GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Basic Mine Surveying**
(Course Code: 4322201)

Diploma programmes in which this course is offered	Semester in which offered
Mining Engineering	Second

1. RATIONALE

Before development and planning process for any mining project, at first field survey of that area is carried out and various type of survey maps are prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and various mining operation etc.

The diploma mining engineer should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. It is also important for them to be well aware about general requirements about plans and sections as per mines regulations.

This course is therefore one of the core courses required for mining engineers. Students are advised to master the desired skills which are expected from them for survey related works in mining industry.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Carry out basic survey in mines to prepare drawings.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO1: Select suitable methods of linear and angular measurement for survey.
CO2: Prepare plans for various land survey.
CO3: Justify the right procedure to be followed for a particular survey work.
CO4: Illustrate the precautionary steps to be taken while surveying.
CO5: Apply usual checks for measuring the accuracy of survey work.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	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 **'*'** (in approx. Hrs column) 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	Perform ranging and chaining operations in different field conditions.	II	04
2	Take offsets (Perpendicular/Oblique) in different field conditions.	II	04
3	Prepare a lay out plan of a stock pile or building by chain surveying method showing all chain lengths, offset lengths and plan length.	II	06
4	Perform temporary adjustments of Prismatic Compass.	III	02
5	By observation through Prismatic Compass measure the bearings of different survey lines and calculate included angles from measured bearings.	III	04
6	Draw a plan of a given survey area by using Chain and Compass survey method.	II & III	06*
7	Prepare a survey plan of a given area by using any one plane table survey method.	IV	02
			28 Hrs.

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	Identify survey instruments and accessories.	10

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
2	Operate instruments.	20
3	Follow safe practices.	10
4	Record observations correctly.	20
5	Interpret the result and conclude.	20
6	Prepare survey drawings.	20
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 usher in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Metric Chain: Length - 20 m and 30 m	1 to 6
2	Steel or Invar Tape: Length - 20 m, 30 m and 50 m	1 to 6
3	Arrows: Material-Steel, Length – 25 cm to 50 cm, Diameter – 4 mm	1 to 6
4	Wooden pegs: Material-Timber, 2.5. to 3 cm square and 15 cm long, tapered at the end	1 to 6
5	Ranging Rod: Material-Iron, Length - 2 or 3 m, Diameter – 3 cm, shod at bottom with heavy iron point, painted black and white or red and white in alternate band length of 20 cm.	1 to 6
6	Cross staff: Metallic head having two pairs of vertical slits giving two lines of sights at right angle to each other made up of brass or any alloy that cannot rust, the base is provided with hollow conical socket at the center that can be Mounted on the top of wooden staff. (Fitted with a pointed iron shoe at the bottom. **Or** Optical Square: Consists of circular brass box and suitable for making right angle offset.	1 to 6
7	Prismatic Compass: Consists of a brass circular box with a diameter of 8 to 12 cm., provided with balanced magnetic needle on a hard steel pivot. Needle carries aluminum circle graduated degrees and half degrees (0 degree to 360 degree).	4 to 6
8	Plane Table: Wooden/Teak wood drawing board/table can be mounted on tripod and rotated about vertical axis. Size- 600 mm x 750 mm x 16 mm/22mm	7
9	Alidade: Metal or wooden rule with two foldable sighting vanes at the ends.	7
10	Plumbing fork: consists of a hair pin-shaped light metal frame having arms of equal length, in which plumb bob can be suspended from the end of the lower arms.	7
11	Spirit level: Tabular or circular type level with flat base.	7
12	Compass: Narrow rectangular non-magnetic metallic box provided magnetic needle in it and covered with glass with graduated scale at the end of the compass.	7

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 fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow safety practices while using various survey instruments.
c) 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

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. 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 **Introduction and Scale**	1a. Define surveying. 1b. Explain object of surveying. 1c. Explain use of surveying in various field. 1d. Describe classification of surveying. 1e. Apply various types of scale as per needs.	1.1 Definition: Surveying 1.2 Object and Uses of Surveying 1.3 Primary division of surveying: Plane and Geodetic surveying 1.4 Classification of Surveying based on the: - Nature of the field survey - Object of survey - Methods employed in survey - Instruments used 1.5 Principles of Surveying 1.6 Definitions: Plan and Map 1.7 Scale and its representation 1.8 Types of Scale
Unit – II **Chain Survey**	2a. Explain various methods of linear measurement. 2b. Recognize various types of instruments used in chain surveying. 2c. Define various technical terms used in chain surveying. 2d. Explain various method of chaining. 2e. Prepare drawing as per recorded measurements in the field book.	2.1 Methods of linear measurement 2.2 Instruments used in Chaining: Chain or Tapes, Arrows, Ranging Rods, Offset rods, Cross staff or Optical Square, Plumb bob, Pegs, Wooden mallet 2.3 Technical Terms: Survey station-Main and Tie station, Base line, Check line, Tie line, Reconnaissance, Offset 2.4 Selection of site for survey station or survey lines

