GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Surface Mining
(Course Code: 4342204)

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

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 select suitable method of working starting from feasibility study, development, production, reclamation and post mining rehabilitation techniques for the socio – economic sustainability of surface mining projects. After completing this course, the student will select suitable machines and design a perfect layout with high degree of accuracy as intended in this course.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills so that student is able to acquire following competency.

- **Adopt suitable technique and procedure for justifying the selection of methods and machines for achieving required socio-economic benefit from surface mining.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

CO1: Describe various points to be considered for selection of applicability, feasibility, planning and designing of a suitable surface mining method.
CO2: Explain all geotechnical and economical parameters considered during development operation of a surface mine.
CO3: Design a suitable pattern of blast holes to achieve the required blasting result.
CO4: Justify a sustainable mode of excavation and transportation system suitable for a particular condition.
CO5: Describe various environmental impact parameters considered for a surface mine.

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	-	-	3	30	70	00	00	100

(*): 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 Student Activity; **P -** Practical; **C -** Credit; **ESE** -End Semester Examination; **PA** - Progressive Assessment

5. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. 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 on site.
d) Practice of environmental friendly methods and processes.

6. 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 **SurfaceMining**	1a. Describe various applicability condition and types of surface mining methods with its advantage and disadvantage. 1b. Explain the points considered for feasibility study of surface mine. 1c. Explain the factors considered for designing and planning of surface mine.	1.1Introduction of surface mining – 1.1.1 Applicable conditions for surface mining methods (i) Stripping ratio (ii) Break even stripping ratio 1.1.2 Types of Surface mining methods (i) Strip mining (ii) Open-pit mining (iii) Mountain top removal (iv) Dredging (v) High wall mining 1.1.3 Advantages & disadvantages of surface mining methods 1.2 Preliminary investigation of surface mining – Feasibility study – Various points considered in feasibility report (i) Type of reserve (ii) Market value and cost (iii) Transport facilities (iv) Power supplying facilities (v) Availability of water resources (vi) Environmental conditions (vii) Presence of nearby township (viii) Availability of skilled labor (ix) Local Topography

		(x) Geotechnical parameters (xi) Control of environmental pollution (xii) Aspect of giving compensation due to damage (xiii) Raising funds (xiv) Government policies for investment/taxation (xv) Socio-economic and political situation (xvi) Communication system 1.3 Factors considered for designing and planning a surface mine:- (i) Dip of the deposit (ii) Form of the deposit (iii) Size of the deposit (iv) Depth of the deposit (v) Surface topography (vi) Geo-technical parameter of rock (vii) Production target, Degree of mechanization, Availability of capital (viii) Environmental condition and town sheep (ix) Land reclamation, Sub-soil management, Environmental management (x) Availability of power (xi) Cost economic analysis
Unit – II **Mine Development**	2a. Explain the factors considered for locating a box cut. 2b. Describe the factors considered before overburden removal process. 2c. Select suitable machine for particular volume and type of overburden material for it's removal. 2d. Describe various methods of overburden removal. 2e. Explain various factors considered for designing a haul road. 2f. Describe various bench designing parameters.	2.1 Opening out surface deposits by box cut – it's location, geometry & technical parameters. 2.2 Overburden removal 2.2.1 Main factors considered (i) Thickness (ii) Dip and depth of the overburden (iii) Manner of occurrence of deposit (iv) Surface topography (v) Ground conditions (vi) Environmental conditions (vii) Production requirement (viii) Geo-technical parameters (ix) Geological disturbance (x) Watery conditions (xi) Stability of overburden benches 2.2.2 Selection of Machines for overburden removal (i) Geotechnical parameters of rock like compressive strength, shear strength, tensile strength and modulus of elasticity

