GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Advanced Surveying
(Course Code: 4340601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering, Mining Engineering	4th Semester

1. RATIONALE

Surveying is the basic andone of the most studied topics in civil engineering.Survey is used in the preparation of maps which help in the location of hills, valleys, rivers, boundaries, roads, canals and railways. It also helps in setting up plans for roads, railways and other important civil engineering structures. In addition to the instruments used for simple surveying, advanced surveying techniques such as Tachometric survey, Setting out of a curve, Total Station survey, use of G.P.S., D.G.P.S., U.A.V. etc. are essential as the speed and accuracy are in high demand in recent time. Also, these modern equipments use software which in turn encourages paperless work and use of green building materials.

At the diploma level, students are expected to study these aspects so as to develop their understanding, and performance-oriented abilities in order to apply their knowledge in the civil engineering field.

2. COMPETENCY

Thepurposeof this course is to help the student to attain the following industry identified competency through various teaching-learning experiences:

Carry out civil engineering surveys with the use of necessary software to prepare drawings &maps using a theodolite, total station, G.P.S., D.G.P.S., U.A.V., etc.

3. COURSE OUTCOMES (COs)

The practicalexercises, the underpinning knowledgeandthe relevant soft skills associated with this competency are to be developed in the studentsto display the following COs:

1. Carry out a contour survey for undulating/hilly regions using a Tacheometer and prepare contour map.
2. Setting out a horizontal curve using a theodolite.
3. Carry out traverse survey using total station, import the data in the computer, and preparedrawing using Auto CAD.
4. Record and retrieve the data using a Hand-Held GPS
5. Give a demonstration of the field procedure of modern surveyingequipments.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marl
L	T	P	C	CA	ESE	CA	ESE	
3	-	4	5	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 thesub-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	Determine the constants of a tacheometer.	I	2
2	Determine the distance and R.L. of a point when a line of sight is horizontal.	I	2
3	Determine the distance and R.L. of a point when a line of sight is inclined for an angle of elevation.	I	2
4	Determine the distance and R.L. of a point when a line of sight is inclined for an angle of depression.	I	2
5	**Carry out the Tacheometry project for 4 to 5 stations for a closed traverse on undulating/hills regions and prepare the drawing sheet.**	**I**	**10**
6	Determine the elements of a simple circular curve.	II	2
7	Computation of the data for setting out the curve by an offset of long Chord method.	II	2
8	Computation of the data for setting out the curve By Rankine (one theodolite) method.	II	2
9	**Carry out the project for setting out a simple horizontal curve by Rankine's methods**	**II**	**4**
10	Identify the parts of the Total Station.	III	2
11	Set out the total station on a given station.	III	2
12	Set out the station by setting up a backsight.	III	2

13	Measure the horizontal, vertical and deflection Angle by total station.	III	2
14	Store and download the data from a total station in the computer and convert the same into Auto CAD file.	III	2
15	**Total Station survey:** **- Carry out the project for a small traverse with 4-5 stations on the ground and prepare the drawing with the required scale.**	**III**	**6**
16	An overview of Hand-held GPS device	IV	2
17	Record and retrieve the data using a Hand-Held GPS	IV	4
18	Know the uses of Modern Surveying techniques	V	2
19	Demonstration of Recording and Retrieving data collected from Modern Surveying techniques such as DGPS, UAV etc.	V	4
	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 theCOs.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 %
(For PrOs 1 to 15& 17)		
1	Operation and handling of survey instruments	20
2	Taking observations and recording and storing	30
3	Computation/Retrieval of survey data and plotting/ Drawing	30
4	Answer the questions	10
5	Follow safe practices measures while performing practicals	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments with broad specificationsfor the PrOsis 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	**Theodolite/Tacheometer:**	01 - 09

	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".	
2	**Total station:** Objective Lens Diameter-45mm (1.77 inches), Magnification-30x, Minimum Focus Distance-1.5 m, 1 prism 3,000m,3 prisms 4,000m, Measuring Accuracy-±(2mm + 2ppm x Distance) Mean Squared Error, Accuracy in angle measurement-5", with display panel and keyboard, Reflectorless operation from 30cm to 500m.	10 -15
3	**Hand-Held GPS:** Display size of screen-7 13 cm, Features-Moving map, Routes-50, Way points-1000.	16-17
4	Modern surveying equipments: (for demonstration only) DGPS&UAV	18-19

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample***Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned CosandPrOs.More could be added to fulfil the development of this competency.

