chalk-Board Model</p> <p>Demonstration Video</p> <p>Demonstrations</p> <p>Case Study</p> <p>Presentations</p> <p>Site/Industry Visit</p> <p>Collaborative learning</p>

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Estimate average rainfall or Runoff from the given data	1	*Estimation of average rainfall OR Runoff using relevant method.	2	CO1
LLO 2.1 Estimate the water requirement for the cropping season for given area.	2	*Estimation of crop water requirement for the given data and cropping season.	2	CO2
LLO 3.1 Estimate Canal capacity based on the given data.	3	Computation of Canal capacity from crop water requirement .	2	CO2
LLO 4.1 Compute the control levels for the reservoir from given data	4	*Computation of control levels for the reservoir.	2	CO2
LLO 5.1 Prepare a detailed technical presentation on major dams in India.	5	*Prepare a detailed report on any two major dams in India by observing relevant videos.	2	CO3
LLO 6.1 Prepare detailed technical report for the identified water resource project.	6	Site visit to any nearby water resource project (Dam/Canal/Weir/diversion headwork/any other irrigation project) and prepare detailed technical report.	2	CO3
LLO 7.1 Prepare detailed technical presentation on any one micro or minor irrigation scheme.	7	*Prepare detailed report on any one irrigation scheme (Micro OR Minor) by site visit or observing relevant videos.	2	CO4
LLO 8.1 Prepare a detailed report on financial assistance of central/state government schemes for the Jalayukt shivar Yojana / Farm ponds / Drip Irrigation scheme.	8	Collect information and Prepare a detailed report on financial assistance of central/state government schemes for the Jalayukt shivar Yojana / Farm ponds / Drip Irrigation scheme.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Draw a labeled sketch of existing Cross section of canal in filling OR cutting OR partial cutting and filling	9	*Sketch the existing Cross section of canal in filling OR in cutting OR in partial cutting and filling, nearby area by measuring actual dimensions.	2	CO5
LLO 10.1 Draw a labeled sketch of Cross Drainage works using actual measurements.	10	Sketch any one existing Cross Drainage works in nearby area by measuring the actual dimensions.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a report of cropping pattern, for the given minor or major irrigation project in your area with reference to growth in yield.
- Prepare a report on any one executed system of rainwater harvesting with reference to its necessity, broad design parameters, economics in your area along with your comments.
- Conduct online / internet survey for Watershed management project (s) in the Maharashtra State with a detailed report of at least five relevant technical inputs.
- Summarize the relevant information in the form of the report from internet regarding types of satellite imagery to capture the necessary details of the given water resource projects.
- Prepare a report on any one executed system of Farm ponds or Jalayukt shivar schemes or drip irrigation scheme with emphasis on its suitability, costing, utility and maintenance after undertaking the visit to it.
- Visit to the nearby rain gauge station and obtain information for the average rainfall for the particular day.
- NOTE: "These are the optional activities for extra learning of students".

Assignment

- Compare Automatic & Nonautomatic rain gauges based on any four points.
- Prepare details report of IMD rain gauge stations in your locality.
- Visit to a drip irrigation installation in your area & write brief report.
- Prepare a short report on well irrigation based on yield & season wise crops grown.
- Prepare a model of dam by using locally available material.
- Write the initiatives taken by state government for drip irrigation & sprinkler irrigation.
- Write a short report on cooperative equal water distribution system in your area.
- Measure evaporation of water in summer season by using available vessels & equipment's.
- NOTE: "These are the optional activities for extra learning of students".

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	N.A	

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Irrigation and Hydrology	CO1	7	4	4	4	12
2	II	Crop water requirement and Reservoir Planning	CO2	9	0	4	12	16
3	III	Dams and Spillways	CO3	11	4	8	6	18
4	IV	Minor and Micro Irrigation	CO4	5	2	4	4	10
5	V	Diversion Headwork and Canals	CO5	8	0	8	6	14
Grand Total				40	10	28	32	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered. For formative assessment of laboratory learning 50 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Term Work, Practical examination.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	1	1	1	1	1			
CO2	3	2	2	1	2	2	1			
CO3	3	3	3	3	2	3	3			
CO4	2	2	3	2	2	2	3			
CO5	3	2	3	2	2	3	2			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Punmia, B.C., Pande B, Lal	Irrigation and water power Engineering	Lakshmi Publications, New Delhi - 110 002. Edition 2016 ISBN 13: 9788131807637
2	Sharma R.K. and Sharma T.K	Irrigation Engineering	S.Chand and Company Ltd.Delhi ISBN 13: 9788121921282 Ed.2002
3	Basak N.N.	Irrigation Engineering	McGraw Hill Education India Pvt. Ltd. New Delhi.Edition 1999 ISBN 13: 9780074635384
4	Dahigaonkar J.G.	Irrigation Engineering	Asian Book Pvt. Ltd., New Delhi ISBN 13: 9788184120080
5	S.K.Garg	Irrigation and Hydraulic structures	Khanna Publishers, Delhi. ISBN: 978-81-7409-047-9

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://wrd.maharashtra.gov.in/	Water resource department, government of Maharashtra, India
2	https://archive.nptel.ac.in/courses/126/105/126105010/	Introduction to Irrigation Engineering and Hydrology
3	https://www.youtube.com/watch?v=fx1uUek3Iqg	Hydrological cycle and Methods of computing Average rainfall
4	https://nptel.ac.in/courses/105105110	Surface & ground water resources
5	https://www.youtube.com/results?search_query=crop+water+requirement	Crop water requirement
6	https://archive.nptel.ac.in/courses/126/105/126105010/	Crop water requirement
7	https://www.youtube.com/watch?v=bDwow2-WzHo	Introduction to Dams
8	https://archive.nptel.ac.in/courses/105/105/105105110/	Notes on Gravity Dam

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Sr.No	Link / Portal	Description
9	https://archive.nptel.ac.in/courses/105/105/105105110/	Notes on Spillways and Energy Dissipators
10	https://archive.nptel.ac.in/courses/126/105/126105019/	Micro irrigation engineering
11	https://archive.nptel.ac.in/courses/126/105/126105010/	Sprinkler irrigation and Drip Irrigation
12	https://archive.nptel.ac.in/courses/126/105/126105010/	Irrigation wells
13	https://www.youtube.com/watch?v=pEdY37n7CdE	Introduction to Canal
14	https://www.nitsri.ac.in/Department/Civil%20Engineering/CIV-604_IHS-6th_CIVIL-Chapter-5_Notes.pdf	Cross Drainage works
15	https://www.youtube.com/watch?v=Ps99Cs0RQJs	Canal design
Note : <ul style="list-style-type: none"> Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students 		

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