GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Surveying for Environmental Engineering**
(Course Code: 4341304)

Diploma programme in which this course is offered	Semester in which offered
Environmental Engineering	Fourth

1. RATIONALE

Before development and planning process for any environmental engineering project, at first field survey of that area is carried out and various type of survey maps are prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process etc.

The diploma pass outs/technicians should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. It is also important for them to be well aware about the use of advance surveying instrument such as total station, GPS and related software to enhance the knowledge and abilities required for surveying in field.

This course is therefore one of the core courses required for environmental engineers. Students are advised to master the desired skills which are expected from them for survey related works.

2. COMPETENCY

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

- **Prepare maps and layout by performing survey for environmental 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) Use appropriate scale according to need by applying basics of Surveying
b) Carry out survey of environment related project by chain or tape.
c) Plot traverse by performing compass survey
d) Prepare contour maps by performing leveling
e) Explain basics of remote sensing and GIS
f) Explain basics of Electronic distance measurement, Total station and GPS

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	0	4	3	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) that 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
1	Perform ranging and chaining operations in different field conditions.	02	**02**
2	Perform chaining and ranging where different types of Obstructions are present.	02	**04**
3	Take offsets (Perpendicular and Oblique) in different field Conditions.	02	**02**
4	Compute area of given plan by Mechanical/ Digital Planimeter	02	**04**
5	Perform temporary adjustments of Prismatic Compass	03	**02**
6	Determine bearings of different survey lines by using Prismatic Compass	03	**06**
7	Determine included angles from measured bearings.	03	**04**
8	Perform temporary adjustments of Level Take and record the level reading in the level book Determine Reduced level using both methods by applying checks	04	**04**
9	Carry out fly levelling in different field conditions.	04	**02**
10	Carry out profile levelling in different field conditions	04	**02**
11	Visit existing Water or waste water treatment plant and perform levelling to generate hydraulic flow scheme.	04	**06**
12	Project in Profile Levelling: Carry out the levelling survey on an undulated ground and prepare the drawing sheet (minimum area under survey (50 m X 60 m)	04	**06**
13	Carryout GPS survey by GPS receiver of the traverse surveyed earlier and Compare results obtained and find out accuracy of GPS receiver	05	**04**
14	Carry out GPS survey and prepare Road map of city where college is situated	05	**06**

15	Carry out traverse survey with the help of total station	06	**02**
	Total Hours		**56**

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	Operation and handling of survey instruments	20
2	Taking observations and recording	20
3	Computation of survey data and plotting/ Drawing	40
4	Answer the questions	10
5	Follow safe practices measures while performing practicals	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED – (Not Applicable)

These 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	Metric Measuring Chain (20m and 30m) as per IS 1492 - 1970. M.S. Arrows of 4 mm diameter and 40 cm height	1 to 3
2	Measuring Tape such as Metallic tape, fiber glass tape, invar tape, steel tape, linen tape etc (5m, 10m, 20m, 30m & 50m)	1 to 3, 6,7,8, 9, 10,11,12
3	Ranging Rods of length 2 to 3 meters with conical metallic shoe fitted at bottom & fully painted with 20 cm. long colour bands of either a) Black & White b) Red & White as per IS 2288 - 1963	1,2,3, 6, 7, 8,
4	Mechanical Planimeter: Accuracy: +/- 0.2 %	4
5	Digital Planimeter: Easy conversion function of unit and scale, Accuracy: Within +/-0.2%(Within +/-2/1000pluses)	4
6	Prismatic Compass consisting of brass or aluminum circular box with a diameter of 100/125 millimeter. Aluminum circle consists ofa needle graduated to 30'.	5 to 7
7	Dumpy Level: Internal Focusing, Magnification 24x to 32x, Length of telescope 300 mm, objective aperture 40 mm, field of view 1° 30', resolution 0.01 cm at 100 mt, plate bubble size 12mm x 87.5 mm, circle diameter 75 mm(magnetic)	8 to 12

