GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-V

Course Title: Irrigation Engineering
(Course Code: 4350607)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

Water is intentionally added to crops during irrigation. This agricultural method, especially in arid regions, enables plants to flourish when there is enough rainfall. It is also used in less arid areas to provide plants with the water they require when setting seeds. Agriculture, which continues to use irrigation more and more, uses about 66% of the world's water catchment. When there is a lack of natural water from rain, irrigation is the artificial technique of adding water to the soil to aid in preserving the landscape or growing agricultural products. In addition, irrigation can be used to avoid soil compaction, control weed growth in grain fields, and protect plants from frost, among other purposes in crop production.

Diploma holders in civil engineering are responsible for supervising the development, upkeep, and repair of canals, headworks, river training projects, cross drainage projects, and other projects. Some diploma holders are also employed to prevent waterlogging and tube well irrigation. This course covers hydrology, flow irrigation, storage, and distribution systems, head works construction features, river training works, cross drainage works, causes and mitigation of waterlogging, and tube well construction.

For a diploma civil engineer, basic knowledge of green building-related construction costs will be very useful. This course provides the necessary knowledge and skills to develop competency in the areas mentioned above professionally.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Impart knowledge about irrigation structures and irrigation systems in different phases.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

(a)Evaluate water requirement for crops and select suitable irrigation method for given Condition.
(b) Explain methods to determine reservoir capacity.
(c) Classify the components of dams and spillways.
(d) Design most economical section of canal.
(e) Describe process of evaluation of irrigation project.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of Cos, and the remaining 20 marks are the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Cos. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Draw sketches of:		08
1	Methods of irrigation	II	
2	The layout of drip irrigation	II	
3	The layout of sprinkler irrigation	II	
4	Types of dams	IV	
5	Types of spillways	IV	
6	Cross sections of canal	V	
7	Cross drainage works	V	
	Solve Numerical from Given data to:		12
8	Compute Base period, duty and delta, GCA, CCA*	I	
9	Design of Sprinkler irrigation system*	II	
10	Design of Drip irrigation system*	II	
11	Calculate the reservoir capacity *	III	
12	Design of the most economical section of the canal*	V	
	Field Visit and Prepare Report:		04
13	Arrange Field visit to nearby Irrigation departments or irrigation project		
	Present in a Seminar:		
14	Select one topic of this subject in a group of four to five students and present it using modern teaching aids in Infront of teachers and students.		04
	Total		**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above-listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs.	Weightage in %
1	Initiative of students in collecting data and computation	20
2	Use of appropriate methods while work in team/group	20
3	Comprehension and presentation skills in drawing	20
4	Follow up standard steps for design calculations	20
5	Presentation of seminar and Timely submission	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practice in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing instruments	1 to 7
2	Computing devices	8 to 12

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the development of the COs and competency is not missed out by the

students and teachers. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit-I Introduction & water requirement of crops	1a. Justify the necessity and scope of Irrigation engineering. 1b. Understand historical irrigation development in India. 1c. Illustrate various terminology regarding irrigation and soil water plant relationship. 1d. Identify the application of irrigation water and its assessment	2.1 Necessity of Irrigation 2.2 Scope of Irrigation 2.3 Historical development of irrigation in India 2.4 Types of irrigation projects in India. 2.5 Duty, Delta, Base period, Net irrigation requirement, Intensity of irrigation, Gross Command area, Culturable command area, Crop period, Core depth, Soil-water-plant relationship, wilting point. 2.6 Consumptive use of water 2.7 Various methods of application of irrigation water 2.8 Benefits and ill effects of irrigation 2.9 Assessment of irrigation water.
Unit-II Methods of Irrigation	2a. Classify methods of irrigation and their suitability. 2b. Differentiate between Sprinkler and Drip irrigation and its pros and cons	2.1 Classification of irrigation 2.2 Surface and Subsurface Irrigation Methods 2.3 Sprinkler Irrigation and Drip Irrigation, Need, components and layout 2.4 Precautions and Maintenance of Sprinkler and Drip irrigation system
Unit-III Reservoir Planning, Water Logging and Land reclamation	3a. Describe surveys carried out for irrigation project and its data collection 3b. Explain methods of computing capacity and reservoir and its control 3c. State water logging and land reclamation with its effects	3.1 Surveys carried out for irrigation Projects and data collection. 3.2 Methods of calculating capacity of Reservoir 3.3 Area capacity curve 3.4 Silting of the reservoir 3.5 Factors affecting silting 3.6 Waterlogging and its Effects 3.7 Remedial measures of waterlogging 3.8 Land Reclamation and its Effects
Unit-IV Dams and Spillway	4a. Explain various types of dams and its site selection criteria 4b. Distinguish between earthen dam and gravity dam 4c. State the failures of earthen	4.1 classification of dams 4.2 Factors affecting in the selection of site for the dam 4.3 Earthen dam, Gravity dam & its cross sections, components, seepage through embankment and foundation with its control

