GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-IV

Course Title: Mine Surveying-II
(Course Code: 4342203)

Diploma programme in which this course is offered	Semester in which offered
Mining Engineering	Fourth

1. RATIONALE

The course is designed to help the student in understanding the different types of surveying carried out before and during mining activity for better planning and designing. Various practical are to be performed to help in understanding mine surveying. This course is helpful to eliminate the errors which normally occur during surveying. This is essentially expected from expert surveyor to minimize the errors to a great extent. It is therefore important for mine engineers to learn this course by heart.

2. COMPETENCY

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

i. **Undertake surface and underground survey for mining operations using various methods and instruments.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

CO1: Select latest and efficient method for linear and angular measurement.
CO2: Prepare plans for various surface and underground survey.
CO3: Justify the right procedure to be followed for correlation survey.
CO4: Illustrate the precautionary steps to be taken while surveying.
CO5: Apply usual checks for measuring the accuracy of survey work.
CO6: Understand duties and responsibilities of surveyor and general requirements about mine plans.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA*	ESE	CA	ESE	
4	-	4	6	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'*.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Measure horizontal & slope distance, horizontal and vertical angle of given surface points by taking observations with Total station.	I	06
2	Prepare a sheet of given area showing all surface features on it with observation tables by using a method of Triangulation.	II	08
3	Prepare a contour plan of a given location with observation tables by using Tacheometry method.	III	06
4	Measure horizontal distance and elevation of given survey stations by using Tangential method of Tacheometry.	III	06
5	Prepare a sheet of underground baseline by measuring the azimuth of it by correlation method suitable for Incline or Adit.	IV	06
6	Establish an underground baseline by measuring the azimuth of it by Co-planning method of correlation and draw a sheet, give justification for suitability of this method.	IV	08
7	Establish an underground baseline by measuring the azimuth of it by Weisbach triangle method of correlation and draw a sheet, give justification for suitability of this method.	IV	08
8	Establish an underground baseline by measuring the azimuth of it by Weiss quadrilateral method of correlation and draw a sheet, give justification for suitability of this method.	IV	08
		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.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	**Selection of survey instruments**	10
2	**Perform Standard Experimental Procedure**	30
3	**Observations and calculations**	30
4	**Follow Safety Precautions**	10
5	**Effective participation in practical group**	10
6	**Answer the question and Submission of work**	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 user in uniformity of practicals in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Total Station	1 and 2
2	Theodolite	3 and 4
3	Levelling staff or Stadia rod	2 to 8
4	Steel or Invar Tape	All
5	Prismatic compass	All
6	Ranging rod	All
7	Arrows	All
8	Wooden Pegs	All
9	Plumb Bob	All

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 while using various survey instruments.
d) Realize importance of survey in mining.

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- I **Basics of Total Station**	1a. Explain Electromagnetic Distance Measurement (EDM). 1b. Describe construction of Total station. 1c. Perform survey using Total station. 1d. Describe steps to measure horizontal and vertical angle	1.1 Introduction of Electromagnetic Distance Measurement (EDM) 1.2 Introduction of Total Station - Parts of total station - Uses, advantages and disadvantages - Set up of total station over a point - Measurements: Azimuth, Horizontal angle, Vertical angle, distance - Precautions to be taken while using Total Station
Unit- II **Triangulation**	2a. Explain concept of triangulation surveying with its classification. 2b. Solve problems based on base Line corrections. 2c. Perform triangulation survey with all calculations and draw sheet.	2.1 Basic concept of triangulation surveying 2.2 Classification of triangulation system. 2.3 Triangulation figures or systems 2.4 Well-conditioned triangles and application of sine rule 2.5 Routine of triangulation survey: Reconnaissance, Erection of signals and towers, Measurement of base line and its extension, Measurement of horizontal angles, Satellite station, computations
Unit- III **Tacheometric Survey**	3a. Explain principles of Tacheometric surveying. 3b. Explain different methods of tachometric survey. 3c. Explain the field work of Tacheometric survey.	3.1 Basic concept of tacheometric surveying 3.2 Instruments: Tacheometer, Levelling staff and Stadia Rod 3.3 Methods of Tacheometry 3.4 Anallatic lens 3.5 Determination of Tachometric constants with problem and solution 3.6 Field work, Errors and precision

