GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Mining Engineering
Subject Code: BE04022031
Subject Name: Underground Mining Machineries

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Mechanics of Solids
Rationale:	The course equips students with comprehensive knowledge of mining machineries used in surface and underground operations. It emphasizes the selection, operation, productivity, safety, and maintenance of equipment. Students gain insight into modern mechanization, automation, and technological advancements essential for efficient, economical, and sustainable mining practices in contemporary industry environments.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	To provide knowledge of various mining machinery used in surface and underground mines.	10
CO-2	To understand the selection criteria, operation, and performance parameters of mining equipment.	12
CO-3	To study maintenance, reliability, and economic considerations of mining machines.	18
CO-4	To familiarize students with automation, remote operation, and emerging technologies in mining machinery.	18
CO-5	To develop competency in practical handling, safety, and troubleshooting of mining equipment.	12

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	SL	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	TW/ SL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

Content:

Sr. No.	Content	Total Hrs
1	**Introduction** Definition, scope, and role of machinery in mining operations; Classification of mining equipment: excavation, loading, haulage, drilling, blasting, supporting, and auxiliary equipment; Mechanization levels in surface and underground mining Basic machine elements: power sources, transmission, hydraulics, pneumatics Selection factors for mining machinery: production, geology, economics, environment, safety Introduction to automation and IoT in mining machines	06
2	**Surface Mining Machineries** **Excavation Machinery** - Shovels, draglines, bucket wheel excavators (BWE); Dozers, rippers, scrapers, graders; Front-end loaders, hydraulic excavators; Productivity calculation, cycle time, machine matching **Aerial ropeways**: Different types, their construction, installation, operation, and Maintenance, their layout including rope tensioning arrangement. **Haulage Machinery:** Dumpers, rear-dump trucks, trolley-assist systems**;** Conveyors, high-angle conveyors, in-pit crushing & conveying (IPCC); Surface miner (cutting principles, performance) **Drilling & Blasting Machinery:** Rotary, percussion, down-the-hole (DTH), top-hammer drills**;** Blast-hole drills, jumbo drills**;** Explosive charging and stemming equipment	12
3	**Underground Mining Machineries** **Drilling & Excavation:** Jackhammers, drifters, jumbo drills; Continuous miners, road headers, longwall shearers; Raise borers and shaft boring machines (SBM) **Loading & Haulage:** Load–haul–dump (LHD), load–dump–transport (LDT); **Transport:** Shuttle cars, locomotives, mine trucks; Conveyors, monorail systems, chairlift transportation, rope haulage – types; construction; installation; maintenance and design calculation; safety. **Roof Support & Auxiliaries:** Powered roof supports (PRS); Rock bolting machines; Shotcrete pumps and mixers	12

4	**Mine Pumps and auxiliary machineries** Mine pumps: centrifugal, reciprocating, submersible, jet pumps; Compressors: piston, screw, and turbo compressors. Hydraulic and pneumatic systems in mining applications Hoisting machinery: mine winder types, headgear, ropes, drum and friction winders; breaks; design calculations, safety hooks. Wire ropes: types; construction; selection; installation; capping; splicing; inspection	**08**
5	**Maintenance, Economics & Emerging Technologies** **Maintenance & Reliability:** Preventive, predictive, and condition-based maintenance; Lubrication systems, wear analysis; Machine availability, utilization, reliability indicators; Failure analysis and troubleshooting techniques. **Machine Economics:** Cost of ownership and operation; Equipment productivity evaluation. Fleet management systems **Modern Trends:** Mine automation, autonomous trucks, and remote-operated loaders; telematics and GPS-based fleet tracking; electric mining vehicles and hybrid drives.	**07**
	TOTAL	**45**

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	**40**	**10**	**10**	**00**	**00**