- Work as a leader/a team member.
- Follow ethical practices.
- Practiceenvironmental 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 isformulatedashigher 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 – I **Tacheometric**	1a. Explain the principles and various methodologies involved in techeometry.	1.1 Introduction, Purpose andPrinciples of TacheometricSurveying. 1.2 Theory of Stadia Tacheometry, Analytic

Surveying	1b. Calculate R.L. and horizontal distance between object and instruments.	Lens andadvantages & disadvantages ofit. 1.3 Methods of determining constants of a Tacheometer 1.4 Methods of Tacheometry (Stadia &Tangential) Method of Fixed Hair : - When the line of sight is horizontal and Staffheld vertically - Whenthe line of sight is inclinedand staffheldvertically (Angle of Elevation & Depression) 1.5 Advantages and disadvantages of Tangential method 1.6 Related examples of Tacheometer constant &Tacheometricmethods
Unit – II **Curves**	2a. Describe differentelements of curves. 2b. Calculate necessarydata required to setting outcurve on field.	2.1 Types of circular curves 2.2 Definitions and notations 2.3 Designation of thecurve 2.4 Relation between Radius and degree of curve 2.5 Elements of a simple circular curve 2.6 Setting out a simple circular curve. 2.7 Methods of setting out simple circular curves 2.8 Transition curves - Requirements and purpose of it. 2.9 Vertical curves 2.10 Related examples of curves.
Unit – III **Total Station Survey**	3a. Explain the principlesof total station. 3b. Record data on total stationas well as on computer. 3c. Retrieving the data andgenerate the drawings usingapplication software.	3.1 Introductionand basics of Digital Theodolite 3.2 Principles of E.D.M. 3.3 Introduction and Basics of Total station - Parts of Total station - Advantages, disadvantages and uses of TotalStation - Types of Total Station - Advancement in Total Station Technology - Automatic Target Recognition ATR 3.4 Surveying using Total Station - Flow chart of data collection - Fundamental Parameters of Total Station 3.5 Precautions to be taken while using Total Station 3.6 Field equipments 3.7 Set up of Total Station

		- Centering, Levelling , back-sight,Azimuth Marks 3.8 Measurement with Total Station 3.9 Total Station Initial Setting 3.10 Field Book recording 3.11 Radial Shooting 3.12 Total Station Traversing 3.13 Survey Station description,Occupied Point Entries 3.14 Data Retrieval 3.15 Field-Generated Graphics 3.16 Construction layout using Total Station 3.17 Overview of Computerized Survey Data System 3.18 Equipment Maintenance 3.19 MaintainingBattery Power, TotalStation Job Planningand Estimating 3.20 Total Survey system errors Sources andhow to avoidthem. 3.21 Controlling errors
Unit IV **Global Positioning System**	4a. Applications ofGPS in civilEngineering. 4b. Retrieving the data and Generatemaps.	4.1 Introduction to GPS 4.2 Maps & types of digitalmap 4.3 Fundamentalsand uses of GPS 4.4 GPS Receivers (Hand-Held GPS Receivers) 4.5 Field procedures of GPS 4.6 Observations and applicationsin Civil Engineering
Unit V **Modern Surveying Techniques**	5a.Explainthe use of ModernSurveying Instruments. 5b.Demonstration of Recording AndRetrievingcollecteddata.	5.1 Introduction and use of modern surveying equipments such asDifferential Global Positioning System (DGPS),Unmanned Arial Vehicle(UAV). 5.2 Field procedures of modern surveying equipments 5.3 Data Retrieval 5.4 Understanding GIS and its components 5.5 Applications of GIS

***Note**:TheUOs 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 ofTheory Marks			
			RLevel	ULevel	ALevel	Total Marks
1	Tacheometry Surveying	12	04	04	12	20

2	Curves	8	02	04	08	14
3	Total Station Survey	10	02	06	08	16
4	Global Positioning System	6	04	02	04	10
5	Modern Surveying Techniques	6	04	06	00	10
Total		**42**	**16**	**22**	**32**	**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 theUOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varyslightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct the 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) Preparea seminar on the relevant topic
b) Undertake micro projects.