8	Digital Level: Accuracy of Height: 1 mm, Resolution of Display: 0.001 / 0.001 m Observing range: 1.6m to 100m, Zoom in: 32x	8 to 12
9	Auto Level: Magnification 24x to 32x, objective aperture 32 mm to 42mm, Field of view: 1° 20' to 1° 25' at 100m	8 to 12
10	Leveling Staff: Made of Aluminium body, Telescopic in 3 PCS, 4m inlength, graduated in meters, dm and cm with white background and 5 mm thick black strips with suitable locking arrangement	8 to 12
11	GPS receiver: Garmin or similar make, Hand held GPS receiver with preloaded worldwide base map and display, WAAS enabled, fast positioning, waterproof, support for paperless geocaching	13,14
12	Total Station with standard accessories	15

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 leader/a team member.
b) Follow ethical practices.
c) Practice environmental 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 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 1 **Introduction to Surveying**	1a. Explain the basics of surveying. 1b. Apply various types of scale as per needs.	1.1 Definitions, Objective and uses of surveying,Classification of Survey, Principles of Survey 1.2 Types of Scale and selection of scale,Construction of diagonal scale
Unit 2 **Linear Measurement**	2a. Explain procedure for linear measurements. 2b. Prepare drawing as per recorded measurements in the field book. 2c. Compute area of plan by planimeter	2.1 Methods & Accessories of Linear Measurement, Principle of Chain Surveying, Method of Chaining on Level Ground 2.2 Errors and Mistakes in Chaining and precautions against it, Chain and Tape Corrections, Ranging, 2.3Well-Conditioned and Ill-Conditioned Triangles, Selection of Survey Stations , Equipments for Chain Survey 2.4Procedure of Field Work, Conventional Symbols , Procedure & Equipments for Plotting 2.5 Computation of Area from Plotted Plan using Planimeter 2.6 Computation of Area by The Mid-Ordinate Rule, The Average-Ordinate Rue, The TrapezoidalRule and Simpson's Rule, Computation of Volume using Prismoidal Rule and Trapezoidal Rule
Unit 3 **Traverse by Compass**	3a. Explain procedure for angular measurements & Record bearing accurately 3b.Compute Interior angles from measured bearings.	3.1 Introduction, Purpose, Definitions & Principle of Compass Surveying, Traversing , Methods of Traversing , Types of Compass , Temporary Adjustment of Prismatic Compass 3.2 Field Procedure of Observing Bearing, Problems on Whole Circle Bearing and Quadrantal Bearing 3.3 Problems on Fore and Back Bearings,Problems on Magnetic Declination 3.4 Problems on Included Angle, Problems onLocal Attraction, 3.5 Field Procedure of Compass Traversing, Plotting of Compass Traverse , Adjustment of Closing Error , Sources of Error in Compass , Precautions to be Taken in Compass Surveying

Unit 4 **Leveling & Contouring**	4.a Explain procedure for leveling using instruments and levelling staff and record reading in level book page. 4.b Carry out corrections for errors in levelling 4.c Prepare contour maps by calculating Reduce level as per level book.	4.1 Introduction Basic terminology related withLeveling 4.2 Types of Level: Dumpy Level, Tilting Level 4.3 Auto Level, Digital Level 4.4 Components of Dumpy Level with neat Sketch, Types of Levelling Staffs 4.5 Temporary adjustment of Level, Classificationof Levelling 4.6 Finding out the R. L. in Level Book by H.I. Methods with necessary check with examples 4.7 Finding out the R. L. in Level Book by Rise & Fall Method with necessary check with examples 4.8 Correction for Curvature and refraction andrelated examples, Errors in Levelling Contour, its uses of & Characteristics 4.9 Methods of Contouring, Interpolation of contours 4.10Preparing drawing & estimation of gradients