Unit- IV **Correlation**	4a. Explain Correlation survey and its various methods. 4b. Explain the importance of National grid and its correlation with mine surveying.	4.1 Introduction 4.2 Purpose of Correlation of survey 4.3 Methods of correlation - Direct traversing through Adit or Incline - Shaft Plumbing (Two plumb wires): (i) Coplaning method (ii) Weisbach Triangle method (iii) Weiss Quadrilateral Method 4.4 Correlation of mine survey to the National Grid
Unit- V **Underground Survey**	5a. Explain various types of curve. 5b. Explain survey works related to maintain direction & gradient of Drivage. 5c. Explain purpose of stope surveying.	5.1 Curve: Introduction and Types of Circular curves: Simple, Compound, Reverse 5.2 Elements of a simple circular curve 5.3 Procedure of maintaining direction and gradient of Drivage 5.4 Measurement of distance and difference in elevation 5.5 Stope Surveying: Introduction and Purpose of stope surveying
Unit-VI **Legislation**	6a. Describe appointment, duties and responsibilities of surveyor. 6b. Describe general requirements about mine plans. 6c. Describe maintenance and storage of mine plans and survey instruments.	6.1 Practical experience of candidates for Surveyor's Examination 6.2 Appointment of surveyor 6.3 Duties and responsibilities of surveyor 6.4 Preparation of plans by surveyors 6.5 General requirements about mine plans 6.6 Types of plans 6.7 Survey instruments and materials 6.8 List of plans, sections and instruments and their storage

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Total Station	08	02	04	04	10
II	Triangulation	12	03	05	07	15
III	Tacheometric Survey	10	04	04	04	12
IV	Correlation	12	03	07	05	15
V	Underground Survey	06	04	02	02	08
VI	Legislation	08	08	02	00	10
Total		**56**	**24**	**24**	**22**	**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 UOs. 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:

Following is the list of proposed student activities like:

1. Visit survey department of nearby mines and make a report.
2. Give presentation on any one survey instrument.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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) Use demonstration, video/animation films field/industry visit for explaining complex/abstract concepts of Hydraulics.
d) This course requires lot of practice on numerical. Students may be asked to solve the numerical during lecture periods and tutorial periods, in addition home assignments may be given. To avoid copying by students each problem must have different parameters for each student or at least there may be five to six sets of problems with different values., In other words each student will get same problem but with varied parameters. (Values of pressure, volume, flow, force, distance, speed etc may be different for each student)
e) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
f) 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.
g) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
h) 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-project 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 she/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-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:

a) Draw a demonstrative schematic diagram of total station and label its all parts on a sheet.
b) Prepare a chart of various survey instruments with its diagram and technical specifications.
c) Visit nearby survey office and make a layout of it.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Mine surveying (Vol-II and III)	S. Ghatak	Lovely Prakashan
2	Surveying (Vol. I and Vol. II)	Dr. B.C.Punmia Dr. Arun Kumar Jain Er. Ashok Kumar Jain	Laxmi Publications

14. SOFTWARE/LEARNING WEBSITES

1. Total station - Wikipedia
2. Triangulation - Wikipedia
3. Surveying: Quick Total Station Setup - YouTube
4. Theodolite - Measuring Angles - YouTube
5. Horizontal Angle - Electronic Theodolite- Engineering SUrveying Practical - YouTube
6. 60seconds-How to Set Up and Level a Total Station - YouTube
7. http://www.youtube.com/watch?v=CBlhQ76LAyI
8. Tacheometry - Wikipedia
9. http://surveying2012.blogspot.in/2013/08/tacheometry-surveying.html
10. http://www.youtube.com/watch?v=aHwg-1CGoTM

15. PO-COMPETENCY-CO MAPPING

Semester IV	Mine Surveying-II (Course Code: 4342203)								
	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** Student will be able to operate flame safety lamp effectively.	**PSO 2** Student will be able to test percentage of inflammable gas.
Competency	**Undertake surface and underground survey for mining operations using various methods and instruments.**								
Course Outcomes **CO1:** Select latest and efficient method for linear and angular measurement.	3	2	-	1	-	-	2	-	-
CO2: Prepare plans for various surface and underground survey.	3	2	2	1	-	-	2	-	-
CO3: Justify the right procedure to be followed for correlation survey.	3	2	2	1	-	-	2	-	-
CO4: Illustrate the precautionary steps to be taken while surveying.	3	2	-	1	-	-	2	-	-
CO5: Apply usual checks for measuring the accuracy of survey work.	3	2	2	1	-	-	2	-	-
CO6: Understand duties and responsibilities of surveyor and general requirements about mine plans.	3	2	-	-	-	-	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

Sr. No.	Name and Designation	Institute	Contact No.	Email
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