ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (UNIVERSITY DEPARTMENTS)

Campus: College of Engineering, Guindy

Department: Mining Engineering

Programme: B.E. Mining Engineering

Regulations: 2023 (Revised 2024), with effect from the AY 2024 – 25 to all the students of UG Programme.

OVERVIEW OF CREDITS

Sem	PCC	PEC	ESC	HSMC	ETC	OEC	ED&S	SDC	UC	SLC	Total
I	-	-	6	11	-	-	-	4	1	-	22
II	-	-	7	11	-	-	-	4	1	-	23
III	11	-	4	4	-	-	-	2	-	-	21
IV	17	-	3	-	-	-	-	1	2	-	23
V	14	3	-	-	-	-	3	3	-	1	24
VI	7	9	-	-	2	3	3	2	-	-	26
VII	3	6	-	3	9	3	-	4	-	-	28
VIII	-	-	-	-	-	-	-	8	-	-	8
Total	52	18	20	29	11	6	6	27	4	1	174
% of Category	30	10	11.5	16.5	6.5	3.5	3.5	15.5	2.5	0.5	

CATEGORY OF COURSES

PCC – Professional Core Course
PEC – Professional Elective Course Management Course
ETC – Emerging Technology Course
OEC – Open Elective Course
SLC – Self Learning Course
ESC – Engineering Science Course
HSMC – Humanities Science and
SDC – Skill Development Course
UC – University Course

For Honours & Minor Degree, please refer the Regulations 2023 (Revised 2024).

SEMESTER – I							
S. No.	**Course Code**	**Course Name**	**Course Type#**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP***		
1.	EN23C01	Foundation English	LIT	2-0-2	4	3	HSMC
2.	MA23C01	Matrices and Calculus	LIT	3-1-0	4	4	HSMC
3.	CY23C01	Engineering Chemistry	LIT	3-0-2	5	4	HSMC
4.	ME23C05	Basics of Mechanical Engineering	T	2-0-0	2	2	ESC
5.	ME23C01	Engineering Drawing & 3D Modelling	LIT	2-0-4	6	4	SDC
6.	CS23C02	Computer Programming in Python	LIT	3-0-2	5	4	ESC
7.	UC23H01	*தமிழர் மரபு* /Heritage of Tamils	T	1-0-0	1	1	UC
8.		NCC/NSS/NSO/YRC	L	0-0-2	2	0	UC
9.		Audit Course – I**	T	2-0-0	2	-	UC
TOTAL CREDITS						**22**	

SEMESTER – II							
S. No.	**Course Code**	**Course Name**	**Course Type#**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP***		
1.	EN23C02	Professional Communication	LIT	2-0-2	4	3	HSMC
2.	MA23C02	Ordinary Differential Equations and Transform Techniques	LIT	3-0-2	5	4	HSMC
3.	PH23C01	Engineering Physics	LIT	3-0-2	5	4	HSMC
4.	ME23C04	Makerspace	LIT	1-0-4	5	3	SDC
5.	ME23C03	Engineering Mechanics	T	3-1-0	4	4	ESC
6.	EE23C03	Basics of Electrical and Electronics Engineering	LIT	2-0-2	4	3	ESC
7	UC23H02	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	UC
TOTAL CREDITS						**22**	

SEMESTER – III							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATE GORY
				L-T-P	TCP*		
1.	MA23C07	Numerical and Statistical Methods	T	3-1-0	4	4	HSMC
2.	CE23C02	Fluid Mechanics and Machinery	LIT	3-0-2	5	4	ESC
3.	CE23C04	Principles of Surveying	LIT	3-0-4	7	5	PCC
4.	MI23301	Mine Development	T	3-0-0	3	3	PCC
5.	GY23C03	Geology for Mining Engineering –I	T	3-0-0	3	3	PCC
6.		Audit Course - II**	T	2-0-0	2	-	UC
7.	GY23C04	Geology Laboratory – I & Field Work for Mining Engineering	L	0-0-4	4	2	SDC
				TOTAL CREDITS		**21**	

*** TCP –** Total Contact Period(s)

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TYPE OF COURSE

LIT – Laboratory Integrated Theory

T – Theory

L – Laboratory Course

IPW – Internship cum Project Work

PW – Project Work

CDP – Capstone Design Project

SEMESTER – IV							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATE GORY
				L-T-P	TCP*		
1.	GY23C05	Geology for Mining Engineering – II	T	3-0-0	3	3	PCC
2.	MI23401	Mine Surveying	T	3-0-0	3	3	PCC
3.	MI23402	Mine Environment and Ventilation	LIT	3-0-2	5	4	PCC
4.	IE23C06	Operational Research	T	3-0-0	3	3	ESC
5.	MI23403	Mining Machinery-I	LIT	3-0-2	5	4	PCC
6.	MI23404	Surface Mining	T	3-0-0	3	3	PCC
7.	MI23U01	Standards – Mining Engineering	T	1-0-0	1	1	UC
8.	UC23U01	Universal Human Values	T	1-0-2	3	2	UC
9.	GY23C06	Geology Laboratory-II & Field Work for Mining Engineering	L	0-0-2	2	1	SDC
						23	

