GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Semester-VI

Course Title: **Mine Environment**

(Course Code:4362204)

Diploma programme in which this course is offered	Semester in which offered
Mining Engineering	6th Semester

1. RATIONALE

Due to the nature of mining activities, it will become an important source of environmental problems such as land damage, deforestation, degradation of water resources, air pollution etc. To reestablish the ecosystem and productivity of these areas, remediation technologies must be taken by the mining engineers. Furthermore, good management of mining wastes during the exploitation period can help to prevent soil degradation in surrounding areas as well in the tailings ponds themselves.

Mining laws also emphasize the provisions regarding environment friendly practices in mines to minimize/ mitigate environmental issues and any circumstances that may create environmental problem. A clear understanding of all environmental factors is always helpful to a mining engineer for making environment management decision.

A mining diploma holder must acquire a deep knowledge and understanding of the post-effects of mining activities on each environmental aspect. This course will improve the competency in selecting suitable methods, and technology as a mitigation measure for mine environmental pollution.

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 effects of pollution on various aspects of mine environment.**
- **Adopt suitable remedial measures against environmental pollution.**

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: Demonstrate the concept of mine environment.
CO2: Identify various components of mine environment.
CO3: Justify impacts of environmental pollution due to mining activities.
CO4: Adopt appropriate preventive measure against mine environmental pollution.
CO5: Recall various provisions of environmental management.

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	
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) that 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	Determination of different parameters of Soil using Soil Testing kits.	II, III, IV	*6
2	Determination of different parameters of Water using Water Testing kits.		*6
3	Measurement of Respirable dust concentration of size PM 2.5 & PM 10.		*6
4	Measurement of Noise Level by Integrating Sound Level Meter.		*6
5	Measurement of Illuminance by Digital Light meter.	II, III	*4
		Total	**28**

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	Basic knowledge in identification of various environmental impact parameters.	30
2	Accuracy in observation of extent of Environmental pollution	30
3	Correctness in answering the questions	20
4	Submission of practical in time	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These 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	**Soil testing kits: -** **Kit includes:** 120 mL extraction solution, 70 mL pH indicator, 75 powder packets (25 each for Nitrogen, Potassium, Phosphorus), 1 mL pipettes (3) test tubes (5), test tube stand, spoon, brush, color cards (4), graduated card, and handbook. **Range of testing:** pH Range: 4 to 9 pH, Nitrate Nitrogen (NO3-N): 0.0 to 20 kgs/acre (low, medium, high), Available Phosphorous (P2O5): 0.0 to >40.0 kgs/acre, Available Potassium (K2O): 0.0 to >180 kgs/acre, Organic Carbon: <0.5% , 0.5-0.75%, >0.75% (low, medium, high)	1
2	**Water testing kits:** **Kit includes:** pH meter, Conductivity, Alkalinity, TDS, Salinity & Temperature Measurements Highly Accurate & Stable User Friendly **Range of Testing:** pH Range: 0.0 to 14.0 pH, Alkalinity Range: 0 to 100 mg/L $CaCO_3$; 0 to 300 mg/L $CaCO_3$, TDS: 0-200ppm, Salinity: 0-200ppm	2
3	**Dust sampler for PM 2.5:** PM 2.5 Sampler, 47 mm polytetrafluoroethylene (PTFE) filter, Analytical Balance: Up to 0.00001 grams, filter paper, hand gloves and stop watch. **Dust sampler for PM 10:** High volume air sampler (HVS), Microfiber filter (8" x 10" size), filter paper, hand gloves and stop watch.	3
4	**Digital sound level meter:** Measuring noise range: 30 to 130 dB, Resolution: 0.1 dB, Accuracy: ±1.5 dB, Frequency response: From 31.5 Hz to 8 kHz and Microphone: 0.5-inch electric condenser microphone	4
5	**Digital Light meter (Lux meter):** Measuring Range: 0 to 2,00,000 lux, Accuracy: ± 5%, Display: liquid crystal display, Receiving light: Silicon of photo electricity diode	5

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) Act as a team member/ individual in decision making process.
b) Display a professional commitment to ethical practice on a daily basis.
c) Adopt environment friendly and sustainable measures for reclaiming environmental issues.

