Gyanmanjari Innovative University

Syllabus
Gyanmanjari Diploma Engineering College
Semester-1 (Diploma)

Subject: Engineering Surveying: Linear and Angular Measurement– DET2CV11202

Type of Course: Engineering Science Courses

Prerequisite: Basic knowledge of mathematics, geometry and measurements

Rationale: Surveying is a fundamental subject in civil engineering that provides essential knowledge and practical skills for measurement, mapping, and layout of engineering works. This course develops students' understanding of surveying principles, use of basic instruments, field observations, data recording, and error analysis. It serves as a foundation for advanced civil engineering subjects such as construction, transportation, irrigation, and geotechnical engineering, while also developing field competency through practical and proficient learning approaches.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	2	5	100	50	150

Legends: CI-Classroom Instructions; T-Tutorial; P -Practical; C –Credit; SEE -Semester End Evaluation; CCE-Continuous and Comprehensive Evaluation

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
1	**Introduction of surveying** ***Theory Topics:*** Definition of Surveying, Objectives of Surveying, Scope of Surveying, Need of Surveying, Principles of Surveying, Plane Surveying, Geodetic Surveying, Chain Surveying, Compass Surveying, Leveling, Units of Measurement, Scales, Representative Fraction (RF), Types of Errors, Accuracy and Precision. ***Practical:*** 1. Observe and identify surveying applications on campus such as roads, buildings, drainage, and open areas to understand real-life field usage. 2. Handle and identify basic surveying instruments like chain, tape, ranging rod, arrows, pegs, compass, and level for practical	10	20 %

familiarity.

3. Perform simple scale conversions and basic measurements to develop skills in observation, recording, and accuracy.
4. Identify possible sources of errors in measurements and estimate basic errors to understand precision and corrections.
5. Observe demonstration of surveying principles like ranging and working from whole to part to link theory with practice.
6. Prepare a simple sketch of a campus feature using approximate measurements and suitable scale.
7. Write a brief observation note highlighting measurements taken, errors found, and improvements for better accuracy.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Basic Surveying Concepts and Error Analysis** Students will be assessed through theory, numerical, and simple scenario-based questions on basic surveying concepts. The assessment covers definitions, objectives, scope, and classification such as plane and geodetic surveying, along with methods like chain, compass, and leveling. It includes understanding of units, scales, and representative fraction with basic calculations. Students will also study types of errors such as gross, systematic, and random errors. The evaluation focuses on students' skills in understanding accuracy and precision, along with concept clarity, simple calculations, and error identification.	20	
2	**Active Learning Assignments: Campus Survey and Error Analysis** Students will individually perform practical activities to identify surveying applications within the campus such as roads, buildings, drainage systems, and open plots, along with documenting observations and explaining their relevance. The task also includes solving practical problems related to scale conversion, basic error calculation, and error correction. This activity promotes self-learning, observation skills, analytical thinking, and		10

		application of surveying principles. The completed assignment must be submitted on the GMIU Web Portal			
		Total	**20**	**10**	

Examination Style:

Basic Surveying Concepts and Error Analysis (20 Marks)
Students will be provided with tasks covering fundamental concepts and principles of surveying. The tasks include classification of surveys and instruments, understanding of units, scales, and representative fraction calculations, as well as identification, analysis, and correction of basic surveying errors. The questions may be descriptive, numerical, scenario-based, or problem-solving in nature and will be prepared by the faculty. This evaluation is designed to assess students' understanding of surveying concepts, their ability to perform scale calculations, and their analytical skills in identifying and evaluating errors.

Campus Survey and Error Analysis (10 Marks)
Students will be provided with tasks involving survey application identification, where they will observe and document surveying applications on campus such as roads, buildings, drainage systems, and open plots, and explain the relevance of surveying in these areas. The next task focuses on scale and error problem solving, where students will solve practical problems related to scale conversion, basic error calculation, and error correction. The evaluation is designed to assess students' observation skills, understanding of practical surveying applications, analytical ability, application of fundamental principles, and accuracy in problem-solving.

2	**Chain surveying** ***Theory Topics:*** Linear Measurement, Methods of Linear Measurement, Direct Measurement, Indirect Measurement, Chain Measurement, Tape Measurement, Instruments for Linear Measurement (Chain, Tape, Arrows, Ranging Rods), Ranging (Direct & Indirect), Chaining Methods, Offsets (Perpendicular & Oblique), Field Book Recording, Errors in Linear Measurement, Errors in Chaining and Tape Corrections, Chain Triangulation. ***Practical:*** 8. Perform direct and indirect ranging to establish straight survey lines and understand proper alignment and coordination in the field. 9. Conduct a chain survey of a small plot using chain/tape and triangulation to practice accurate measurement and observation skills. 10. Measure perpendicular and oblique offsets to locate field details	25	20 %

and understand their importance in accurate mapping.