Unit 5 **Basics of Remote Sensing and GIS and their application**	5a. Explain Remote sensing 5b. Identify Types of remote sensing 5c. Differentiate between Ideal and real remote sensing system 5d. Appreciate the Applications of remote sensing in Environmental Engineering 5e. Explain GIS 5f. Classify various Data mode of GIS 5g. Appreciate the Applications of GIS in Environmental Engineering	5.1 History of Remote sensing, advantages and disadvantages 5.2 Passive and active remote sensing 5.3 Characteristics of ideal and real remote sensing system 5.4 Various applications of remote sensing in areas of agriculture, forest mapping, land cover mapping 5.5 Need for GIS, benefit of GIS 5.6 Rater form and vector form 5.7 Various applications of GIS in areas like Environmental Impact Analysis, Disaster management, surveying, irrigation water management, energy use tracking and planning, site suitability for waste treatment plant, environmental monitoring
Unit 6 **Electronic distance measurement, Total station and GPS**	6a. Explain Principles of EDM 6b. Explain Methods of measurement 6c. Identify parts of Total station 6d. Explain Global positioning system and its application	6.1 Introduction Principles of EDM 6.2 Methods of measurement like Pulse 6.3 Introduction to total station its advantages and disadvantages and various parts of total station with applications of total station 6.4 Application of GPS, advantages and disadvantages and various applications

***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 to Surveying**	02	1	2	1	04
II	**Linear Measurement**	10	4	6	6	16
III	**Traverse by Compass**	10	4	6	6	16
IV	**Leveling & Contouring**	10	4	6	6	16
V	**Basics of Remote Sensing and GIS and their application**	06	3	5	2	10
VI	**Electronic distance measurement, Total station and GPS**	04	3	3	2	08
Total		**42**	**19**	**28**	**23**	**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. Visit a working site and calculate area of land using planimeter and compare it with actual area according to drawing
b. Visit nearby open plot and plot its boundaries with respect to adjacent road/ wall using chain/tape/compass surveying
c. Undertake micro-project.
d. 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) Use video/animation films to explain various processes related to Surveying
g) Use different instructional strategies in classroom teaching.

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 list of tools and equipment used in chain and Tape survey
b) Perform compass survey and prepare drawing of compass traverse in AutoCAD and find its area.
c) Prepare a chart showing difference between WCB and Reduced bearing
d) Conduct market survey and find the latest price of surveying instruments and report it.
e) Perform site selection for landfill site using GIS.
f) Prepare a land use/land change map of residing district using RS and GIS.
g) Conduct GPS survey and prepare road network
h) Overlay the road network prepared by GPS receiver on satellite image.
i) Prepare a report on application of GIS in any of the field related to environmental engineering.
j) Find the accuracy of GPS receiver.
k) Draw layout of college with the help of Total station

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Books	Author	Publication
1	Surveying and levelling Vol-I & II	T. P. Kanetkar & S. V. Kulkarni	Puna Vidyarthi Griha Prakashan
2	Surveying and Levelling Vol-I & II	Dr. B. C. Punmia	Laxmi Publications Pvt. Ltd.
4	Surveying and Levelling Vol-I & II	Hussain & Nagrani	S. Chand New Delhi
5	Surveying	Mimi Das Saikia	PHI Learning Pvt. Ltd
6	Fundamentals of Surveying	S. K. Roy	PHI Learning Pvt. Ltd
7	Surveying and Levelling	N. N. Basak	Tata Mc Graw Hill

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) www.khanacademy
c) www.Autodesk.com
d) www.arcgis.com

15. PO-COMPETENCY-CO MAPPING

Semester IV	Surveying for Environmental Engineering (Course Code:4341304)								
	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 Environmental planning & design	PSO 2 Environmental Impact Assessment
Competency - Prepare maps and layout by performing survey for environmental projects									
a. Use appropriate scale according to need by applying basics of Surveying	3	2	1	3	-	-	2	2	2
b. Carry out survey of environment related project by chain or tape.	**3**	**2**	2	**3**	-	2	2	2	2

c. Plot traverse by performing compass survey	3	3	2	3	-	2	2	2	2
d. Prepare contour maps by performing leveling	3	3	2	3	3	2	2	2	2
e. Explain basics of remote sensing and GIS	3	2	2	3	3	2	3	2	3
f. Explain basics of Electronic distance measurement, Total station and GPS	3	2	2	3	3	2	3	2	3

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

S. No.	Name and Designation	Institute	Contact No.	Email
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