		(ii) Geophysical characteristics like thickness, stratification, massiveness, scattered condition, friability, hardness, looseness, watery condition, and floor condition 2.2.3 Methods of overburden removal (i) Over Casting or Side casting by dragline (ii) Shovel and conveyer combination (iii) By bucket wheel excavator and bridge conveyer 2.3 Design of haul road – Factors considered for deciding numbers and location of entries/ramps to enter and exit from the mine 2.4 Bench designing parameters - bench,bench height & width, bank width, berm, toe, crest, face angle, overall pit slope angle & ultimate pit slope angle.
Unit – III **Drilling & Blasting**	3a. Describe various drilling patterns used for bench blasting. 3b. Explain various technical parameters considered for blast hole design. 3c. Calculate the powder factor for the broken volume of rock by the consumed explosive.	3.1 Various drilling patterns used for bench blasting 3.2 Various technical parameters of blast hole design - Hole diameter, Charging length, Stemming length, Sub grade drilling, Spacing, Burden, Free face etc. 3.3 Charging and blasting of holes- (i) Various blast hole charging techniques (ii) Calculation of quantity of explosive required for blasting. (iii) Calculation of volume of broken rock.
Unit – IV **Excavation & Transportation**	4a. Describe constructional and working principles of excavation machines. 4b. Describe constructional and working principles of transportation machines. 4c. Calculate required number of excavating and transportation machines to optimize transportation system.	4.1 Type of excavation machines used in surface mines - Constructional and Working principles of surface machines - single bucket and multi-bucket excavators, Pay loader, Drag line, Ripper, Scrapper and Surface miner. 4.2 Mode of transportation used in surface mines- Constructional and Working principles of transportation machines – Truck/Dumper, Belt Conveyer, Aerial Ropeway, Railway System. 4.3 Optimization of transportation system in surface mines - Optimization of shovel-dumpercombination – calculation of appropriate number of shovel and dumper to match with required production capacity.

Unit – V **Environmental Impacts of Surface Mining**	5a. Describe various environmental factors considered for impacts due to surface mining. 5b. Describe various environmental effects due to surface mining activities.	5.1 Concept of environment – Main constituents considered for analyzing mine environment (i) Land (ii) Water (iii) Air (iv) Flora & Fauna 5.2 Various effects on these environmental components due to surface mining activities. (i) Land degradation – Non fertile land (ii) Acid mine drainage – Ground/river water pollution (iii) Air born dust pollution – Various Health issues (iv) Deforestation issues

7. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Surface Mining	08	8	7	0	15
II	Mine Development	10	8	4	2	14
III	Drilling and Blasting	10	6	6	4	16
IV	Excavation & Transportation	08	8	7	0	15
V	Environmental Impacts of Surface Mining	06	5	5	0	10
Total		**42**	**35**	**29**	**6**	**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.*

8. 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:

Student will visit nearby Surface Mines and Submit report consisting basic information of surface mine, type of method used for mining, type of machineries and their specification etc. for the same.

9. 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, 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***.

10. 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) Prepare a report on working method of Surface mine visited by you.
b) Design a flow sheet of mining activities conducted on surface mine with equipment/machines involved.
c) Calculate number of excavator machines required for a given targeted production.
d) Design a blasting layout for bench blasting.
e) Prepare a chart showing applicable condition with transportation method.
f) Prepare a flowchart showing various impacts of surface mining on environment.

11. SUGGESTED LEARNING RESOURCES

- **List of Books:**

Sr. No.	Title of Books	Author	Publication
1.	Elements of Mining Technology	D. J. Deshmukh	Central techno publication
2.	Surface Mining Technology	Samir kumar Das	Lovely prakashan
3.	U.M.S.		Lovely prakashan
4.	Engineering Rock Blasting Operations	Sushil Bhandari	A.A.Balkema/Rotterdam/Brook Field

12. List of Software/Learning Websites

1. http://www.youtube.com/playlist?list=PLkxYmnB5O9sewknlIfPPlLy816fs7Z2PQ
2. https://www.youtube.com/playlist?list=PLRv9aGFxXwGQqFqfCTuwAKNpy9mxGUdEK
3. Surface mining lectures (NPTEL) - https://archive.nptel.ac.in/courses/123/105/123105007/
4. https://www.mining-journal.com/

13. PO –COMPETENCY – CO MAPPING

Semester IV	Surface Mining (Course Code:4342204)								
	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 forsociety, 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	Adopt suitable technique and procedure for justifying the selection of methods and machines for achieving required socio-economic benefit from surface mining.								
Course Outcome **CO1:** Describe various points to be considered for selection of applicability, feasibility, planning and designing of a suitable surface mining method	3	-	-	-	1	-	-	-	-
CO2: Explain all geotechnical and economical parameters considered during development operation of a surface mine	3	1	-	-	2	-	-	-	-
CO3: Design a suitable pattern of blast holes to achieve the required blasting result.	3	2	2	3	2	2	2	-	-

CO4: Justify a sustainable mode of excavation and transportation system suitable for a particular condition	3	2	2	-	1	-	-	-	-
CO5: Describe various environmental impact parameters considered for a surface mine	3	-	-	-	3	-	-	-	-

14. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

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