

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Semester-III

Course Title: Surveying
(Course Code: 4330601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering, Mining Engineering	Third

1. RATIONALE

Before development and planning process for any civil engineering or mining 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.

Therefore, this course is designed in such a way that diploma holder can easily carryout survey of given area using traditional and modern survey instrument like chain/tape, dumpy level, theodolite, total station, and use data obtained from survey to measure dimensions, compute area/volume and plot important stations on drawing sheet to obtain plan/map of desired area.

2. COMPETENCY

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

1. Carry out civil engineering survey to prepare drawings & maps
2. Interpret the drawings and maps for calculating different physical quantities like length, area, volume, elevations etc.

3. COURSE OUTCOMES (COs)

1. Use basics of Surveying and choose appropriate scale.
2. Carry out civil engineering survey using chain and tape, compass & Plane table and prepare drawing
3. Carry out leveling using dumpy level/ Digital level/ Auto level and draw contours.
4. Carry out theodolite traverse survey, compute necessary data and draw traverse
5. Compute R.L. of given points using trigonometric survey.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	CA*	ESE	CA	ESE	
03	-	04	05	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. 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	02
3	Take offsets (Perpendicular and Oblique) in different field conditions.	02	02
4	Compute area of given plan by Mechanical/ Digital Planimeter	02	02
5	Perform temporary adjustments of Prismatic Compass	03	02
6	Determine bearings of different survey lines by using Prismatic Compass	03	04
7	Determine included angles from measured bearings.	03	02
8	Set plane table by different orientation methods on given survey station	03	04
9	Project in Plane Table Survey: - Prepare map of open vacant land (min 600 sq.m) using any plane table method	03	04
10	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
11	Carry out fly levelling in different field conditions.	04	02
12	Carry out profile levelling in different field conditions	04	02
13	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
14	Identify various parts of the theodolite and Temporary Adjustment of Theodolite	05	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
15	Measurement of horizontal angle by Repetition & Reiteration	05	04
16	Measurement of vertical angle & deflection angle	05	02
17	To Carry out the project for a closed traverse 4 to 5 stations and prepare the drawing sheet using Gale's Table	05	06
18	Calculation of Height of Object using trigonometry survey	06	04
	Total		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

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical 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, 8, 9, 12, 13, 17, 18
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, 6, 7, 8, 9, 15, 17
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 of a needle graduated to 30'.	5 to 7

S. No.	Equipment Name with Broad Specifications	PrO. No.
7	Plane table board of 750mm x 900 mm size with a fitted tripod, with standard accessories namely Trough compass, Telescopic alidade, Spirit level, Canvas cover, Plumbing Fork etc.	8, 9
8	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)	10 to 13
9	Digital Level: Accuracy of Height: 1 mm, Resolution of Display: 0.001 / 0.001 m Observing range: 1.6m to 100m, Zoom in: 32x	10 to 13
10	Auto Level: Magnification 24x to 32x, objective aperture 32 mm to 42mm, Field of view: 1° 20' to 1° 25' at 100m	10 to 13
11	Leveling Staff: Made of Aluminium body, Telescopic in 3 PCS, 4m in length, graduated in meters, dm and cm with white background and 5 mm thick black strips with suitable locking arrangement	10 to 13
12	Vernier Theodolite: Length of telescope 178 mm, Magnification 25X Effective Aperture 38mm, Field of View 2.6 M at 100M, Short Focus 1.5M, Stadia Ratio 1:100, Stadia Constant 0, Circle Diameter Hz113mm, V100 mm Graduation 20' / 10', Vernier Reading 20" / 10".	14 to 18

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 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, 2.3 Well-Conditioned and Ill-Conditioned Triangles, Selection of Survey Stations , Equipments for Chain Survey 2.4 Procedure 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 Trapezoidal Rule and Simpson's Rule, Computation of Volume using Prismoidal Rule and Trapezoidal Rule
Unit 3 Traverse by Compass and Plane Table	3a. Explain procedure for angular measurements & Record bearing accurately 3b. Compute Interior angles from measured bearings. 3c. Prepare drawing as per field conditions and requirements using plane table	Compass: 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 on Local 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 Plane Table: 3.6 Principle & Accessories of Plane Table , Orientation , 3.7 Procedure of Setting up Plane Table over a Station, Methods of Plane Tabling