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 **Introduction of mine environment**	1a. Explain the concept and scope of mine environment. 1b. Explain the objective and importance of environmental impact studies.	1.1 Concept of Mine Environment 1.2 Scope of environmental study 1.3 Objective and importance of assessing impacts of environmental pollution.
Unit – II **Components of mine environment**	2a. Explain the components for environmental study. 2b. Explain the importance of various environmental components for impact study. 2c. Elaborate the mine environmental components in detail.	2.1 **Land:** Land use pattern, Top soil profile, importance of flora and fauna 2.2 **Water:** Surface water & Ground water, Aquatic ecosystem like marine and fresh water ecosystem. 2.3 **Air:** Factors considered for air pollution like dust (PM 2.5 -10) and gases (NOx and SiO2). 2.4 **Societal Environment:** Population, ethical culture, societal complexion, sex-ratio, cost of living, migration, civic facilities, income pattern, urbanization, education, medical, infrastructure, transport & communication, health & Recreation, Aspirations, Addiction, Noise level and Domestic waste 2.5 **Others:** Waste rock, tailings their sources, Noise, Vibration and Illumination.
Unit– III **Impacts on various Environmental components**	3a. Classify the impacts based on various components. 3b. Explain effects of pollution occurred in various environmental components. 3c. Explain health hazards occurred due to various environmental pollution.	3.1 **Impacts due land pollution:** Changes in - Topography, land use pattern and land ecosystem. Land degradation cycle due to Mining. 3.2 **Impacts due to Water pollution:** Surface & groundwater degradation, changes in drainage pattern, Acid Mine Drainage and effluents discharge. 3.3 **Impacts due to Air pollution:** On human-being like visibility, gas poisoning, lung and throat diseases and living cost. 3.4 **Socio-economic impacts:** Migration, loss

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		of land, Quality of Life (QOL), livelihood and health hazards. 3.5 **Impacts due to Noise Pollution:** Auditory effects, Physiological effects and other effects. 3.6 **Impacts due to Vibration and Illumination:** Ground disturbance, structural disturbance, landslides, road accidents due to poor illumination, eye-sight problems.
Unit– IV **Control and Prevention of Environmental Pollution**	4a. Explain top soil and sub-soil management. 4b. Describe physical and biological reclamation techniques. 4c. Explain sources of pollution and its preventive measures to control environmental pollution. 4d. List out the parameters considered for checking the quality of environmental components.	4.1 Top soil and sub soil management, Reclamation-Physical and Biological. 4.2 Water quality criteria, various parameters of water, water pollution sources and preventive measures, National standards of Drinking water. 4.3 Air pollution sources and preventive measures, National standards of ambient air quality. 4.4 Noise pollution sources and preventive measures, Ambient Air quality standards in respect to noise, Types of Noise control techniques.
Unit – V **Environmental management**	5a. Explain various factors considered for EIA and EMP. 5b. Explain various provisions of environmental management related to Mining.	5.1 Factors considered for Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) statement. 5.2 Brief introduction of Mine Closure planning, Environmental Protection Act, 1986, Forest conservation Act, 1980 and Forest conservation rules, 1981 related to Mining.

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 of mine environment	04	03	03	00	06
II	Components of mine environment	08	06	06	04	16
III	Impacts on various Environmental components	12	06	07	06	19
IV	Control and Prevention of Environmental Pollution	12	04	08	07	19
V	Environmental management	06	06	04	00	10
Total		**42**	**25**	**28**	**17**	**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) Visit nearby mine area.
b) Visit a mine reclaimed area, mines township and nearby villages for observing environmental impacts due to Mining.
c) Attend expert lectures arranged by department on environmental pollution and its control topics.
d) Participate in seminars conducted by MEAI/department student chapter on related topics.
e) Make a group discussion on environmental issues and its mitigational measures.
f) Watch videos related to reclamation and rehabilitation techniques taken globally.
g) Undertake micro-project.

