GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Mining Geology**
(Course Code: 4332204)

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

1. RATIONALE

The Mining Engineers are involved in the mine development, supervision of mining operations, etc. Being Mining Diploma graduate, he/she should be able to identify various minerals, their recovery process, utility, occurrences, origin, etc. They should also identify and differentiate various kinds of rocks, their formation, joints, folds and problems. This course attempts to teach knowledge of geology required for mining, and hence it is a core course for all mining engineers.

2. COMPETENCY

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

- **Identify different geological structures, minerals, rocks and its formation process.**

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: Analyze volcanoes, weathering, and natural forces for causes, effects, and products.
CO2: Identify various types of geological disturbances.
CO3: Analyze different rocks formations, structures, and textures.
CO4: Examine properties of minerals, their distribution and economic significance.
CO5: Evaluate hydrology, classify groundwater, understand aquifers' geological role.

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	0	2	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 – Not Applicable

The following practical outcomes (PrOs) that 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'*.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify various geological structures.	I, II	*4
2	Plot different landforms from given contours.	II	*4
3	Draw Longitudinal profile of given contours.	II	*4
4	Identify different minerals based on Physical Properties	III	*6
5	Locate various types of mineral occurrences on map.	III	*4
6	Plot sub-surface Hydrological profile.	V	*4
	Total		**26**

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 different rocks and minerals	30
2	Creating given 3-dimensional diagram	30
3	Answer the question	20
4	Submission of practical in time	20
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED – (Not Applicable)

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Models of Fold, Fault and Joints	3 to 4
2	Set of different Rock samples (Sedimentary, Igneous & Metamorphic rock)	5
3	Set of different Mineral Samples.	6
4	Moh`s Scale Hardness Testing Box	6

7. AFFECTIVE DOMAIN OUTCOMES

The following 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 ethical practices.
c) Practice environmentally friendly methods and processes in Mining geology. (Environment related)

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 **Physical Geology**	1a. Explain physical geology 1b. Describe weathering 1c. Explain different process of physical geology 1d. Explain natural disaster-Volcano.	1.1 Physical & Chemical Weathering. 1.2 Process of physical & chemical weathering. 1.3 Introduction of works of winds, stream, sea & glaciers. 1.4 Volcanoes: types, causes, effects and its products.
Unit – II **Primary structures & Secondary structures**	2a. Explain different types of geological structures. 2b. Describe 3-dimensional diagram of folds 2c. Explain Faults in geology. 2d. Explain geological joints. 2e. Explain different types of unconformities.	2.1 Primary and Secondary structures 2.2 Define: Outcrop, In crop, Bedding Plane, dip, strike and contours. 2.3 Geological folds: origin, categories of fold, parts of fold, classification of fold. 2.4 Geological joints: description of some important joints, classification. 2.5 Faults in geology- Distinction between faults & joints, origin, classification. 2.6 Different types of unconformities
Unit– III **Petrology**	3a. Explain different types of rocks. 3b. Explain formation process of rocks. 3c. Explain different characteristics of rocks. 3d. Explain occurrence of different rocks in India	3.1 Igneous rocks- formations, its classification, its structures & textures. 3.2 Sedimentary rocks - formations, classification, its structures & textures. 3.3 Metamorphic rocks- formations, its structures & textures.
Unit– IV	4a. Explain physical & chemical properties of minerals.	4.1 Minerals - Physical & chemical properties.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Mineralogy	4b. Locate different minerals on Indian map. 4c. Explain economic importance of minerals.	4.2 Distribution of minerals in India. 4.3 Economic importance of minerals.
Unit– V **Hydro-geology**	5a. Define terminologies of Hydro-geology. 5b. Explain various stages Hydrological cycle. 5c. Describe various hydrological properties of rocks. 5d. Classify sub-surface ground water. 5e. Classify various aquifers and groundwater.	5.1 Terminology 5.2 Hydrological cycle, 5.3 Hydrological properties of rocks – permeability, porosity and specific yield, 5.4 Sub-surface classification of ground water, 5.5 Classification of aquifers & groundwater as a geological agent (erosional & depositional agent)

***Note**: The UOs 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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Physical Geology	07	03	06	04	13
II	Primary & Secondary Structures	10	03	06	05	14
III	Petrology	09	04	07	04	15
IV	Mineralogy	08	03	07	03	13
V	Hydro-geology	08	03	07	05	15
Total		**42**	**16**	**33**	**21**	**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 specification table for different types of minerals and rocks.
b) Undertake micro-projects in teams.
c) Give seminar on any relevant topic.
d) Prepare report on various issues related to geological activities.

e) Publish a research paper on themes related to geological advancement.
f) Undertake some small mini projects on various issues related geological process
g) Submit a report on visit to a geological site.
h) 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) 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***.
e) Arrange visit to nearby industries and workshops for understanding geological activity.
f) Use video/animation films to explain various processes related to geological activity.
g) Use different instructional strategies in classroom teaching.
h) Write the report on properties of different rock and minerals.
i) Display various technical brochures of recent projects/themes related to geology industry.

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 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) Build a Chart showing advancement in geological activity
b) **Primary structure:** Build a model of primary structure
c) **Secondary structure:** Build a model of secondary structures.
d) Practice stimulation and Plotting of Longitudinal profile of various geological disturbances and structures. Prepare a report showing various structures and its detailing. Website - https://micromyearth.com/ URL: - https://visible-geology.appspot.com/
e) Study and report preparation of plotting of various structures by using Virtual Labs by Ministry of Education, website- vlab.co.in, URL:- https://mg-nitk.vlabs.ac.in/
f) Visit to nearby geological site and study various aspects related to environment and sustainable development and prepare a report of it.

g) Prepare a chart showing Hydrological cycle.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Text book of Geology	G.B. Mahapatra	CBS Publishers and Distributors Pvt. Ltd. ISBN:- 81-239-0013-9
2	Principles of Engineering Geology	K. M. Bangar	Standard Publishers Distributors ISBN:- 81-8014-115-2
3	Engineering & General geology	Parbin Singh	S.K Kataria & Sons ISBN- 9788188458516
4	Engineering Geology and Rock Mechanics	Dr. B. P. Verma	Khanna Publishers ISBN:- 978-93-87394-15-5
5	Text Book of Physical Geology	G.B. Mahapatra	CBS Publishers and Distributors Pvt. Ltd. ISBN:- 81-239-0110-0

14. SOFTWARE/LEARNING WEBSITES

1. http://emg.geoscienceworld.org/content/current
2. http://en.wikipedia.org/wiki/Mineral_exploration
3. https://nptel.ac.in/courses/123/105/123105007/
4. https://en.wikipedia.org/wiki/Petrology
5. Website - https://micromyearth.com/ URL: - https://visible-geology.appspot.com/
6. website- vlab.co.in, URL:- https://mg-nitk.vlabs.ac.in/

15. PO-COMPETENCY-CO MAPPING

Semester III	Mining Geology (Course Code: 4332204)								
	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	**Identify different geological structures, minerals, rocks and its formation process.**								
Course Outcomes **CO1:** Analyze volcanoes, weathering, and natural forces for causes, effects, and products.	3	2	-	-	-	-	-	-	-
CO2: Identify various types of geological disturbances.	3	-	-	2	2	-	2	-	-
CO3: Analyze different rocks formations,	3	-	-	-	-	-	-	-	-

structures, and textures.									
CO4: Examine properties of minerals, their distribution and economic significance.	3	-	-	3	2	-	2	-	-
CO5: Evaluate hydrology, classify groundwater, understand aquifers' geological role.	2	2	-	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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