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:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Mining Machinery and Equipment	G. Sarkar	Khwaab Publication 978-8198949462
2.	Principles of Mining Machinery & Systems	R. Hasim and M.K. Mallick	Khwaab Publication 978-8198949462
3.	Mine Machinery-II For Mining	L. Narsima Rao	Planet Publishing House First Edition B01MU80KRZ
4.	Introductory Mining Engineering	Howard L. Hartman and Jan M. Mutmansky	Wiley Second Edition 978-0471348511
5.	SME Surface Mining Handbook	Peter Darling	Society for Mining, Metallurgy, and Exploration 978-0873354820
6.	Underground Mining Methods: Engineering Fundamentals and International Case Studies	William A. Hustrulid and Richard L. Bullock	Society for Mining, Metallurgy, and Exploration 978-0873351935
7.	Surface and Underground Excavations: Methods, Techniques and Equipment	Ratan Raj Tatiya	CRC Press First Edition 978-9058096272
8.	Mining Haulage The Classic Mine Technology	International Textbook Company	Periscope Film LLC 978-0981652627
9.	Manufacturer's Handbooks and Technical Manuals	(Caterpillar, Komatsu, Sandvik, Epiroc, Joy Global/Komatsu Mining)	
10.	Elements of mining Technology VOL. I, II,III	D.J.Deshmukh	Lovely prakashan Dhanbad
11.	Mine Pumps and Haulages	S.Ghatak	Lovely Prakashan Dhanbad
12.	Heavy Earth Moving Machinery	Amitosh Dey	Lovely Prakashan Dhanbad

List of Experiments:

i. Study and classification of mining equipment's based on operations.
ii. Study of constructional features of aerial ropeway.
iii. Study of haulage machineries used in opencast mining.
iv. Study of surface drill and jumbo drill used in surface mining.
v. Constructional features of different type of rope haulage.
vi. Study and design of belt conveyors for material transportation in mines.
vii. Study of characteristic curves of centrifugal pumps.

viii. Draw and explain winding drum used in mines.
ix. Study of safety devices used in mine winding systems.
x. Draw and explain different types of wire ropes used in mine.
xi. Introduction to automation and IoT in mining machines.

Major Equipment:

i. Models of various machines.
ii. Working models of all safety devices.
iii. Mine haulage Models
iv. Rope coupling models
v. Dumper models
vi. Shovel models. v. Dozer models.
vii. Rock drill machines.
viii. Jack Hammers.
ix. Air compressor for Jack Hammer.
x. Mine Pumps
xi. Laboratory model of headgear
xii. Laboratory model of mine winders
xiii. Model king detaching safety hook
xiv. Model of armoured detaching safety hooks.
xv. Belt conveyor systems
xvi. Explosive charging and stemming equipment

List of Open-Source Software/learning website:

i. http://www.phmining.com/
ii. http://dhi.nic.in/MINING-CONSTN-EQUIPMENT.pdf
iii. http://bemlindia.com/product_mc.php
iv. http://en.wikipedia.org/wiki/Heavy_equipment_(construction)
v. http://catalogs.indiamart.com/manufacturers/earth-moving-heavy-equipment.html
vi. http://www.joy.com/
vii. http://www.mtu-online.com/mtu/applications/mining/undergroundmining-machines/

List of suggested activities for Problem Based Learning:

a. **Assignments**: (Seminar Topics/ Visits/Self-Learning Topics) Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.)

i. Prepare a report on the features and specifications of various machines used in mines, utilizing online resources.
ii. Visit to the nearby underground mine to observe the working of various types of underground machinery.
iii. Prepare a report on maintenance practice: lubrication, condition monitoring, fault diagnosis
iv. Prepare report on LHD, SDL, conveyor operation and layout study (virtual/field visit)

v. Visit to workshop: pump, compressor, and hydraulic system demonstration

b. Micro Projects: A Suggested list of course-wise micro-projects is mentioned herewith

i. Design a working model of the excavation or transportation machine for laboratory purposes.
ii. Design the comparison chart of machine selection criteria.
iii. Design a project on productivity estimation and fleet size calculation

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