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) '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 assessed using different assessment methods.
e) With respect to section No.10, teachers need to ensure to create opportunities and provisions for co-curricular activities.
f) Guide students on how to address issues on environment and sustainability.
g) Video lectures showing various reclamation operations.
h) Guide students on how to address societal environmental issues nearby mine areas.
i) Animated documentaries on various environmental reclamation topics.

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. 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-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 poster showing various components of mine Environment.
b) Prepare a model showing layered structure of top soil, sub-soil, country rock and coal seam.
c) Prepare an illustrative diagram of Land degradation cycle.
d) Prepare a banner related to environmental impacts with reference to local community.
e) Presentation on any case study related to land reclamation techniques used by Mining Industry.
f) Prepare a poster showing National Ambient Air Quality/Noise/Water standards.
g) Make slides showing various health hazards due to Air and Noise pollution.
h) Prepare a banner illustrating various factors considered for EIA and EMP statement.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Environmental Management in Mining Areas	Naresh Chandra Saxena, Gurdeep Singh, Rekha Ghosh	Pawan kumar scientific Publishers Year: 2002 ISBN: 81-7233-296-3
2	Environmental Impact of Mining and Mineral Processing Management, Monitoring and Auditing strategies	Ravi K. Jain Zengdi CUI, Jeremy K. Domen	Butterworth-Heinemann publications Elsevier Inc. Year: 2016 ISBN: 978-0-12-804040-9
3	Environmental Engineering in Mines	V S Vutukuri and R. D. Lama	Cambridge University Press Year: 1986 ISBN : 978-0-521-24605-7
4	Environmental Impacts of Mining Monitoring, Restoration, and Control	Mritunjoy Sengupta	CRC Press Year: 2021 ISBN : 9781003164012
5	Environmental Pollution and Environmental Management	Padmanabh Dwivedi	Scientific Publishers Journals Dept Year: 2004 ISBN-13 : 978-8172333584

14. SOFTWARE/LEARNING WEBSITES

- NPTEL videos on Topic: - Ecology and Environment
  link: https://archive.nptel.ac.in/courses/127/106/127106004/
- NPTEL videos on Topic: - Environment and Ecology (Web)
  link: https://archive.nptel.ac.in/courses/122/102/122102006/
- https://www.fao.org/3/I9183EN/i9183en.pdf
- https://www.rpcau.ac.in/wp-content/uploads/2020/03/Water-Pollution.pdf
- https://www.rpcau.ac.in/wp-content/uploads/2020/03/CAUSES-EFFECTS-AND-CONTROL-MEASURES-OF-AIR-POLLUTION.pdf
- https://kanchiuniv.ac.in/coursematerials/AirPollutionandControlEngineering.pdf
- https://www.britannica.com/science/land-pollution
- https://en.wikipedia.org/wiki/Environmental_resource_management
- https://en.wikipedia.org/wiki/Sustainability_and_environmental_management
- https://www.academia.edu/39508649/Environmental_Pollution_and_Control_Fourth_Edition_PDF

15. PO-COMPETENCY-CO MAPPING

Semester VI	Mine Environment (Course Code:4362204)								
	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 effects of pollution on various aspects of mine environment.** • **Adopt suitable remedial measures against environmental pollution.**								
Course Outcomes **CO1:** Demonstrate the concept of Mine Environment.	3	-	-	-	-	-	2	-	-
CO2: Identify various components of Mine Environment.	3	-	-	-	-	-	2	-	-
CO3: Justify impacts of Environmental Pollution due to Mining activities.	2	3	-	-	2	-	2	-	-
CO4: Adopt appropriate preventive measure against Mine environmental pollution.	2	3	2	2	2	1	2	-	-
CO5: Recall various provisions of environmental management.	3	-	1	-	-	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

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