GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-IV

Course Title: Estimating and Costing in Environmental Engineering
(Course Code: 4341302)

Diploma programme in which this course is offered	Semester in which offered
Environmental Engineering	4th Semester

1. RATIONALE

Estimation and Costing is a vital part of Environmental Engineering. No project can begin without the total Estimation and Costing done by the Engineer. The entire cost of construction and the infrastructure used for the purpose of construction is estimated and the final costing is done on the basis of which funding is arranged for the project and orders are given to construction firms. Valuation is also one such important part of Estimation and Costing. Valuation is done after the project is complete on the latest trends of the land prices in the market. Therefore, this course has been designed so that the diploma Environmental engineer is able to prepare estimate and costing of Treatment Plant and other Environmental engineering projects which involves civil construction work.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

- **Prepare estimate and cost of water and waste water treatment plant projects.**

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) Outline the fundamentals of estimating and costing
b) Prepare estimate by interpreting detailed drawing for environmental projects
c) Prepare specifications and rate analysis for the items of environment related construction works
d) Draft tender and contract documents for environment related construction projects
e) Estimate value of a property using appropriate methods.

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 integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the 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. *All the **PrOs** 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
1	Interpretation of building drawings and identification of mode of measurement of various civil works	I	02
2	Estimate the civil works like footing, Column, Beam, Slab, Lintel, Weather shed.	I	02
3	Estimate items of RCC Compound wall, Residential Building	II	02
4	Estimate cost of septic tank of given specification	II	02
5	Estimate cost of brick cum RCC type underground water storage tank of given specification or by measuring the dimensions of the existing structure.	II	02
6	Estimate cost of egg shaped sewer of given specification or by measuring the dimensions of the existing structure.	II	02
7	Estimate of Surface Drain of given specification	II	02
8	Estimate Aeration tank of given specification	II	02
9	Estimate of Sedimentation tank with hopper bottom of given specification	II	02
10	Write the specification for different civil construction items.	III	02
11	Compare the actual analysis rates of items with the S.O.R. of P.W.D	III	02
12	Prepare Rate Analysis for various civil items of work	III	02
13	Study Tender notices and identify type of tender and contract	IV	02
14	Solve examples based on valuation of properties.	IV	02
	Total hrs.		**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	Content of Assignment	10
2	Organization of Assignment	10
3	Clarity of concept and ability to solve examples	40
4	Neatness	10

5	Timeliness	10
6	Discipline	10
7	Viva-voce	10
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 practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system (An computer system with basic configuration)	(2-14)

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 fulfill the development of this competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) Practice of environmental friendly methods and processes.

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 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 attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Introduction to Estimation and mode of measurement**	1a. Explain the objective and importance of estimating and costing 1b. Interpret construction drawings 1c. Draw format of measurement sheet, abstract sheet 1d. Explain different provisions made in I.S.1200 for measurement of different construction item.	1.1 Importance, Meaning & objectives of estimating & costing. 1.2 Types of Projection adopted in Building Drawing. 1.3 Skills required for a good estimator 1.4 Fundamental component of the drawing 1.5 Standard format of measurement sheet, abstract sheet and its use 1.6 Purpose, accuracy, units, rules of measurement of various items of civil work.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		1.7 Mode of measurements for civil works items (As per I.S. 1200)
Unit – IIDetailed Estimation	2a. Explain the different types of estimates and terminology 2b. Compute the quantities different construction works items- Residential building, lintel, beam slab, Septic Tank, Earthwork, Brick cum RCC type underground water storage tank, Egg shaped sewer, Surface Drain, Aeration Tank. 2c. Describe Lead and Lift, converting Lift into Lead, method of calculation of earthwork, Balancing depth, Estimate of Canal 2d. Prepare the measurement sheet	2.1Types of estimates: Preliminary and detail estimates, approximate methods of costing, centerline method and long wall short wall method 2.2Define: Provisional sum, provisional item, prime cost, spot item, Day Work, Overhead charges, contingencies, water charges, establishment charges, contractor's profit, Administrative approval, Technical Sanction (Competent Authority), Work charged establishment, organization chart of various departments. 2.3 Methods of computing the quantities- Center line method, Long wall and short wall method 2.4 Estimate of Septic tank and study of its constructional features, advantages and disadvantages, Brick cum RCC type underground water storage tank , Egg shaped sewer, Surface Drain, Aeration Tank, Canal earthwork
Unit– III **Specification and Rate Analysis**	3a. Explain the importance of specifications. 3b.Prepare the specification for civil works items. 3c. Describe the importance of rate analysis. 3d. Explain the factors affecting rate analysis. 3e. Compute rate analysis of various civil works items.	3.1 Definition, purpose & importance of specifications and its types 3.2 Principles of Design and drafting of specifications 3.3 Specification writing for some useful items like Excavation, Cement Concrete, Brickwork, Plaster, laying of pipes 3.4 Definitions, Importance, purpose & factors affecting the rate analysis. 3.5 Rate analysis of various civil works items like excavation for foundation, plain cement concrete in foundation, R.C.C. slab, 1st class brickwork, cement plaster etc.
Unit– IV **Tender and Contract**	4a. Define the tender and classify tenders. 4b. Describe Tender document and all terms related to tender. 4c. Draft a tender notice of invitation for a specified work	4.1 Tenders :Classification , Opening and scrutiny , Modes of acceptance , Powers of accepting , Revocation ,Documents required for inviting tender, Tender form and notice inviting tender, Unbalanced, Informal and Global tender