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 assessedusing different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environmental and sustainability
g) Expert lecture by a practicing surveyoron modern surveying equipments.
h) Expert lecture on the latest software used for modern surveying.

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 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 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 orientedCOs.

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) Measure Horizontal and vertical distance of given objects(minimum 02 objects)
b) Compute Tacheometric constants in the field
c) Calculation of Elements of a simple circular curve from given data
d) Use different methods of setting out simple circular curves.
e) Prepare technical specifications of the Total station.
f) Find out the height of the tower or tall object by total station.
g) Carry out small levelling projects with the help of a total station.
h) Prepare a report on field procedures of GPS.
i) Stack out waypoints with the help of GPS
j) Prepare areport on GIS, its components and its application

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Surveying and Levelling Vol-II	T.P.Kanetkar&S. V.Kulkarni	PunaVidyarthiGrihaPrakashan
2	SurveyingandLevellingVol-II	Dr.B.C.Punmia	Laxmi Publications Pvt.Ltd.
3	SurveyingandLevellingVol-II	S.S. bhavikatti	WILEY-India
4	FundamentalsofSurveying	S.K.Roy	PHILearningPvt.Ltd
5	Surveying and Levelling	N NBasak	McGraw Hill Education Pvt. Ltd
6	A Textbook of Surveying and Levelling	R. Agor	Khanna Publishers

14. SOFTWARE/LEARNING WEBSITES

a) https://www.digimat.in/nptel/courses/video/105107121/L01.html
b) https://www.digimat.in/nptel/courses/video/105107121/L02.html
c) https://www.digimat.in/nptel/courses/video/105107121/L03.html
d) https://www.digimat.in/nptel/courses/video/105107121/L04.html
e) https://www.digimat.in/nptel/courses/video/105107121/L05.html
f) https://www.digimat.in/nptel/courses/video/105107121/L27.html
g) https://www.digimat.in/nptel/courses/video/105107121/L28.html
h) https://www.digimat.in/nptel/courses/video/105107158/L17.html
i) https://www.digimat.in/nptel/courses/video/105107158/L18.html
j) https://www.digimat.in/nptel/courses/video/105107158/L20.html
k) https://www.digimat.in/nptel/courses/video/105107158/L21.html
l) https://www.digimat.in/nptel/courses/video/105107158/L23.html
m) https://www.digimat.in/nptel/courses/video/105107158/L24.html

Note: For more videos students are suggested to visit the website of NPTEL

15. PO-COMPETENCY-CO MAPPING

Semester IV	**Advanced Surveying (Course Code: ……)**									
	POs and PSOs									
Competency & Course Outcomes	**PO 1 Basic & Discipline - 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 → / **Course Outcomes ↓**	**Carry out civil engineering surveys with the use of necessary software to prepare drawings & maps using a theodolite, total station, G.P.S., D.G.P.S., U.A.V., etc.**									
CO a) Carry out a contour survey for undulating/ hilly regions using a Tacheometer and prepare contour map.	3	3	2	3	-	3	2	-	-	-
CO b) Setting out a horizontal curve using a theodolite.	3	2	2	2	-	2	2	-	-	-

CO c) Carry out traverse survey using total station, import the data in the computer, and prepare drawing using Auto CAD.	3	2	2	2	2	2	3	-	-	-
CO d) Record and retrieve the data using a Hand-Held GPS	2	1	1	2	-	-	1	-	-	-
CO e) Give a demonstration of the field procedure of modern surveying equipments	2	1	1	1	1	-	1	-	-	-

Legend: '**3'** for high,'**2**' for medium, **'1'** for low or **'-'**for the relevant correlationof eachcompetency, CO, with PO/ PS

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	ContactNo.	Email ID
1	Ketan C.Varmora I/C HOD	Government Polytechnic Kheda	9725335599	kcvarmora@gmail.com
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