GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Civil Engineering		
Semester	III	Version	1.0.0.0
Effective from Academic Year	2026-27	Effective for the batch Admitted in	JULY 2025
Course code	1CI3102	Course Name	Advanced Surveying

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course code	Course Title	Teaching & Learning Scheme									Examination Scheme							
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1CI3202	Advanced Surveying	3	0	2	5	3	0	4	3	10	40	60	100	60	40	100	20	220

Abbreviation:	**CL-** Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**NLH** - Notional Learning Hours	**SLA** - Self Learning Assessment
	FA - Formative Assessment (Term work +Mid Sem Exam +Attendance)		**SA -** Summative Assessment

II. PRE-REQUISITES

Basic knowledge Elements of Civil Engineering & Basic surveying.

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

Prepare plans and Contour maps using Surveying Equipment's and Techniques.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the followingcourselearningoutcomes:

CO1. Ability to use a theodolite for surveying and traversing.
CO2. Use of tacheometric surveying methods for distance and elevation measurement.
CO3. Determination of elevation of points using direct and reciprocal observations.
CO4. Application of circular, transition, and vertical curves in route surveying.
CO5. Use modern surveying instruments and geospatial technologies for accurate surveying, mapping, and planning.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Theodolite	**TLO 1.1** Understand the basic parts, terms, and fundamental axes of a theodolite. **TLO 1.2** Explain methods of measuring horizontal and vertical angles using a theodolite. **TLO 1.3** Describe the applications of theodolite and identify common errors in its use. **TLO 1.4** Compute traverse data and explain closing errors and traverse balancing methods.	**1.1** Various terms related to theodolite and their definitions. **1.2** Fundamental axis of theodolite and their relationship. **1.3** Methods of measuring horizontal angles and vertical angles. **1.4** Use of theodolite for measuring a magnetic bearing, deflection angle, ranging and prolonging a line. **1.5** Errors in theodolite work. **1.6** Theodolite Traversing. **1.7** Traverse computations. **1.8** Closing errors and balancing the traverse. **1.9** Gale's Traverse Table.	**18**	**10**

		1.10 Numerical examples.		
Unit-2 Tacheometry surveying	**TLO 2.1** Understand the purpose, principles, and basic theory of tacheometric surveying. **TLO 2.2** Explain stadia tacheometry, tacheometer constants, and the function of an anallatic lens. **TLO 2.3** Describe different methods of tacheometry including stadia, tangential, and fixed hair methods. **TLO 2.4** Analyze distance and elevation determination for horizontal and inclined lines of sight. **TLO 2.5** Apply tacheometric methods to solve numerical problems and compare advantages and disadvantages of methods.	**2.1** Introduction **2.2** Purpose and Principles of tacheometric surveying **2.3** Theory of Stadia Tacheometry **2.4** Anallatic Lens **2.5** Methods of determining constants of a Tacheometer **2.6** Examples on tacheometer constants **2.7** Methods of Tacheometry (Stadia and Tangential) **2.8** Method of Fixed Hair **2.9** When line of sight is horizontal and staff held vertically **2.10** When line of sight is inclined and staff held vertically (Angle of Elevation & Depression). **2.11** Advantages and disadvantages of Tangential method. **2.12** Examples ofTacheometer using all methods.	**12**	**8**
Unit-3 Trigonometric levelling	**TLO 3.1** Understand direct and reciprocal observation methods. **TLO 3.2** Determine elevation of points with accessible and inaccessible bases. **TLO 3.3** Apply trigonometric levelling methods to solve elevation-related numerical problems.	**3.1** Introduction **3.2** Methods of observations (Direct and Reciprocal) **3.3** Methods of determining the elevation of a particular point **3.4** When base of the object is accessible **3.5** When base of the object is inaccessible **3.6** Examples using all methods	**6**	**5**
Unit-4 Curves	**TLO 4.1**Understand different types of curves, including circular, transition, and vertical curves. **TLO 4.2** Define and explain basic terms, notations, and elements of a simple circular curve. **TLO 4.3** Explain curve designation and the relationship between radius and degree of curve. **TLO 4.4** Describe linear and angular methods of setting out simple circular curves and handling obstacles. **TLO 4.5** Apply curve-setting principles to solve numerical examples of	**4.1** Introduction & types of curves **4.2** Types of circular curves **4.3** Definitions and notations for simple curves **4.4** Designation of curve **4.5** Relation between Radius and degree of curve **4.6** Elements of simple circular curve **4.7** Setting out simple circular curve **4.8** Methods of setting out simple circular curve (Linear methods & Angular methods) **4.9** Obstacles is setting out simple curves **4.10** Transition and vertical curves **4.11** Examples of curves.	**12**	**10**