SEMESTER – V							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	MI23501	Mining Machinery-II	LIT	3-0-2	5	4	PCC
2.	MI23502	Underground Mining Methods – Coal	T	3-0-0	3	3	PCC
3.	MI23503	Rock Mechanics and Ground Control	LIT	3-0-2	5	4	PCC
4.	MI23504	Underground Mining Methods – Metal	T	3-0-0	3	3	PCC
5.	MI23U02	Perspectives of Sustainable Development	LIT	2-0-2	4	3	ED&S
6.	-	Professional Elective-I	T	3-0-0	3	3	PEC
7.	MI23L01	Self-Learning Course	T	1-0-0	1	1	SLC
8.	-	Industry Oriented Course - I	-	-	-	1	SDC
9	MI23505	Industrial Training – I	L	----	-	2	SDC
			TOTAL CREDITS			**24**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	MI23D01	Capstone Design Project – Level I	CDP	0-0-8	8	4	SDC
(OR)							
1.	-	Honours Elective – I	T	3-0-0	3	3	
2.	-	Honours Elective – II	T	3-0-0	3	3	
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATEGORY**
				L-T-P	**TCP***		
1.	-	Minor Elective – I	T	3-0-0	3	3	
2.	-	Minor Elective – II	T	3-0-0	3	3	

SEMESTER – VI							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	MI23601	Mine Economics and Investment	T	3-0-0	3	3	PCC
2.	MI23602	Mineral Processing	LIT	3-0-2	5	4	PCC
3.	-	Open Elective – I	T	3-0-0	3	3	OEC
4.	-	Professional Elective-II	T	3-0-0	3	3	PEC
5.	-	Professional Elective-III	T	3-0-0	3	3	PEC
6.	-	Professional Elective-IV	T	3-0-0	3	3	PEC
7.	UC23E01	Engineering Entrepreneurship Development	LIT	2-0-2	4	3	UC
8	-	Industry Oriented Course - II	-	-	-	1	SDC
9.	MI23603	Advanced Rock Blasting Laboratory	L	0-0-4	4	2	ETC
10.	MI23604	Mine Survey Camp	L	---	-	1	SDC
			TOTAL CREDITS			**26**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	MI23D02	Capstone Design Project – Level II	CDP	0-0-12	12	6	SDC
(OR)							
1.	-	Honours Elective – III	T	3-0-0	3	3	
2.	-	Honours Elective – IV	T	3-0-0	3	3	
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	-	Minor Elective – III	T	3-0-0	3	3	
2.	-	Minor Elective – IV	T	3-0-0	3	3	

SEMESTER – VII							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	MI23701	Mine Management, Legislation and General Safety	T	3-1-0	4	4	PCC
2.	MI23702	Mine Digitalization and Automation	T	3-0-0	3	3	ETC
3.	-	Professional Elective-V	T	3-0-0	3	3	PEC
4.	-	Professional Elective-VI	T	3-0-0	3	3	PEC
5.	MI23703	Mine Environmental Engineering	T	3-0-0	3	3	PCC
6.	IE23C08	Project Management	T	3-0-0	3	3	HSMC
7.	-	Open Elective – II	T	3-0-0	3	3	OEC
8.	-	Industry Oriented Course - III	-	-	-	1	SDC
9.		Computer Aided Mine Planning and Design (CAMPAD) Laboratory	L	0-0-4	4	2	ETC
10.	MI23704	Comprehension	L	0-0-2	2	1	SDC
11.	MI23705	Industrial Training – II	L	-	-	2	SDC
			TOTAL CREDITS			**28**	
COURSES FOR HONOURS DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	MI23D03	Capstone Design Project – Level III	CDP	0-0-16	16	8	SDC
(OR)							
1.	-	Honours Elective – V	T	3-0-0	3	3	
2.	-	Honours Elective – VI	T	3-0-0	3	3	
COURSES FOR MINOR DEGREE							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	-	Minor Elective – V	T	3-0-0	3	3	
2.	-	Minor Elective – VI	T	3-0-0	3	3	

SEMESTER – VIII							
S. NO.	**COURSE CODE**	**COURSE NAME**	**COURSE TYPE#**	**PERIODS / WEEK**		**CREDITS**	**CATE GORY**
				L-T-P	**TCP***		
1.	MI23801	Project Work / Internship cum Project Work	PW / IPW	0-0-16	16	8	SDC
				TOTAL CREDITS		**8**	

TOTAL CREDIT OF THE PROGRAMME: 174

PROFESSIONAL ELECTIVE COURSES: VERTICALS

PEC No.	Rock Mechanics	Advanced Mining	Safety, Health and Environment	Mining Governance	Geological Exploration	Other Electives
1	Applied Rock Engineering	Innovative Mining Systems	Hazard Analysis and Risk Assessment	Mine Economics and Investment	Applied Hydrogeology	Chemistry for Mining Engineering
2	Subsidence Engineering	Material Handling	Mine Safety Engineering	Energy Conservation And Management	Geospatial Technology	Electrical Drives and Control
3	Rock Reinforcement Engineering	Small Scale Mining and Marine Mining	Risk and Workplace Safety Management	Mine Planning and Economics	Geophysical Exploration	Tunnelling Engineering
4	Rock Slope Engineering	Computer Applications in Mining	Occupational Health Aspects in Mines	Mining, Energy and Climate Change	Marine Exploration	Underground Space Technology
5	Rock Excavation Engineering	Advanced Surface Mining Technology	Eco-friendly Mining	System Engineering in Mining	Coal and Petroleum Geology	Numerical Methods in Mining Engineering
6	Drilling and Blasting Engineering	Advanced Rock Blasting Technology	Environmental Management in Mines	Sustainable Mining	Advanced Mining Geology	Non-Destructive Testing