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	4d. State modes of acceptance of tender. 4e. Describe contract, its types with their advantages and disadvantages 4f. Explain important terms- Earnest money, Retention money, Security deposits and various types of bills. 4g. Differentiate between Departmental execution and contract system 4h. State the conditions of Termination of contract	4.2 Contract: Types, Elements of validity, Conditions, Termination, Methods for execution of work done in P.W.D, selection of mode of execution Elements of perspective drawing. 4.3Define Earnest money, Retention money, Security deposits and various types of bills. 4.4 Difference between Departmental execution and contract system 4.5 Termination of contract
Unit– V Valuation	5a. Describe various terms related to valuation. 5b. Describe valuation methods and sinking fund. 5c. Describe characteristics of good valuer 5d. State the types of Value and Factors affecting the value of a Property 5e. Describe sinking fund and application. 5f. Explore recent trends in valuation	5.1Terms of valuation : Cost, Price, Value, Real estate, Personal estate 5.2Valuation- its purpose and methods for property. 5.3 Mortgage, freehold property, leasehold property, Property income, gross income, net income, outgoing, Depreciation and obsolescence 5.4 Characteristics of good valuer 5.5 Factors affecting the value of a property. 5.6 Sinking fund: its computation and application. 5.7 New aspects to be considered in Valuation-Big Data and valuation, Blockchain and valuation, Artificial intelligence and automated valuation.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution ofTheory Marks			
			R Level	U Level	A	Total Marks
I	Introduction to Estimation and mode of measurement	3	04	02	00	06
II	Detailed Estimation	7	02	05	05	12
III	Specification and Rate Analysis	10	04	08	14	26
IV	Tender and Contract	6	04	04	08	16
V	Valuation	2	02	04	04	10
Total		**28**	**16**	**23**	**31**	**70**

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

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test*

items/questions 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) Interpret various drawings of environmental structures and label the parts and identify various dimensions
b) Collect the tenders notice and identity the different informations given in it.
c) Visit construction site and study the drawings and quantity estimation sheets.
d) Prepare Organization Chart of water supply & sewage Board, Pollution control board, Gujarat Ecology Commission, Gujarat State Public Works Department.
e) Undertake micro-project.
f) Give seminar on any relevant topic.

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.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability

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 six.***

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) Prepare a chart depicting rules of deduction of openings for below mentioned items of work as per IS 1200-a) Brick masonry b) Stone masonry c) Plastering d) Pointing
b) Visit construction site and prepare report on actual labors required for particular item of civil work like earthwork, concrete work, plastering, painting, flooring
c) Prepare a chart showing difference between market price and SOR price of various building materials
d) Perform rate analysis using market rates and SOR rates and compare the results.
e) Prepare report on Artificial Intelligence and automated valuation.
f) Prepare a chart showing cut outs of various types of Tender notices appearing in newspaper
g) **Model:** Prepare a scaled model of a reinforcement details of beam, lintel, Retaining wall, hopper bottom sedimentation tank.
h) **Model:** Prepare a scaled model of a various environmental structures like Aeration tank, clarifier, tube settler, trickling filter etc.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Estimating & Costing in Civil Engg	B.N. Dutta	UBSPD
2	Estimating & Costing (Civil Engg.)	S. C. Rangwala	Charotar Publication
3	A text book of Estimating & Costing	G. S. Birdie	DhanpatRai
4	Estimating & Costing	Vazirani & Chandola	Khanna Publisher
5	Civil Estimating costing & valuation	Amarjit Aggarwal & A.K. Upadhay	S.K.Kataria
6	CPWD SOR(2012)	CPWD	Director general,CPWD,New Delhi
7	PWD Hand books (Vol. I & Vol. II)	Govt.of Gujarat	Govt.of Gujarat
8	I.S. code 1200 (Part I to XXX)	B.I.S., Delhi	B.I.S., Delhi

14. SOFTWARE/LEARNING WEBSITES

a) https://onlinecourses.swayam2.ac.in/
b) www.ensoftindia.com
c) www.newtonindia.com
d) www.estimator.com
e) www.cpwd.gov.in>Publication

15. PO-COMPETENCY-CO MAPPING

Semester IV	Estimating and Costing in Environmental Engineering(Course Code:4341304)									
	POs and PSOs									
Competency & Course Outcomes	**PO 1Basic& Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3Design / development of solutions**	**PO 4Engineering Tools, Experimentation &Testing**	**PO 5Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7Life-long learning**	**PSO 1 Environmental planning & design**	**PSO 2 Environmental Impact Assessment**	**PSO 3** (If needed)
Competency	i. Prepare estimate and cost of water and waste water treatment plant projects.									
Course Outcomes CO a) Outline the fundamentals of estimating and costing	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO b) Prepare estimate by interpreting detailed drawing for environmental projects	**3**	**3**	**3**	**1**	**2**	**-**	**2**	**2**	**2**	**-**
CO c) Prepare specifications and rate analysis for the items of environment related construction works	**3**	**2**	**2**	**-**	**1**	**-**	**2**	**2**	**2**	**-**
CO d) Draft tender and contract documents for environment related construction projects	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**
CO e) Estimate value of a property using appropriate methods.	**3**	**2**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**

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

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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