	simple, transition, and vertical curves.			
Unit-5 Advanced Survey Equipments	**TLO 5.1** Understand the basic principles and components of digital theodolite, EDM, and total station. **TLO 5.2** Explain the parts, types, advantages, disadvantages, and uses of a total station. **TLO 5.3** Describe correct setup procedures and precautions while using a total station. **TLO 5.4** Apply total station techniques for carrying out surveying work and field measurements.	**4.1** Introduction **4.2** Basics of Digital theodolite **4.3** Introduction and Principles of E.D.M. **4.4** Introduction and Basics of Total station **4.5** Parts of Total station **4.6** Advantages, disadvantages and uses of Total Station **4.7** Types of Total Station **4.8** Set up of Total Station **4.9** Precautions to be taken while using Total Station **4.10** Surveying using Total Station	**6**	**6**
Unit-6 Remote sensing, GPS and GIS	**TLO 6.1** Understand the basic principles, platforms, sensors, and applications of remote sensing. **TLO 6.2** Explain the fundamentals of GPS, coordinate positioning, and its use in surveying and mapping. **TLO 6.3** Describe GIS concepts, types of data (spatial, attribute, vector, raster), and GIS applications. **TLO 6.4** Understand the integration of Remote Sensing, GPS, and GIS for modern surveying and planning work.	**6.1** Introduction to Remote Sensing **6.2** Principles of Remote Sensing **6.3** Platforms and Sensors **6.4** Applications of Remote Sensing in Land use, land cover mappingand disaster management. **6.5** Introduction to GPS **6.6** GPS Measurements with Coordinates and positioning **6.7** Applications of GPS in surveying and mapping. **6.8** Introduction to GIS **6.9** GIS DataSpatial, attribute, Vector and raster data. **6.10** Applications of GIS in Urban and regional planning **6.11** Integration of Remote Sensing, GPS and GIS **6.12** Basic introduction about drone technology, types of drone, applications of drone.	**6**	**6**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
Sr. No.	**Practical/Laboratory Learning Outcome (LLO)**	**Practical Titles**	**Relevant COs**
1	**LLO 1.1** Use a transit theodolite to measure a horizontal angle by the direct method.	Measure a horizontal angle using a transit theodolite by the direct method.	CO1
2	**LLO 1.2** Use a transit theodolite to measure a horizontal angle by the repetition method.	Measure a horizontal angle using a transit theodolite by the repetition method.	CO1
3	**LLO 1.3** Use a transit theodolite to measure a vertical angle.	Measure a vertical angle using a transit theodolite.	CO1