VERTICAL I: ROCK MECHANICS

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GY23C08	Applied Rock Engineering	PEC	3	0	0	3	3
2.	MI23001	Subsidence Engineering	PEC	3	0	0	3	3
3.	MI23002	Rock Reinforcement Engineering	PEC	3	0	0	3	3
4.	MI23003	Rock Slope Engineering	PEC	3	0	0	3	3
5.	MI23004	Rock Excavation Engineering	PEC	3	0	0	3	3
6.	MI23005	Drilling and Blasting Engineering	PEC	3	0	0	3	3

VERTICAL II: ADVANCED MINING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MI23006	Innovative Mining Systems	PEC	3	0	0	3	3
2.	MI23007	Material Handling	PEC	3	0	0	3	3
3.	MI23008	Small Scale Mining and Marine Mining	PEC	3	0	0	3	3
4.	MI23009	Computer Applications in Mining	PEC	3	0	0	3	3
5.	MI23010	Advanced Surface Mining Technology	PEC	3	0	0	3	3
6.	MI23011	Advanced Rock Blasting Technology	PEC	3	0	0	3	3

VERTICAL III: SAFETY, HEALTH AND ENVIRONMENT

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MI23012	Hazard Analysis and Risk Assessment	PEC	3	0	0	3	3
2.	MI23013	Mine Safety Engineering	PEC	3	0	0	3	3
3.	MI23014	Risk and Workplace Safety Management	PEC	3	0	0	3	3
4.	MI23015	Occupational Health Aspects in Mines	PEC	3	0	0	3	3
5.	MI23016	Eco-friendly Mining	PEC	3	0	0	3	3
6.	MI23017	Environmental Management in Mines	PEC	3	0	0	3	3

VERTICAL IV: MINING GOVERNANCE

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MI23018	Mine Economics and Investment	PEC	3	0	0	3	3
2.	MI23019	Energy Conservation And Management	PEC	3	0	0	3	3
3.	MI23020	Mine Digitalization and Automation	PEC	3	0	0	3	3
4.	MI23021	Mining, Energy and Climate Change	PEC	3	0	0	3	3
5.	MI23022	System Engineering in Mining	PEC	3	0	0	3	3
6.	MI23023	Sustainable Mining	PEC	3	0	0	3	3

VERTICAL V: GEOLOGICAL EXPLORATION

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GY23C09	Applied Hydrogeology	PEC	3	0	0	3	3
2.	GY23C10	Geospatial Technology	PEC	3	0	0	3	3
3.	GY23C11	Geophysical Exploration	PEC	3	0	0	3	3
4.	GY23C12	Marine Exploration	PEC	3	0	0	3	3
5.	GY23C13	Coal and Petroleum Geology	PEC	3	0	0	3	3
6.	GY23C14	Advanced Mining Geology	PEC	3	0	0	3	3

VERTICAL VI: OTHER ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CY23C05	Chemistry for Mining Engineering	PEC	3	0	0	3	3
2.	EE23050	Electrical Drives and Control	PEC	3	0	0	3	3
3.	MI23024	Tunnelling Engineering	PEC	3	0	0	3	3
4.	MI23025	Underground Space Technology	PEC	3	0	0	3	3
5.	MI23026	Numerical Methods in Mining Engineering	PEC	3	0	0	3	3
6.	MI23027	Non-Destructive Testing	PEC	3	0	0	3	3

MINOR ELECTIVES (ROCK ENGINEERRING)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GY23C08	Applied Rock Engineering	PEC	3	0	0	3	3
2.	MI23007	Material Handling	PEC	3	0	0	3	3
3.	MI23008	Small Scale and Marine Mining	PEC	3	0	0	3	3
4.	MI23003	Rock Slope Engineering	PEC	3	0	0	3	3
5.	MI23004	Rock Excavation Engineering	PEC	3	0	0	3	3
6.	MI23023	Sustainable Mining	PEC	3	0	0	3	3

HONOURS ELECTIVES

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS
				L-T-P	TCP*	
1	MI23028	Mine Closure Planning	T	3-0-0	3	3
2	MI23029	Mine Economics and Valuation	T	3-0-0	3	3
3	MI23030	Mine Management	T	3-0-0	3	3
4	MI23031	Mine Acquisition and Operationalization	T	3-0-0	3	3
5	MI23032	Planning And Design for Tunnels	T	3-0-0	3	3
6	MI23033	Novel Methods of Mining	T	3-0-0	3	3
7	GY23C07	Mineral Exploration and Geo-Statistics	T	3-0-0	3	3
8	MI23034	Dimensional Stone Technology	T	3-0-0	3	3
9	MI23035	Open Pit Slope Analysis and Design	T	3-0-0	3	3
10	MI23036	Rock Blasting Technology for Mining and Construction	T	3-0-0	3	3

OPEN ELECTIVES FOR OTHER PROGRAMME

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS
				L-T-P	TCP*	
1	MI23901	Mining For Nation Building	T	3-0-0	3	3
2	MI23902	Rock Blasting Engineering	T	3-0-0	3	3
3	GY23901	Oil Exploration And Production	T	3-0-0	3	3

EN23C01 **FOUNDATION ENGLISH** **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To develop students' foundational skills in reading, writing, grammar and vocabulary to enable them to understand and produce various forms of communication.
- To enhance students' proficiency in reading comprehension, narrative and comparative writing.
- To comprehend and analyse descriptive texts and visual images
- To articulate similarities and differences in oral and written forms.
- To improve students' proficiency in reading and writing formal letters and emails.

UNIT I BASICS OF COMMUNICATION **6**

Reading - Telephone message, bio-note; Writing – Personal profile; Grammar – Simple present tense, Present continuous tense, wh-questions, indirect questions; Vocabulary – Word formation (Prefix and Suffix).