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	dam and preventive measures 4d. Illustrate different types of spillways and its suitable location	4.4 failures of earthen dam and its preventive measures 4.5 Types and Components of spillways and its suitability Criteria 4.6 Energy dissipators
Unit-V Canal Irrigation & cross drainage works	5a. Classify canals according to alignment and position 5b. Design the most economical section of the canal 5c. Explain canal lining and its purpose 5d. Identify various cross drainage works and canal regulators	5.1 Classification of canals according to alignment and position 5.2 cross-sections of canal in embankment with partially cutting and partially filling. 5.3 Most economical section of canal with its design. 5.4 Canal lining: purpose, material used and its properties, advantages 5.5 cross drainage works: Aqueduct, siphon aqueduct, super passage, level crossing 5.6 canal head regulators and cross regulators.
Unit-VI Evaluation of irrigation projects	6a. Describe the main criteria for the evaluation of the irrigation project 6b. Explain the process of evaluation of the irrigation project 6c. State the case study of the irrigation project.	6.1 theory for water evaluation for farming use 6.2 methodology for Estimation of hydraulic investment 6.3 Result of methodology 6.4 Case study of irrigation project

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction and Water requirement of crops	08	4	4	4	12
II	Methods of irrigation	07	2	4	6	12
III	Reservoir planning, water logging, and land reclamation	10	4	6	6	16
IV	Dams and spillways	06	2	4	4	10
V	Canal irrigation and cross-drainage works	07	4	4	4	12
VI	Evaluation of irrigation projects	04	0	4	4	8
Total		**42**	**16**	**24**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students in their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U, and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

(a) Prepare Model of Dams and Spillways
(b) Prepare model of Cross drainage works

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

f) Guide students on how to address issues on environ and sustainability
g) Expert lecture by practicing valuer on Valuation techniques, methods and criteria of any property.
h) Expert lecture on latest software for Estimating and costing

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

(a) Automated irrigation system using IoT Technology
(b) Design of sprinkler/Drip irrigation system
(c) Analysis of ground water quality for irrigation
(d) Development of Solar powered irrigation system
(e) Optimization of water use for irrigation through crop water requirement Estimation
(f) Development of Smart irrigation system

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year, and ISBN
1	Irrigation theory and practice	A.M. Mitchel	Vikas Pub. House Pvt. Ltd, Delhi. ISBN: 9780706924848, 2008
2	Irrigation, Water Resources, and Water Power Engg.	Dr. P.N. Modi	Standard Book House, Delhi. ISBN: 9788189401290, 2008
3	Hydrology and Water Resources	R.K. Sharma	Dhanpat Rai and Sons, Delhi. 1987
4	Hydrology and Water Resources Engg.	S. K. Garg	Khanna Pub., Delhi. ISBN: 8174090614, 2015 edition
5	Watershed management in India	J.V.S. Moorthy	Willey Eastern Ltd. ISBN: 8122435181, 2017
6	Water Resources Engg-	C. Satyanarayan	New Age International

S. No.	Title of Book	Author	Publication with place, year, and ISBN
	Principles and Practice	Murthy	Ltd., New Delhi ISBN: 9788122413823

14. SOFTWARE/LEARNING WEBSITES

a) www.guj-nwrws.gujarat.gov.in
b) www.swhydrology.gujarat.gov.in
c) www.nptel.ac.in

15. PO-COMPETENCY-CO MAPPING

Semester IV	ESTIMATING, COSTING & VALUATION (Course Code: ……)									
	POs and PSOs									
Competency & Course Outcomes	**PO 1** Basic & Discipline-specific knowledge	**PO 2** Problem Analysis	**PO 3** Design/ development of solutions	**PO 4** Engineering Tools, Experimentation &Testing	**PO 5** Engineering practices for society, sustainability & environment	**PO 6** Project Management	**PO 7** Life-long learning	**PSO 1**	**PSO 2**	**PSO 3** (If needed)
Competency	Impart knowledge about irrigation structures and irrigation systems in different phases.									
CO(a) Evaluate water requirements for crops and select suitable irrigation methods for given conditions.	3	3	-	-	1	-	-			
CO(b) Explain methods to determine reservoir capacity.	3	3	-	-	-	-	-			
CO(c) Classify the components of dams and spillways.	3	1	-	-	1	-	-			
CO(d) Design most economical section of canal.	3	3	2	-	-	-	2			
CO(e) Describe process of evaluation of irrigation project.	3	-	-	-	1	1	1			

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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