



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Engineering**

**Level: Diploma**

**Branch: Civil Engineering**

**Course / Subject Code: DI03006021**

**Course / Subject Name: Advance Surveying**

|                                |                 |
|--------------------------------|-----------------|
| <b>w. e. f. Academic Year:</b> | 2024-25         |
| <b>Semester:</b>               | 3 <sup>rd</sup> |
| <b>Category of the Course:</b> | PCC             |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Prerequisite:</b> | Students must be proficient in Mathematics and Basic Surveying, have a keen interest in surveying, and have problem-solving skills.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Rationale:</b>    | Conducting a field survey of the area and preparing various survey maps are essential for any civil engineering or mining project. These maps are crucial for planning, design, estimation, and construction decisions. Diploma holders need to understand different surveying methods and equipments. They should also be skilled in using and operating them. The course is designed to help diploma holders efficiently conduct surveys using equipments like Chain/tape, Theodolite, Total Station, Handheld G.P.S., etc. They will acquire skills in measuring dimensions, computing areas and volumes, and creating precise drawings, strengthening their practical knowledge and field expertise. |

## Course Outcome:

After Completion of the Course, the students will be able to:

| No | Course Outcomes                                                                            | RBT Level |
|----|--------------------------------------------------------------------------------------------|-----------|
| 01 | Carry out theodolite traverse survey, compute necessary data, and draw traverse.           | R, U, A   |
| 02 | Conduct contour survey for undulating/hilly regions using a Tacheometer and draw contours. | R, U, A   |
| 03 | Set out a horizontal curve using a theodolite.                                             | R, U, A   |
| 04 | Conduct a traverse survey using a total station and demonstrate a Hand-Held GPS.           | R, U, A   |

*\*Revised Bloom's Taxonomy (RBT)*

## Teaching and Examination Scheme:

| Teaching Scheme<br>(in Hours) |    |    | Total<br>Credits<br>L+T+<br>(PR/2) | Assessment Pattern and Marks |        |                      |         | Total<br>Marks |
|-------------------------------|----|----|------------------------------------|------------------------------|--------|----------------------|---------|----------------|
| L                             | T  | PR | C                                  | Theory                       |        | Tutorial / Practical |         |                |
|                               |    |    |                                    | ESE<br>(E)                   | PA (M) | PA(I)                | ESE (V) |                |
| 02                            | 00 | 04 | 04                                 | 70                           | 30     | 20                   | 30      | 150            |



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## Course Content:

| Unit No. | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No. of Hours | % of Weightage |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| 1        | <b>Theodolite Traverse:</b><br>1.1 Introduction to theodolite, Uses of theodolite, Sketch and parts of Transit Vernier theodolite.<br>1.2 Reading of main and vernier scale on horizontal and vertical plate.<br>1.3 Temporary adjustment of a theodolite.<br>1.4 Permanent adjustment of theodolite (Fundamental axis of theodolite and their relationship).<br>1.5 Definitions and various technical terms.<br>1.6 Methods of measuring horizontal angles and vertical angles.<br>1.7 Use theodolite to measure a magnetic bearing, prolong a line, and range a line.<br>1.8 Measuring direct and deflection angles.<br>1.9 Errors in theodolite work.<br>1.10 Theodolite Traversing.<br>1.11 Traverse computations, closing errors, Balancing the traverse.<br>1.12 Gale's Traverse Table & Related Examples. | 07           | 23             |
| 2        | <b>Trigonometric and Tacheometric Survey:</b><br>2.1 Introduction & Methods of Observations.<br>2.2 Methods of determining the elevation of a particular point when the base of the object is accessible or inaccessible.<br>2.3 Introduction, Purpose, and Principles of Tacheometric Surveying.<br>2.4 Theory of Stadia Tacheometry, Analytic Lens and advantages & disadvantages of it.<br>2.5 Methods of determining constants of a Tacheometer.<br>2.6 Methods of Tacheometry (Stadia method).<br>2.7 Method of Fixed Hair:<br>- When the line of sight is horizontal and staff held vertically<br>- When the line of sight is inclined and staff held vertically<br>(Angle of Elevation & Depression).<br>2.8 Related examples of Tacheometer constant & Tacheometric methods.                             | 10           | 33             |
| 3        | <b>Curves:</b><br>3.1 Types of circular curves.<br>3.2 Definitions and Notations<br>3.3 Designation of the curve<br>3.4 Relation between Radius and degree of curve<br>3.5 Elements of a simple circular curve                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 05           | 17             |