LAB ACTIVITY: **6**

Listening – Telephone conversation; Speaking Self-introduction; Telephone conversation – Video conferencing etiquette

UNIT II NARRATION **6**

Reading – Comprehension strategies - Newspaper Report, An excerpt from an autobiography; Writing – Narrative Paragraph writing (Event, personal experience etc.); Grammar – Subject-verb agreement, Simple past, Past continuous Tenses; Vocabulary – One-word substitution

LAB ACTIVITY: **6**

Listening – Travel podcast; Speaking – Narrating and sharing personal experiences through a podcast

UNIT III DESCRIPTION **6**

Reading – A tourist brochure, Travel blogs, descriptive article/excerpt from literature, visual images; Writing – Descriptive Paragraph writing, Grammar – Future tense, Perfect tenses, Preposition; Vocabulary – Descriptive vocabulary

LAB ACTIVITY: **6**

Listening – Railway / Airport Announcements, Travel Vlogs; Speaking – Describing a place or picture description

UNIT IV COMPARE AND CONTRAST **6**

Reading – Reading and comparing different product specifications - Writing – Compare and Contrast Essay, Coherence and cohesion; Grammar – Degrees of Comparison; Vocabulary – Transition words (relevant to compare and contrast)

LAB ACTIVITY: **6**

Listening – Product reviews, Speaking – Product comparison based on product reviews - similarities and differences

UNIT V EXPRESSION OF VIEWS 6

Reading – Formal letters, Letters to Editor ; Writing – Letter writing/ Email writing (Enquiry / Permission, Letter to Editor); Grammar – Compound nouns, Vocabulary – Synonyms, Antonyms

LAB ACTIVITY: 6

Listening – Short speeches; Speaking – Making short presentations (JAM)

TOTAL: 60 PERIODS

TEACHING METHODOLOGY

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab assessment

Listening

Speaking

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- Use appropriate grammar and vocabulary to read different types of text and converse appropriately.
- Write coherent and engaging descriptive and comparative essay writing.
- Comprehend and interpret different kinds of texts and audio visual materials
- Critically evaluate reviews and articulate similarities and differences
- Write formal letters and emails using appropriate language structure and format

TEXT BOOKS:

1. “English for Engineers and Technologists” Volume I by Orient Blackswan, 2022

2. “English for Science & Technology - I” by Cambridge University Press, 2023

REFERENCES

1. “Interchange” by Jack C.Richards, Fifth Edition, Cambridge University Press, 2017.

2. “English for Academic Correspondence and Socializing” by Adrian Wallwork, Springer, 2011.

3. “The Study Skills Handbook” by Stella Cortrell, Red Globe Press, 2019

4. www.uefap.com

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										√		√
CO2										√		
CO3										√		√
CO4										√		
CO5										√		√

MA23C01	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques in solving practical problems.
- To familiarize the student with functions of several variables.
- To solve integrals by using Beta and Gamma functions.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To acquaint the students with the concepts of vector calculus which naturally arise in many engineering problems.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors- Cayley-Hamilton theorem (excluding proof) – Diagonalization of matrices - Reduction of Quadratic form to canonical form by using orthogonal transformation - Nature of a Quadratic form.

UNIT II FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limit, continuity, partial derivatives – Homogeneous functions and Euler's theorem - Total derivative – Differentiation of implicit functions – Jacobians -Taylor's formula for two variables - Errors and approximations – Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.

UNIT III INTEGRAL CALCULUS **9+3**

Improper integrals of the first and second kind and their convergence – Differentiation under integrals - Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions-Properties – Evaluation of single integrals by using Beta and Gamma functions..

UNIT IV MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals-

Evaluation of double and triple integrals by using Beta and Gamma functions.

UNIT V VECTOR CALCULUS **9+3**

Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields - Line integrals over a plane curve - Surface integrals – Area of a curved surface – Volume Integral - Green's theorem, Stoke's and Gauss divergence theorems (without proofs)– Verification and applications in evaluating line, surface and volume integrals.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students wherever applicable from the content of the course.

General engineering applications / branch specific applications from the content of each units wherever possible will be introduced to students.

Suggested Laboratory based exercises / assignments / assessments :

Matrices

1. Finding eigenvalues and eigenvectors
2. Verification of Cayley-Hamilton theorem
3. Eigenvalues and Eigenvectors of similar matrices
4. Eigenvalues and Eigenvectors of a symmetric matrix
5. Finding the powers of a matrix
6. Quadratic forms

Functions of Several Variables

1. Plotting of curves and surfaces
2. Symbolic computation of partial and total derivatives of functions

Integral Calculus

1. Evaluation of beta and gamma functions
2. Computation of error function and its complement

Multiple Integrals

1. Plotting of 3D surfaces in Cartesian and Polar forms

Vector Calculus

1. Computation of Directional derivatives
2. Computation of normal and tangent to the given surface

OUTCOMES:

CO 1 :Use the matrix algebra methods for solving practical problems.

CO 2 :Use differential calculus ideas on several variable functions.

CO 3 :Apply different methods of integration in solving practical problems by using Beta and Gamma functions.

CO 4 :Apply multiple integral ideas in solving areas and volumes problems.

CO 5 :Apply the concept of vectors in solving practical problems.