11. Record all measurements systematically in a field book to develop proper documentation and presentation skills.
12. Plot the survey data on paper using suitable scale to convert field measurements into a graphical representation.
13. Identify common errors during chaining such as misalignment and incorrect readings, and apply necessary corrections.
14. Apply chain triangulation in fieldwork to understand its role in locating positions and improving survey accuracy.
15. Write a brief reflection on field observations, errors encountered, and methods to improve measurement accuracy.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Numerical, Field Book, and Plotting Task** Students will be assessed through analytical and application-based tasks related to chain surveying principles. The evaluation includes direct and indirect ranging, chaining methods, offset measurements (perpendicular and oblique), and chain triangulation. Students will also perform error identification and correction, along with proper field book recording and plotting of survey data. The assessment focuses on accuracy in calculations, correct recording methods, plotting skills, and overall understanding of chain surveying procedures.	20	
2	**Active Learning Activity:** **Field Work Performance and Record Book Activity**: Students will perform practical field activities involving linear measurement using chain surveying instruments, including ranging, chaining, and offset measurement. They will also prepare survey plots based on the collected field data. Additionally, students are required to maintain a field record book containing observations, field book entries, calculations, and neatly drawn survey plans. This activity enhances practical skills, accuracy in measurement, proper instrument		10

		handling, teamwork, and systematic documentation. The completed record book and related work must be submitted on the GMIU Web Portal.			
		Total	**20**	**10**	

Examination Style:

Numerical, Field Book, and Plotting Task (20 Marks)
Students will be provided with tasks related to chaining and ranging operations (direct and indirect), offset measurements, and triangulation applications. The tasks also include field book recording of observations and plotting of chain survey data into graphical representations. These tasks may involve numerical problems, field book entries, plotting exercises, and practical scenario-based questions prepared by the faculty. This assessment is designed to evaluate students' ability to perform survey calculations, maintain accurate field records, and convert field measurements into properly plotted drawings.

Field Work Performance and Record Book Activity (10 Marks)
Students will be assessed through two activity-based tasks. The first task involves field work performance, where students will conduct practical exercises such as ranging, chaining, offset measurements, and simple plot surveying. The evaluation focuses on instrument handling, measurement accuracy, teamwork, and proper execution of field procedures. The second task involves record book preparation, where students will prepare and submit a field record book including observations, field book entries, calculations, and plotted survey drawings based on field exercises. This assessment emphasizes completeness, neatness, correctness, and proper interpretation of recorded data, reflecting the application of surveying principles.

3	**Compass Surveying** ***Theory Topics:*** Angular Measurement, Methods of Angular Measurement, Direct Angular Measurement, Indirect Angular Measurement, Instruments for Angular Measurement, Types of Angles (Horizontal & Vertical), Bearing Systems (Whole Circle Bearing, Quadrantal Bearing), Magnetic Meridian and True Meridian, Fore Bearing and Back Bearing, Local Attraction and Corrections, Included Angles, Deflection Angles, Traverse Surveying (Open & Closed Traverse), Errors in Angular Measurement, Adjustment of Angular Errors ***Practical:*** 16. Perform handling of a prismatic compass including centering, levelling, focusing, and taking readings to develop proper field operation skills. 17. Measure fore bearings and back bearings of survey lines using a	25	20 %

compass to understand directional measurement and accuracy.
18. Conduct a closed traverse survey to apply angular measurement and coordinated fieldwork practices.
19. Identify local attraction in observed bearings and apply necessary corrections to improve measurement accuracy.
20. Prepare computation sheets for bearings, latitude, departure, and closing error to develop calculation skills.
21. Plot the traverse using computed data and suitable scale to convert field observations into a drawing.
22. Check traverse closure and analyze balancing results to understand reliability and precision of survey data.
23. Write a short reflection on observations, errors, corrections applied, and improvements for better accuracy.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Bearing and Traverse Survey Work:** Students will be assessed through analytical and application-based tasks related to compass surveying principles. The evaluation includes bearing calculations using Whole Circle Bearing (WCB) and Quadrantal Bearing (QB) systems, compass traversing, magnetic declination, and correction of local attraction. It also covers latitude and departure computations, determination of closing error, balancing of traverse, and traverse plotting. This assessment focuses on conceptual understanding, computational accuracy, plotting skills, and the application of compass surveying techniques in practical situations.	20	
2	**Active Learning Activity:** **Field Activity and Computation Sheet of Compass Survey:** Students will perform practical activities involving the handling of a prismatic compass, measurement of fore and back bearings, and execution of traverse surveying. They will identify and correct local attraction, compute latitude and departure, balance the traverse, and plot the survey data. Additionally, students will prepare computation sheets and graphical representations based on		10

		field observations. This activity emphasizes instrument handling, accuracy in observations, field discipline, analytical skills, and systematic presentation of survey computations and drawings. The completed work must be compiled in PDF format and submitted on the GMIU Web Portal..			
		Total	**20**	**10**	