		2.5 Offset and its types: Perpendicular and Oblique 2.6 Ranging: Direct ranging and Indirect ranging 2.7 Method of chaining 2.8 Error in length due to incorrect length of chain or tape and related problems 2.9 Obstacles in chaining 2.10 Conventional Symbols 2.11 Recording of measurements in field Book: Single-line and double-line field book 2.12 Field work in chain surveying 2.13 Measuring lines in Underground mines
Unit– III **Compass Survey**	3a. Explain compass surveying and related technical terms. 3b. Explain procedure for angular measurements. 3c. Describe construction of prismatic compass. 3d. Explain use of prismatic compass and its adjustment. 3e. Record bearing accurately. 3f. Prepare drawing as per recorded measurements of bearing of survey line.	3.1 Introduction 3.2 Technical Terms: - Angles - Bearings - Azimuth - Fore and Back Bearing - True Meridian and bearing - Magnetic Meridian and bearing - Arbitrary Meridian and bearing - Magnetic Dip - Magnetic Declination 3.3 Whole circle bearing system and Quadrantal bearing system - Conversion of bearing from one system to the other 3.4 Method of finding angles from bearing 3.5 Prismatic Compass: Construction and functions of different parts 3.6 Adjustment of Prismatic compass 3.7 Local Attraction and its detection 3.8 Elimination of Local attraction 3.9 Errors in Compass Survey
Unit– IV **Plane Table Survey**	4a. Explain procedure for plane table survey. 4b. Prepare drawing using any plane table method. 4c. Explain advantages and disadvantages of plane table survey.	4.1 Introduction and Principle of plane table 4.2 Equipment and accessories of plane table survey 4.3 Method of setting up the plane table over the station 4.4 Method of plane tabling

		- Radiation - Intersection - Traversing - Resection 4.5 Errors in Plane table survey 4.6 Advantages and Disadvantages of plane table survey
Unit-V Mine surveying and Legislation	5a. Define mine surveying. 5b. List plan and section to be maintained as per mines regulation.	5.1 Introduction to Mine surveying 5.2 Plan and Section: - General requirements about mine plans as per mining regulations - Types of plans and sections - Conventions for preparing plans and sections

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	Introduction and Scale	08	02	08	02	12
II	Chain Survey	10	04	06	10	20
III	Compass Survey	10	02	06	10	18
IV	Plane table survey	08	02	04	08	14
V	Mine surveying and Legislation	06	03	03	00	06
Total		**42**	**13**	**27**	**30**	**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:

a) Prepare a list of latest instruments used in surveying with its specification.
b) List out the provisions for maintenance of survey instruments.
c) Give seminar on any survey instrument with its application in mining.
d) Visit any survey office and submit a report on it.

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.
'L' in section No. 4 means different types of teaching methods that are to be **employed** by teachers to develop the outcomes.
c) 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.
d) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

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 is group-based (group of 3 to 5).

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 duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students 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) Prepare a chart of various survey instruments with its diagram and technical specifications.
(b) 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 and Levelling – Vol.1	S.Ghatak	Lovely Prakashan, Dhanbad (Bihar)
2	Surveying – Vol.1	Dr. B.C.Punmia Er. Ashok Kr. Jain Dr. Arun kumar Jain	Laxmi Publication, New Delhi ISBN :9788170088530
3	The Coal Mines Regulations 2017	The Gazette of India	The Gazette of India Directorate General of Mines Safety, Dhanbad
4	The Metalliferous Mines regulation 1961	The Gazette of India	The Gazette of India Directorate General of Mines Safety, Dhanbad

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.ac.in
b) https://ndl.iitkgp.ac.in
c) www.dgms.gov.in
d) https://surveyofindia.gov.in

15. PO-COMPETENCY-CO MAPPING

Semester II	Basic Mine Surveying (Course Code: 4322201)								
	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 inflamma ble gas.
Competency	**Carry out basic survey in mines to prepare drawings.**								
Course Outcomes **CO1:** Select suitable methods of linear and angular measurement for survey.	3	2	-	2	-	-	2	-	-
CO2: Prepare plans for various land survey.	3	1	-	1	-	-	2	-	-
CO3: Justify the right procedure to be followed for a particular survey work.	3	1	-	1	-	-	2	-	-
CO4: Illustrate the precautionary steps to be taken while surveying.	3	-		1	-	-	2	-	-
CO5: Apply usual checks for measuring the accuracy of survey work.	3	1		-	-	-	2	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Branch specific Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	S.G.Srivastav, HOD (Mining)	Govt. Polytechnic-Bhuj	9998131511	shashiv07@rediffmail.com
2	C.V.Thakor , Lecturer	Govt. Polytechnic-Bhuj	7069052545	chiragthakor4u@gmail.com