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir "'Thomas' Calculus", Pearson Education., New Delhi, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, New Delhi, 2020.
3. James Stewart, Daniel K Clegg & Saleem Watson "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2023.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.
2. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5th Edition, New Delhi, 2017.
4. Narayanan S. and Manicavachagom Pillai T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
6. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO5 :	3	3	2	3	1	2	1	1	1	1	1	3

PH23C01 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E/B.Tech Programmes) **3 0 2 4**

COURSE OBJECTIVES

- To familiarize with crystal structure, bonding and crystal growth.
- To impart knowledge on Mechanics of Materials.
- To impart knowledge of oscillations, sound and Thermal Physics
- To facilitate understanding of optics and its applications, different types of Lasers and fiber optics.
- To introduce the basics of Quantum Mechanics and its importance.

UNIT I CRYSTAL PHYSICS **9+6**

Crystal Bonding – Ionic – covalent – metallic and van der Walls's/ molecular bonding. Crystal systems - unit cell, Bravais lattices, Miller indices - Crystal structures - atomic packing density of BCC, FCC and HCP structures. NaCl, Diamond, Graphite, Graphene, Zincblende and Wurtzite structures - crystal imperfections- point defects - edge and screw dislocations – grain boundaries. Crystal Growth – Czocharalski method – vapor phase epitaxy – Molecular beam epitaxy- Introduction to X-Ray Diffractometer.

1. Determination of Lattice parameters for crystal systems.
2. Crystal Growth – Slow Evaporation method
3. Crystal Growth Sol – Gel Method

UNIT II MECHANICS OF MATERIALS **9+6**

Rigid Body – Centre of mass – Rotational Energy - Moment of inertia (M.I)- Moment of Inertia for uniform objects with various geometrical shapes. Elasticity –Hooke's law - Poisson's ratio - stress-strain diagram for ductile and brittle materials – uses- Bending of beams – Cantilever - Simply supported beams - uniform and non-uniform bending - Young's modulus determination - I shaped girders –Twisting couple – Shafts. Viscosity – Viscous drag – Surface Tension.

4. Non-uniform bending -Determination of Young's modulus of the material of the beam.
5. Uniform bending -Determination of Young's modulus of the material of the beam
6. Viscosity – Determination of Viscosity of liquids.

UNIT III OSCILLATIONS, SOUND AND THERMAL PHYSICS **9+6**

Simple harmonic motion - Torsional pendulum –- Damped oscillations –Shock Absorber -Forced oscillations and Resonance –Applications of resonance.- Waves and Energy Transport –Sound waves – Intensity level – Standing Waves - Doppler effect and its applications - Speed of blood flow. Ultrasound – applications - Echolocation and Medical Imaging. Thermal Expansion – Expansion joints – Bimetallic strip – Seebeck effect – thermocouple -Heat Transfer Rate – Conduction – Convection and Radiation.

7. Torsional pendulum-Determination of rigidity modulus of wire and moment of inertia of the disc
8. Melde's string experiment - Standing waves.
9. Ultrasonic interferometer – determination of sound velocity and liquids compressibility

UNIT IV OPTICS AND LASERS **9+6**

Interference - Thin film interference - Air wedge- Applications -Interferometers–Michelson Interferometer -– Diffraction - CD as diffraction grating – Diffraction by crystals -Polarization - polarizers -– Laser – characteristics – Spontaneous and Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG

laser, CO_2 laser, Semiconductor laser - Industrial and medical applications - Optical Fibers – Total internal reflection – Numerical aperture and acceptance angle – Fiber optic communication – Fiber sensors – Fiber lasers.

10. Laser - Determination of the width of the groove of the compact disc using laser.
    Laser Parameters
    Determination of the wavelength of the laser using grating
11. Air wedge -Determination of the thickness of a thin sheet/wire
12. Optical fibre - Determination of Numerical Aperture and acceptance angle
    -Determination of bending loss of fibre.
13. Michelson Interferometer (Demonstration)

UNIT V QUANTUM MECHANICS 9+6

Black body radiation (Qualitative) – Planck's hypothesis – Einstein's theory of Radiation - Matter waves–de Broglie hypothesis - Electron microscope – Uncertainty Principle – The Schrodinger Wave equation (time-independent and time-dependent) – Meaning and Physical significance of wave function - Normalization - Particle in an infinite potential well-particle in a three-dimensional box - Degenerate energy states - Barrier penetration and quantum tunneling - Tunneling microscope.

14. Photoelectric effect – Determination of Planck's constant.
15. Black Body Radiation (Demonstration)
16. Electron Microscope (Demonstration)

TOTAL: 75 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1: Understand the significance of crystal structure and bonding. Learn to grow crystals.
CO2: Obtain knowledge on important mechanical and thermal properties of materials and determine them through experiments.
CO3: Conceptualize and visualize the oscillations and sound.
CO4: Grasp optical phenomenon and their applications in real life.
CO5: Appreciate and evaluate the quantum phenomenon.
CO6 Develop skill set to solve engineering problems and design experiments.

TEXT BOOKS:

1. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2013.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics. John Wiley & Sons, 10th Edition, 2015.
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students, Springer-Verlag, 2012.
4. Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson, College Physics, McGraw-Hill Higher Education, 2012.