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|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |            |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|
|          | 3.6 Setting out a simple circular curve.<br>3.7 Methods of setting out simple circular curves.<br>3.8 Transition curves<br>- Requirements and purpose of it.<br>3.9 Vertical curves.<br>3.10 Related examples of curves.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |            |
| <b>4</b> | <b>Advanced Surveying Equipments:</b><br>4.1 Introduction and basics of Digital Theodolite.<br>4.2 Principles of E.D.M.<br>4.3 Introduction and Basics of Total station:<br>- Parts of Total station<br>- Advantages, disadvantages and uses of Total Station<br>- Types of Total Stations<br>- Advancement in Total Station Technology<br>- Automatic Target Recognition ATR.<br>4.4 Surveying using Total Station:<br>- Flow chart of data collection<br>- Fundamental Parameters of Total Station<br>4.5 Precautions to be taken while using Total Station.<br>4.6 Set up of Total Station<br>- Centering, Levelling, back-sighting, Azimuth Marks.<br>4.7 Various Measurements with Total Station.<br>4.8 Total Station Initial Setting, creating new file.<br>4.9 Total Station Traversing.<br>4.10 Survey Station description, Occupied Point Entries.<br>4.11 Data Retrieval.<br>4.12 Field-Generated Graphics.<br>4.13 Construction layout using Total Station<br>4.14 Overview of Computerized Survey Data System.<br>4.15 Maintaining Battery Power, Total Station Job Planning, and Estimating.<br>4.16 Introduction and uses of Hand-Held GPS.<br>4.17 Field procedures of Hand-Held GPS. | 08        | 27         |
|          | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>30</b> | <b>100</b> |

**Suggested Specification Table with Marks (Theory): (in %)**

| Distribution of Theory Marks (in %) |         |         |         |         |         |
|-------------------------------------|---------|---------|---------|---------|---------|
| R Level                             | U Level | A Level | N Level | E Level | C Level |
| 30                                  | 40      | 30      | -       | -       | -       |



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Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

## References/Suggested Learning Resources:

### (a) Books:

| 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 Griha Prakashan         |
| 2      | Surveying and Levelling Vol-I                    | Dr. B. C. Punamia               | 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      | Surveying and Levelling, 2 <sup>nd</sup> Edition | N N Basak                       | McGraw Hill Education Pvt. Ltd         |
| 6      | A Textbook of Surveying and Levelling            | R. Agor                         | Khanna Publishers                      |

### (b) Open-source software and website:

1. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in).
2. Auto CAD, Civil Architect
3. [www.Autodesk.com](http://www.Autodesk.com).

## Suggested Course Practical List:

| Exp. No. | List of Practicals                                                                                                                                  | Unit No. | Approx. hrs. Required |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------|
| 1        | Measurement of horizontal angle by Repetition & Reiteration method.                                                                                 | 1        | 04                    |
| 2        | Measurement of vertical angle & deflection angle.                                                                                                   | 1        | 04                    |
| 3        | <b>Project 1: Carry out the project for a closed traverse of 4 to 5 using Theodolite stations and prepare the drawing sheet using Gale's Table.</b> | 1        | 06                    |
| 4        | Calculate the height of the object using a trigonometric survey.                                                                                    | 2        | 02                    |
| 5        | Determine the constants of a tacheometer.                                                                                                           | 2        | 02                    |
| 6        | Determine the distance and R.L. of a point when a line of sight is horizontal.                                                                      | 2        | 02                    |
| 7        | Determine the distance and R.L. of a point when a line of sight is inclined for an elevation angle.                                                 | 2        | 02                    |
| 8        | Determine the distance and R.L. of a point when a line of sight is inclined for an angle of depression.                                             | 2        | 04                    |
| 9        | Carry out the Tacheometry mini project for 3 to 4 stations for a closed                                                                             | 2        | 06                    |



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|              |                                                                                                                                                                     |   |           |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----------|
|              | traverse on undulating/hilly regions and prepare the drawing.                                                                                                       |   |           |
| 10           | Computation of the data for setting out the curve by an offset of the long Chord method.                                                                            | 3 | 02        |
| 11           | Computation of the data for setting out the curve by Rankine (one theodolite) method.                                                                               | 3 | 02        |
| 12           | <b>Project-2:</b> Carry out the project for setting out a simple horizontal curve by Rankine's methods.                                                             | 3 | 04        |
| 13           | Identify the parts of the Total Station.                                                                                                                            | 4 | 02        |
| 14           | Set out the total station on a given station.                                                                                                                       | 4 | 02        |
| 15           | Set out the station by setting up a backsight.                                                                                                                      | 4 | 02        |
| 16           | Measure the horizontal, vertical, and deflection angles by total station.                                                                                           | 4 | 04        |
| 17           | Store and download the data from a total station on the computer and convert it into an AutoCAD file.                                                               | 4 | 02        |
| 18           | <b>Project-3:</b> Carry out the project for a small traverse with 4-5 stations using a Total Station on the ground and prepare the drawing with the required scale. | 4 | 06        |
| 19           | Demonstration of Hand-Held G.P.S.                                                                                                                                   | 4 | 02        |
| <b>Total</b> |                                                                                                                                                                     |   | <b>60</b> |

## List of Laboratory/Learning Resources Required:

| S. No. | Equipment Name     | Experiment No.    |
|--------|--------------------|-------------------|
| 1      | Vernier Theodolite | 1,2,3,4,10, 11,12 |
| 2      | Tacheometer        | 5,6,7,8,9         |
| 3      | Total Station      | 13,14,15,16,17,18 |
| 4      | Hand-held GPS      | 19                |

**Note:** To ensure accuracy and reliability, it is recommended that surveying equipment meet the standards specified in the relevant I.S. Codes.

**Suggested Project List:** As per the Suggested Course Practical List

### Suggested Activities for Students:

- (A) Survey a nearby open plot, mapping its boundaries with adjacent roads or walls using theodolite.
- (B) Complete a given micro-project.
- (C) Deliver a seminar on a relevant topic of your choice.

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