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		Special Methods of Resection 3.8 Procedure of Plane Table Traversing, Advantages and Disadvantages of Plane Tabling
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 with Leveling 4.2 Types of Level: Dumpy Level, Tilting Level, Auto Level, Digital Level 4.3 Components of Dumpy Level with neat Sketch, Types of Levelling Staffs 4.4 Temporary adjustment of Level, Classification of Levelling 4.5 Finding out the R. L. in Level Book by H.I. Methods with necessary check with examples 4.6 Finding out the R. L. in Level Book by Rise & Fall Method with necessary check with examples 4.7 Correction for Curvature and refraction and related examples, Errors in Levelling 4.8 Contour, its uses of & Characteristics 4.9 Methods of Contouring, Interpolation of contours 4.10 Preparing drawing & estimation of gradients Calculation of capacity of reservoirs & related examples
Unit 5 Theodolite Traverse	5a. Explain the basic function of different parts theodolite. 5b. Operate theodolite and read horizontal and vertical angle. 5c. Determine the latitude and departure of given points.	5.1 Introduction to theodolite, Uses of theodolite, Sketch and parts of Transit Vernier theodolite 5.2 Reading of main and vernier scale on horizontal and vertical plate 5.3 Temporary adjustment of a theodolite 5.4 Permanent adjustment of theodolite (Fundamental axis of theodolite and their relationship) 5.5 Definitions and various technical terms 5.6 Methods of measuring horizontal angles and vertical angles 5.7 Use theodolite for measuring a magnetic bearing, prolong a line, ranging a line 5.8 Measuring direct and deflection angles 5.9 Errors in theodolite work 5.10 Theodolite Traversing 5.11 Traverse computations Closing errors, Balancing the traverse 5.12 Gale's Traverse Table & Related examples
Unit 6 Trigonometric Survey	6a. Calculate the height of objects through a trigonometrical levelling.	6.1 Introduction & Methods of observations (Direct and Reciprocal) 6.2 Methods of determining the elevation of a particular point when base of the object is accessible 6.3 when base of the object is inaccessible 6.4 Related examples using all methods

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Surveying	02	02	02	00	04
II	Linear Measurement	06	04	06	04	10
III	Traverse by Compass and Plane Table	08	02	04	04	14
IV	Leveling & Contours	10	04	04	08	16
V	Theodolite Traverse	12	06	06	08	20
VI	Trigonometric Survey	04	00	02	04	06
Total		42	18	24	28	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 COs. 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:

- Visit a working site and calculate area of land using planimeter and compare it with actual area
- Visit nearby open plot and plot its boundaries with respect to adjacent road/ wall / using chain/tape or theodolite surveying
- Undertake micro-project.
- 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:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- Guide student(s) in undertaking micro-projects.
- '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-projects 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 a 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 a 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:

1. Find out the area of the given plan by planimeter/ digital planimeter
2. Find out the area of an open plot using linear measurement instruments
3. Calculate the Volume of Earthwork of road/canal section using standard equations and compare the results.
4. Compute Interior angles from Fore bearings and back bearings using Prismatic Compass
5. Calculate the volume of earthwork from a given contour map
6. Measure the vertical height and find out the R.L. of the top of the tower/object using a theodolite
7. Prepare Auto CAD drawing of contour map
8. Prepare Auto CAD drawing of Theodolite traverse and find area of it
9. Prepare Auto CAD drawing of Compass Traverse
10. Collect the relevant technical and commercial information of the survey instruments available in the market with specifications.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
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S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Surveying and levelling Vol-I	T. P. Kanetkar & S. V. Kulkarni	Puna Vidyarthi GrihaPrakashan
2	Surveying and Levelling Vol-I	Dr. B. C. Punmia	Laxmi Publications Pvt.Ltd.
3	Surveying and Levelling Vol-I	Hussain & Nagrani	S. Chand New Delhi
4	Surveying	Mimi Das Saikia	PHI Learning Pvt. Ltd
5	Fundamentals of Surveying	S. K. Roy	PHI Learning Pvt. Ltd
6	Surveying and Levelling, 2 nd Edition	N N Basak	McGraw Hill Education Pvt. Ltd
7	A Textbook of Surveying and Levelling	R. Agor	Khanna Publishers

14. SOFTWARE/LEARNING WEBSITES

1. www.nptel.iitm.ac.in
2. Auto CAD, Civil Architect
3. www.Autodesk.com,

15. PO-COMPETENCY-CO MAPPING

Semester II	Civil Engineering Drawing(Course Code:4320601)									
	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	1. Carry out civil engineering survey to prepare drawings & maps 2. Interpret the drawings and maps for calculating different physical quantities like length, area, volume, elevations etc.									
CO a) Use basics of Surveying and choose appropriate scale.	3	2	-	-	-	-	2	-	-	-
CO b) Carry out civil engineering survey using chain and tape, compass & Plane table and prepare drawing	3	2	2	3	-	2	3	-	-	-
CO c) Carry out leveling using dumpy level/ Digital level/ Auto level and draw contours.	3	3	3	3	-	3	3	-	-	-
CO d) Carry out theodolite traverse survey, compute	3	3	3	3	-	3	3	-	-	-

necessary data and draw traverse										
CO e) Compute R.L. of given points using trigonometric survey.	3	3	3	3	-	-	2	-	-	-

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
1	Shri Ketan C Varmora	Government Polytechnic, Kheda	9725335599	kcvarmora@gmail.com
2	Shri Pranav P Mehta	Government Polytechnic, Ahmedabad	9904779952	pranavhy@gmail.com