REFERENCES:

1. R. Wolfson, Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D. Kleppner and R. Kolenkow. An Introduction to Mechanics, McGraw Hill Education, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1							
CO2	3	2	1	1								

CO3	3	2	1	1								
CO4	3	2	1	1	1							
CO5	3	2	1	1	1							
CO6	3	2	1	2								

ME23C05	BASICS OF MECHANICAL ENGINEERING	L	T	P	C
		2	0	0	2

UNIT I CASTING, FORMING, AND WELDING PROCESSES 6

Sand casting, lathe machine and its parts, lathe machine operations (turning, taper turning, facing, chamfering, etc.), Drilling, forming process – Bulk Deformation (Forging, Rolling), Sheet metal operation (Blanking, punching) – Demonstration of relevant experiments

UNIT II WELDING AND ADDITIVE MANUFACTURING 6

Welding – types, Shielded Metal Arc Welding, gas welding, MIG and TIG welding, Additive manufacturing : Types and its applications - Demonstration of relevant experiments

UNIT III THERMODYNAMICS 6

Basic Terminologies related to Thermodynamics, zeroth Law, First Law of thermodynamics, Second Law of thermodynamics, Third Law of thermodynamics, Vapor compression cycle , Air Conditioner and Refrigerator- Demonstration of relevant experiments

UNIT IV IC ENGINES AND RECENT DEVELOPMENTS 6

Introduction to IC Engine, 2 stroke Engine, 4 Stroke Engine, Petrol Engine, Diesel Engine –Demonstration Electric Vehicles - Introduction & Challenges –Demonstration of relevant experiments.

UNIT V POWER PLANT ENGINEERING 6

Coal based power plants- working, advantages & disadvantages, Hydro Electric power plants- working, advantages & disadvantages, nuclear power plants- Types, working, advantages & disadvantages, solar power plant- working, advantages & disadvantages, wind-based power generation- working, advantages & disadvantages.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

- **CO1** Discuss the basic concepts of casting, forming, and machining processes
- **CO2** Explain welding, and Additive manufacturing
- **CO3** Discuss the basics laws and application of thermodynamics
- **CO4** Summarize the basics of IC engines, electric vehicles.
- **CO5** Explain various power generation methods

TEXT BOOKS:

1. Nag, P.K., “Engineering Thermodynamics “, IInd Edition, Tata McGraw Hill Publishing Co., Ltd., 1995.
2. Rajput, R .K, “Thermal Engineering”, Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, “Theory of Machines”, Eurasia Publishing House (P) Ltd., 2004.
4. A TEXTBOOK OF MANUFACTURING TECHNOLOGY by RK Rajput, December 2007, Panchu Publisher
5. A Text-Book of Production Technology Volume I by O.P.KHANNA, Dhanpat Rai publications

REFERENCES:

1. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, Springer New York, NY, https://doi.org/10.1007/978-1-4939-2113-3.
2. Electric Vehicles, Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Spring3er Singapore, https://doi.org/10.1007/978-981-15-9251-5

Mapping COs and POs:																
COs	**POs**												**PSOs**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-
CO2	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-
CO3	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-
CO4	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-
CO5	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-
Avg	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-

ME23C01	ENGINEERING DRAWING AND 3D MODELING	L	T	P	C
		2	0	4	4

INTRODUCTION

Manual drawing tools (Mini Drafter, Set Squares, Protractor, Compass, and different grades of pencil). **'**BIS' specifications and rules of Engineering Drawing – Arrows (2H thin line body, HB Filled head and L:W = 3:1 ratio), lettering (Digital fonts, font sizes pertaining to usage and representation), types of line and their syntax (Drawing based – Continuous thin & thick, dashed, dashed dotted and Application based – extension, dimensioning, construction, projection, reference, axis, section, hatching, and break lines), scaling (up, down and equal), and dimensioning. Placing and positioning the 'A3' size drawing sheet over the drawing table. Principal planes and projection, Division of line and circle in to equal parts, and construction of polygons

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UNIT 1: ENGINEERING CURVES, PROJECTION OF POINTS AND LINES

Construction of conic curves with their tangent and normal – ellipse, parabola, and hyperbola by eccentricity method

Construction of special curves with their tangent and normal – cycloid, epicycloid, and involute

Projection of points and I angle projection of lines inclined to both principal planes by rotating line method and trapezoidal rule – marking their traces.

Lab exercises: Study exercise – Introduction to Sketching (or) Drawing, and modification tools in CAD software (AutoCAD, CREO, CATIA, Solid Works, Inventor, Fusion 360)

(6+12 = 18 Hours)

Activities based learning: Identification of the curves used in the application given in the flash card, demonstration of the instantaneous centre of rotation of governors with respect to angle of inclination of the arms of the governors

UNIT 2: PROJECTION OF SURFACES & SOLIDS, AND 2D MODELING

Projection of surfaces inclined to both the principal planes – polygonal, trapezoidal, rhomboidal and circular

Projection of solids – prisms, pyramids, and axisymmetric solids when the axis inclined to both the principal planes – freely hanging – contour resting condition on either of the planes by rotating object method

Lab exercises: Construction of basic sketches – lines, circle, polygon, spline curves, coils, along with dimensioning. Familiarizing with geometric constraints and their types

(6+12 = 18 Hours)

Activities based learning: Making the solids using cardboards, shadow mapping and contour drawing at different orientation of the solids using torches

UNIT 3: 3D PROJECTION OF SOLIDS AND 3D MODELING OF SIMPLE PARTS

Free hand sketching – I & III angle projections of engineering parts and components

Isometric projection of combination of solids – prisms, pyramids, axisymmetric solids, frustum

Perspective projection of prisms, pyramids and axisymmetric solids by visual ray method

Lab exercises: 3D Modeling and 2D drafting of machine parts

(6+12 = 18 Hours)

Activities based learning: Flipped classroom for Free hand sketching, Jig saw activity for Isometric projection, arts and crafts for perspective view