Examination Style:

Bearing and Traverse Survey Work(20 Marks)
Students will be provided with questions related to bearing calculations using Whole Circle Bearing (WCB) and Quadrantal Bearing (QB) systems, compass traversing, and correction of local attraction. The tasks also include latitude and departure computations, determination of closing error, balancing of traverse, and traverse plotting with interpretation of survey data. The questions may include numerical problems, field-data-based computations, plotting exercises, and application-oriented scenarios prepared by the faculty. This assessment is designed to evaluate students' understanding of compass surveying principles, computational skills, analytical ability, and accuracy in plotting traverse survey data.

Field Activity and Computation Sheet of Compass Survey (10 Marks)
Students will perform activities involving compass survey field work, where they will handle a prismatic compass, measure bearings, conduct simple traverse surveys, and identify and correct local attraction. The evaluation will be based on instrument handling, accuracy of observations, field procedures, teamwork, and practical execution. The next phase involves traverse computation and plotting, where students will prepare and submit computation sheets including bearing calculations, latitude and departure computations, determination of closing error, balancing of traverse, and plotting of survey data based on field observations. The evaluation will focus on correctness of computations, graphical presentation, interpretation of results, and application of compass surveying principles.

4	**Levelling and Contouring** ***Theory Topics:*** Levelling and Contouring, Levelling Concepts (RL, BM, BS, FS, IS), Types of Levelling Instruments, Temporary Adjustments of Level, Methods of Levelling (Height of Instrument Method, Rise and Fall Method), Profile Levelling, Introduction to Contours, Definition of	20	20%

Contours, Properties of Contours, Contour Interval, Contour Interpolation

Practical:

24. Perform setup and operation of a dumpy level including temporary adjustments and staff readings to develop proper levelling skills.
25. Calculate reduced levels using the Height of Instrument method from field observations to practice measurement and computation.
26. Determine reduced levels using Rise and Fall method and compare results to understand accuracy and arithmetic checks.
27. Conduct profile levelling along a selected route and prepare a longitudinal profile to represent ground variation.
28. Prepare simple contour maps from observed data and perform contour interpolation to understand terrain features.
29. Identify common errors in levelling work and apply necessary checks to improve measurement reliability.
30. Interpret contour patterns and profile data for applications like road alignment and drainage planning.
31. Write a brief reflection on observations, errors, computations, and improvements for better levelling accuracy.

Examination Style:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Field Numerical of RL and Profile Levelling:** Students will be assessed through analytical and application-based tasks related to levelling and contouring principles. The evaluation includes reduced level calculations using the Height of Instrument and Rise and Fall methods, profile levelling, contour interpolation, and interpretation of contour data. Students may also be required to solve field-data-based numerical problems and prepare profile and contour representations. This assessment focuses on conceptual understanding, computational accuracy, interpretation of field observations, and application of levelling and contouring techniques in engineering practice.	20	
2	**Feld Work Record Submission for Levelling and Contouring:** Students will perform practical activities		10

		involving the setup and operation of a dumpy level, staff handling, determination of reduced levels (RL), profile levelling, contour plotting, and interpretation of terrain features. They will prepare and submit field records including observation tables, RL calculations, profile drawings, contour maps, interpolation work, and analysis of results based on field data. This activity emphasizes instrument handling, accuracy in observations, field discipline, computational skills, graphical representation, and technical documentation.			
		Total	**20**	**10**	

Field Numerical of RL and Profile Levelling (20 Marks)
Students will be provided with questions related to reduced level calculations using the Height of Instrument method, reduced level calculations using the Rise and Fall method with arithmetic checks, profile levelling and preparation of longitudinal profiles, and contour interpolation, contour plotting, and interpretation of terrain features. The questions may include computational, practical scenario-based and plotting exercises prepared by the faculty. This task is designed to assess students' ability to perform levelling calculations, interpret field observations, prepare profile and contour representations, and apply contouring concepts accurately.

Field Work Record Submission for Levelling and Contouring (10 Marks)
Students will perform activities involving levelling and contouring field work, where they will set up the levelling instrument, perform temporary adjustments, take staff readings, determine reduced levels, and carry out profile levelling and simple contouring operations. The evaluation will be based on instrument handling, accuracy of observations, field procedures, teamwork, and practical execution of levelling activities. The second activity involves field record book and contour representation, where students will prepare and submit a field record book containing observation tables, reduced level calculations with arithmetic checks, profile drawings, contour plots, interpolation work, and interpretation of terrain features based on field data. The evaluation will focus on correctness, completeness, neatness, technical presentation, and application of levelling and contouring techniques.

