GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172213
Semester – VII
Subject Name: Rock Fragmentation

Type of course: Undergraduate

Prerequisite: Zeal to learn the subject

Rationale: The course is designed to help the student in understanding the mechanisms of rock fragmentation by drilling, blasting and energy partitioning during blasting. This course is helpful in understanding the various blast design approaches for surface mines, blast design and evaluation of blast results. This course is also helpful in grasping process of mine production and also to gain knowledge about the emerging trends in explosives, initiation systems, blast monitoring tools and techniques, analysis and interpretation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Drilling system and method:** Methods of drilling for production of minerals in surface and underground mines; rotary, percussive and rotary –percussive drilling, Operational components of drilling system, different types of drill machines, hydraulic drills, long hole drilling, Factors influencing selection of drill, different types of bits and bit wear, Variables in drilling, mechanics of drilling, drillability of rock and penetration rate.	12
2	**Explosives and Blasting devices:** Composition of Explosive, properties of explosives, Classification of explosive, Type of explosives, Permitted explosive and its type, Emerging trends in explosives, Detonators and its type, other blasting or initiating devices, general application and uses and Emerging trends in initiating systems.	8
3	**Blasting Systems or methods:** Mechanism of rock blasting, Electric and non-electric method of blasting, Blast design parameters and its calculation, Powder factor, Blast design approaches or pattern, Fragmentation prediction approaches, delay blasting techniques, Computational models of blasting	10

4	**Blast Monitoring:** Tools and techniques for pre-blast, in-blast and post-blast monitoring; high speed video camera, V.O.D. Probe, vibration monitor, Borehole pressure, image analysis techniques for measurement of rock fragmentation by blasting;	**7**
5	**Blasting damages and control:** Ground vibrations and air blast. Impact of ground vibration and air blast on the neighboring structures and communities and mitigative measures, reinforcement and design alternatives, Rock mass damage and its implications, Methods to assess blast damage. Control blasting techniques	**9**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
12	**15**	**15**	**10**	**10**	**8**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr. No.	**Author**	**Title of Books**	**Publication**
1	D.J.Deshmukh	Elements of Mining Technology, Vol.1	Denett & Co., Nagpur.
2	B.V. Gokhale	Blasthole drilling Technology	MultiFields, Bombay
3	Dr G..K.Pradhan	Explosives & Blasting Techniques	Mintech Publications, Bhubaneswar.
4	Dr.Sushil Bhandari	Engineering Rock Blasting Operations	A.A.Balkema Publisher Old post Road, Brook field, TO5036, USA.
5	Dr S.K.Das	Explosive & Blasting Practices in Mines	Lovely Prakashan, Dhanbad

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply suitable drilling techniques depending upon the physico-mechanical paratemers of rock/rockmass.	25

CO-2	Familarise emerging trends in explosives, initiation systems, blast monitoring tools and techniques, analysis and interpretation.	30
CO-3	Apply integrated blast design approach and pattern depending upon various geotechnical conditions of rock.	25
CO-4	Assess and control of environmental impacts of blasting and blasting damage.	20

List of Experiments:

Following experiments are suggested for Laboratory work

Sr. No	Practical /Exercise	Approx. Hours Required
1	Study of various methods of drilling used for production of mineral from surface and underground mines.	4
2	Determination of drill ability of rock.	4
3	Analysis of various blast designs and their effect on Powder Factor.	4
4	Designing a blast hole pattern for a surface mine bench for various conditions.	4
5	Analyzing controlled blasting and secondary blasting.	4
6	Performing a Time study of drilling and blasting operation of a mine with optimization suggestions.	4
7	Measurement of VOD By VOD mate and its analysis.	4
Total		28

Important Note:

80 % From above suggested laboratory work should be covered and remaining 20 % is as per facility available at Department

Design based Problems (DP)/Open Ended Problem:

Visit to a mines and study the operation and working of drill machines and Blasting process.

Major Equipment:

1. Drillability testing machine
2. VOD mate
3. Various charts of Blast Geometry
4. Working model of drill machine
5. Fragmentation analysis Software

List of Open Source Software/learning website:

i. www.researchgate.net

ii. https://www.slideshare.net
iii. https://en.wikipedia.org/wiki/Drilling_rig
iv. https://nptel.ac.in
v. https://miningandblasting.wordpress.com/tag/blast-pattern/
vi. www.journal.elsevier.com
vi. www.mdpi.com/journal/mineral
vii. www.min.eng.com