UNIT 4: SECTION OF SOLIDS AND SECTIONED DRAFTING OF ASSEMBLED COMPONENTS

Section of simple and hollow solids – prisms, pyramids and axisymmetric solids, solids with holes/ slots when the section plane perpendicular to one principal plane and inclined to other principal plane ('On the axis' and 'from the axis' conditions)

Application based – section of beams (I, T, L, and C), section of pipe bracket, wood joints, composite walls, shells, flange of a coupling and other similar applications

Lab exercises: Assembly of parts with respect to engineering constraints, and sectioned drafting of assembled components

(6+12 = 18 Hours)

Activities based learning: Making of mitered joint in wood, sectioning the beams in different angles of orientation and identifying the true shape

UNIT 5: LATERAL SURFACE DEVELOPMENT AND SHEET METAL DESIGN

Lateral surface development of sectioned solids when the section plane perpendicular to VP and inclined to HP.

Application based – construction of funnel, chimney, dish antenna, door latch, trays, AC vents, lamp shade, commercial packaging boxes with respect to sectioning conditions and other similar applications

Lab exercises: Sheet metal design and drafting, drafting of coils, springs and screw threads

(6+12 = 18 Hours)

Activities based learning: Fabrication of funnels, chimney, lamp shade, boxes using card boards, ply woods, acrylics

Total: 90 Hours

Note: Activities based learning should not be covered in the regular class hours. It should be given as assignments to the group of maximum 3 members

COURSE OBJECTIVES

After successful completion of this course, the students will be able to:

1. Understand and use the engineering curves in engineering applications and projection techniques to construct conic curves, points and lines.
2. Develop skills in projecting surfaces and solids and create 2D models using CAD software.
3. Develop skills in 3D projection and 3D modeling of simple parts manually as well as using CAD software.
4. Understand and apply sectioning techniques to solids and assemble components.
5. Develop skills in lateral surface development and sheet metal design.

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Construct and identify different types of conic curves and special curves, and project the points and lines pertaining to engineering applications

CO2: Project and visualize surfaces and solids in different orientations and utilize the CAD tools for designing.

CO3: Create and draft accurate 3D models and 2D drawings of machine parts manually as well as using CAD software

CO4: Determine the true shape of a sectioned solid and draft the assembled parts accordingly

CO5: Develop lateral surfaces of sectioned solids and design sheet metal components

TEXT BOOK

1. “Engineering Drawing” by N S Parthasarathy and Vela Murali, Oxford University Press; UK ed. Edition, 2015.
2. “Engineering Drawing + Auto CAD” by Venugopal K, V. Prabhu Raja, New Age International Publishers, Sixth edition (1 January 2022).

REFERENCES

1. "Basic Engineering Drawing: Mechanical Semester Pattern" by Mehta and Gupta, Charotar Publishing House, 2nd edition, 2018.
2. "Engineering Drawing" by Basant Agrawal and C M Agrawal, Vikas Publishing House, 3rd edition, 2020.
3. "Engineering Drawing With Auto CAD" by B V R Gupta, McGraw Hill Education, 4th edition, 2019.
4. "Engineering Drawing" by P S Gill, Tata McGraw Hill Education, 5th edition, 2018.
5. "Engineering Drawing with an Introduction to AutoCAD" by Dhananjay Jolhe, Cengage Learning, 2nd edition, 2020.
6. "Engineering Drawing" by M B Shah, Charotar Publishing House, 3rd edition, 2019
7. "Fundamentals of Engineering Drawing" by Imtiaz Hashmi, Pearson Education, 2nd edition, 2018.
8. "Computer Aided Engineering Drawing" by S Trymbaka Murthy, Scitech Publications, 3rd edition, 2020.

9. "CAED: Computer Aided Engineering Drawing for I/II Semester BE/Btech Courses" by Reddy K B, CBS Publishers & Distributors, 2nd, 2019.
10. "Computer-Aided Engineering Drawing" by Subrata Pal, Oxford University Press, 2nd, 2020.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2		1				3	1		3	3	3	2
2	3	3	2		2				3	2		3	3	3	2
3	3	3	3	1	2				3	3		3	3	3	2
4	3	3	3	1	3				3	3		3	3	3	2
5	3	3	3	1	3				3	3		3	3	3	2

ME23C04	MAKERSPACE	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

1. To practice the usage of various tools towards assembly and dis-assembly of different items / equipment.
2. To make simple part / component using welding processes.
3. To train on the basic wiring practices of boards, machines, etc.
4. To provide a hands-on experience on the use of electronic components, equipment, sensors and actuators.
5. To expose to modern computer tools and advanced manufacturing / fabrication processes.

LIST OF ACTIVITIES **1L,4P**

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.

ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.

iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.

iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.

ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.

iii. Hands-on session of preparing base material & Joint groove for welding.

iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.

ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box,

iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.

iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.

ii. Dis-assembly and assembly of Computers.

iii. Hands-on session of Soldering Practices in a Printed Circuit Breaker.

iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.

v. Hands-on session of integration of sensors and actuators with a Microcontroller.

vi. Demonstration of Programmable Logic Control Circuit.

(E).Contemporary Systems

i. Demonstration of Solid Modelling of components.

ii. Demonstration of Assembly Modelling of components.

iii. Fabrication of simple components / parts using 3D Printers.

iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

TOTAL: 75 Periods (15 Lecture + 60 Practical)

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Assemble and dis-assemble various items / equipment.

CO2: Make simple parts using suitable welding processes.

CO3: Setup wiring of distribution boards, machines, etc.

CO4: Utilise the electronic components to fabricate a simple equipment, aided with sensors and actuators.