4	**LLO 1.4** Prepare a closed traverse using a transit theodolite.	Use a transit theodolite to carry out a closed traverse survey with a minimum of 5 sides and prepare the drawing sheet using Gale's traverse table.	CO1
5	**LLO 1.5** Use theodolite as a tacheometer to find the tacheometric constant.	Determine the tacheometric constant using a theodolite.	CO2
6	**LLO 1.6** Use theodolite as a tacheometer to calculate reduced levels and horizontal distances.	Determine reduced levels of given stations and horizontal distances by the tacheometric method (stadia method).	CO2
7	**LLO 1.7** Use theodolite as a tacheometer to calculate reduced levels and horizontal distances.	Determine reduced levels of given stations and horizontal distances by the tacheometric method (Tangential method).	CO2
8	**LLO 1.8** Apply tachometric surveying techniques to carry out a closed traverse in undulating or hilly terrain and prepare the corresponding drawing.	Carry out the tacheometry mini project for 3 to 4 stations for a closed traverse on undulating/hilly regions and prepare the drawing.	CO2
9	**LLO 1.9** Use trigonometric surveying principles to calculate the height of an object.	Calculate the height of an object using trigonometric surveying.	CO3
10	**LLO 1.10** Compute setting-out data for a simple circular curve using the offset from long chord method.	Computation of the data for setting out the curve by an offset of the long chord method.	CO4
11	**LLO 1.11** Compute setting-out data for a simple circular curve using the offset from long chord method.	Computation of the data for setting out the curve by Rankine (onetheodolite) method.	CO4
12	**LLO 1.12** Apply Rankine's method to compute and set out a simple horizontal circular curve accurately.	Carry out the project for setting out a simple horizontal curve by Rankine's method.	CO4
13	**LLO 1.13** Identify and understand the function of the main parts of a Total Station used in surveying.	Identify the parts of the Total Station.	CO5
14	**LLO 1.14** Set up a Total Station correctly over a given station by accurate centering and levelling.	Set out the Total Station on a given station.	CO5
15	**LLO 1.15** Store, download, and process Total Station survey data on a computer and convert it into an AutoCAD drawing.	Store and download the data from a Total Station on the computer and convert it into an AutoCAD file.	CO5
16	**LLO 1.16** Carry out a small traverse survey using a Total Station for 4–5 stations and prepare an accurate drawing to the required scale.	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.	CO5
17	**LLO 1.17** Understand the working principles and basic operations of a hand-held GPS receiver for position fixing and navigation.	Demonstration of Hand-Held G.P.S. Demonstration of Drone technology	CO6

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

- Measure the height of any building in your institute using Theodolite as a tacheometer.
- Measure the height of the slab bottom of the second floor of your institute building using Theodolite as a tacheometer.
- Mark any building layout using Total station.
- Measure distance between two distant points using EDM
- Locate the coordinates of the campus using GPS

Mini projects

- Carry out comparative study of following survey instruments of different make and brands: Total station/EDM/GPS/Digital theodolite.
- Collect the relevant technical and commercial information of minimum five advanced survey instruments available in the market with specifications.
- Download specifications for Total Station/ EDM/GPS and make a chart.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Transit Vernier theodolite with accessories
2	Levelling staff
3	Electronic Digital Theodolite with accessories.
4	Total Station (± 3mm accuracy) instrument withaccessories
5	Hand-held GPS

IX. LIST OF REFERENCE BOOKS

Sr.No.	Title	Author	Publication
1	Surveying Vol. I	B. C. Punmia, A. K. Jain, Arun K. Jain	Laxmi Publications
2	Surveying & Levelling	N. N. Basak	Mc Graw Hill Education
3	Surveying I &II	S. K. Duggal	McGrawHillEducation,NewDelhi,ISBN: 978- 00-701-5137-6
4	Surveying & Levelling	S. C. Rangwala	Charotar Publication

X. LINK OF LEARNING WEB RESOURCE

1	https://nptel.ac.in/courses/105107121
2	https://nptel.ac.in/courses/105104101
3	https://youtu.be/C6HJrVlhniI?si=T8Be-8MdZQtJX1vD
4	https://nptel.ac.in/courses/105104100
5	https://www.youtube.com/watch?v=bbs5AEPstl4
6	https://www.vlab.co.in/broad-area-civil-engineering

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Theodolite	CO1	10	6	7	5	18
2	Tachometric survey	CO2	8	4	5	3	12
3	Trigonometric levelling	CO3	5	2	2	2	6
4	Curves	CO4	10	4	4	4	12

5	Advanced Survey Equipment's	CO5	6	2	3	1	6
6	Remote sensing, GPS and GIS	CO6	6	3	3	0	6
		Grand Total	45	21	24	15	60

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	3	0	1	1	3	1	2
CO2	3	3	1	3	0	0	1	3	1	2
CO3	3	3	1	3	0	0	1	3	1	2
CO4	3	2	3	2	1	1	1	3	2	3
CO5	3	3	2	3	1	1	2	3	2	3

Legends: -3- High 2-Moderate/Medium 1-Slight/Low 0-None