5	**Errors & Accuracy** ***Theory Topics:*** Errors in Surveying, Types of Errors, Sources of Errors in	10	20 %

Surveying, Systematic Errors, Random Errors, Gross Errors, Accuracy vs Precision, Permissible Error, Basic Corrections in Surveying, Error Propagation, Correction Methods, Reduction of Errors in Measurements.

Practical:

32. Analyze field observations to identify gross, systematic, and random errors in measurements and recording to understand data reliability.
33. Identify and correct chaining errors related to alignment, tape handling, and measurement discrepancies to improve accuracy.
34. Perform arithmetic checks and adjustments in levelling data to verify reduced levels and improve precision.
35. Compare measured survey values with actual or standard values to understand deviations and causes of error.
36. Prepare an error analysis worksheet showing identified errors, corrections applied, and corrected results for better data interpretation.
37. Conduct repeated measurements and improved field procedures to reduce errors and enhance accuracy of results.
38. Apply permissible error limits and tolerance checks in practical surveying tasks to evaluate acceptance of results.
39. Write a reflection note on observed errors, corrections applied, and strategies for improving surveying accuracy.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Error Correction Numerical** Students will be assessed through analytical and numerical problem-solving tasks related to types and sources of errors in surveying, accuracy and precision, permissible errors, basic corrections, and error propagation. The evaluation includes correction of linear and angular measurements, adjustment of field data, and analysis of surveying accuracy through practical case-based situations. This assessment focuses on conceptual understanding, analytical ability, application of correction methods, and interpretation of corrected survey data.	20	
2	**Error Analysis Activity:** Students will perform practical activities involving identification and analysis of gross, systematic, and random errors		10

	from observed field data, along with correction of chaining and levelling errors. They will compare measured and actual values and apply permissible error concepts in surveying practice. Students will also prepare analytical worksheets and reports showing identified errors, applied corrections, corrected results, and recommendations to improve accuracy and reliability. This activity emphasizes analytical thinking, corrective procedures, verification methods, and technical documentation..				
	Total	**20**	**10**		

Examination Style:

Error Correction Numerical (20 Marks)
Students will be provided with questions related to identification and classification of surveying errors, permissible error calculations and application of tolerance limits, correction of linear and angular measurements with adjustment of field data, and problem-solving related to error propagation, precision, and surveying accuracy. The questions may include numerical problems, practical case-based situations, and analytical exercises prepared by the faculty. This task is designed to assess students' understanding of sources of errors, application of correction methods, and their ability to analyze and improve accuracy in surveying results.

Error Analysis Activity (10 Marks)
Students will perform activities involving field error analysis and correction, where they will analyze observed field data to identify gross, systematic, and random errors and apply suitable correction procedures in measurements and calculations. Students may also perform chaining and levelling correction exercises and compare measured values with actual or standard values. The evaluation will be based on analytical approach, correctness of error identification, application of correction techniques, and interpretation of results. The second activity involves error analysis report and accuracy improvement, where students will prepare and submit an analytical worksheet or report containing identified errors, applied corrections, corrected observations, permissible error checks, and recommendations for improving precision and reliability in surveying work. The evaluation will focus on correctness, technical presentation, interpretation quality, and understanding of accuracy enhancement methods.

Suggested Specification table with Marks (Theory): 100

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	15%	30%	15%	10%	20%

Course Outcome:

After learning the course, the students should be able to:	
CO1	Foundational knowledge of surveying.
CO2	Use of surveying instruments, field experimentation.
CO3	Traverse computations in analysis and tools.
CO4	Contour interpretation introduces engineering solution thinking.
CO5	Error analysis develops critical thinking and lifelong learning.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

Practical examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Reference Books:

[1] Surveying Vol. I, *Dr. B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain,* Laxmi Publications, ISBN: 978-8131808148.

[2] Surveying and Levelling (Vol. I), *T.P. Kanetkar& S.V. Kulkarni,* Pune Vidyarthi GrihaPrakashan, ISBN: 978-8185825825

[3] Fundamentals of Surveying, *S.K. Roy,* PHI Learning, ISBN: 978-8120341953

[4] A Textbook of Surveying, *C. Venkatramaiah,* Universities Press, ISBN: 978-8173715794

[5] Surveying Theory and Practice, *James M. Anderson & Edward M. Mikhail*, McGraw Hill Education India, ISBN: 978-0070159145

[6] Elementary Surveying, *Gopi Sathikumar R., Pearson India,* ISBN: 978-9332584862