CO5: Take advantage of modern manufacturing practices.

REFERENCES:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th ed. (Indian edition), 2017.
5. Mazidi, Naimi, Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 1st edition 2013.
6. Visualization, Modeling, and Graphics for Engineering Design, D.K. Lieu, S.A. Sorby, Cengage Learning; 2nd edition.

UC23H01 **தமிழர்மரபு /Heritage of Tamils** **L T P C**

1 0 0 1

அலகு I **மொழி மற்றும் இலக்கியம்**: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்**: **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UC23H01 **HERITAGE OF TAMILS** **L T P C**
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

NCC Credit Course Level 1*

UC23P01	(ARMY WING) NCC Credit Course Level - I	L	T	P	C
		2	0	0	2

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P02	**(NAVAL WING) NCC Credit Course Level – I**	**L T P C**
		2 0 0 2

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P03	**(AIR FORCE WING) NCC Credit Course Level – I**	**L T P C**
		2 0 0 2

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

EN23C02 **PROFESSIONAL COMMUNICATION** **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To read and comprehend different forms of official texts.
- To develop students' writing skills in professional context.
- To actively listen, read and understand written and oral communication in a professional context.
- To comprehend and analyse the visual content in authentic context.
- To write professional documents with clarity and precision

UNIT I CAUSE AND EFFECT **6**

Reading – Newspaper articles on Social and Environmental issues; Writing – Instructions, Cause and effect essay; Grammar - Modal verbs; Vocabulary – Cause and effect, Idioms

LAB ACTIVITY: **6**

Listening and Speaking – Listen to news reports and summarise in oral form.

UNIT II CLASSIFICATION **6**

Reading – An article, social media posts and classifying based on the content; Writing – Definition, Note making, Note taking (Cornell notes etc.) and Summarising; Grammar – Connectives; Vocabulary – Phrasal verbs

LAB ACTIVITY: **6**

Listening and speaking: Social interaction (Conversation including small talk)

UNIT III PROBLEM AND SOLUTION **6**

Reading – Visual content (Tables/charts/graphs) for comprehension; Writing - Problem and Solution Essay; Grammar – If conditionals; Vocabulary – Sequential words.

LAB ACTIVITY: **6**

Listening – Group discussion; Speaking – Participating in a group discussion

UNIT IV REPORT **6**

Reading – Formal report on accidents (industrial/engineering); Writing – Industrial Accident report; Grammar – Active and passive voice, Direct and Indirect speech; Vocabulary – Numerical adjectives.

LAB ACTIVITY: **6**

Listening / watching – Television documentary and discussing its content, purpose etc.

UNIT V JOB APPLICATION AND INTERVIEW **6**

Reading - Job advertisement and company profile; Writing – Job application (cover letter and CV) Grammar – Mixed Tenses; Vocabulary – Collocations related to work environment

LAB ACTIVITY: **6**

Listening – Job interview; Speaking – Mock interviews

TOTAL: 60 PERIODS

TEACHING METHODOLOGY

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab Assessment

Group discussion (Peer assessment)

Listening

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- To apply appropriate language structure and vocabulary to enhance both spoken and written communication in formal contexts.
- Comprehend different forms of official documents
- Write professional documents coherently and cohesively.
- Interpret verbal and graphic content in authentic context
- Analyse and evaluate verbal and audio visual materials.

TEXT BOOKS:

1. “English for Engineers and Technologists” Volume 2 by Orient Blackswan, 2022

2. “English for Science & Technology - II” by Cambridge University Press, 2023.

REFERENCES:

1. “Communicative English for Engineers and Professionals” by Bhatnagar Nitin, Pearson India, 2010.

2. ”Take Off – Technical English for Engineering” by David Morgan, Garnet Education, 2008. 3. “Advanced Communication Skills” by Mathew Richardson, Charlie Creative Lab, 2020.

4. www.uefap.com

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										√		√
CO2										√		√
CO3										√		√
CO4										√		√
CO5										√		√

MA23C02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To make the students to understand the Laplace transforms techniques.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques in solving difference equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Homogeneous linear ordinary differential equations of second order -superposition principle - general solution- Particular integral - Operator method - Solution by variation of parameters - Method of undetermined coefficients - Homogeneous equations of Euler–Cauchy and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II LAPLACE TRANSFORMS 9+3

Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace transforms- Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.

UNIT III FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Computation of harmonics.

UNIT IV FOURIER TRANSFORMS 9+3

Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions – Inverse Fourier Transforms - Convolution theorem (without proof) – Parsevals's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Properties of Z-transform – Inverse Z-transform – Convolution theorem – Evaluation of Inverse Z transform using partial fraction method and convolution theorem - Initial and final value theorems – Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

Suggested Laboratory based exercises / assignments / assessments :

Ordinary differential equations

1. Symbolic computation of linear ordinary differential equations
2. Solving System of simultaneous linear differential equations using ODE SOLVER

Laplace transforms

1. Symbolic computation of Laplace transform and Inverse Laplace transform
2. Plotting Laplace transforms

Fourier Series

1. Symbolic computation of Fourier Coefficients
2. Computation of harmonics
3. Plotting truncated Fourier Series

Fourier Transform

1. Symbolic computation of Fourier Transforms
2. Plotting truncated Fourier Transforms

Z – transform

1. Symbolic computation of Z-Transforms

OUTCOMES:

CO1 :Solve higher order ordinary differential equations which arise in engineering applications.

CO2 :Apply Laplace transform techniques in solving linear differential equations.

CO3 :Apply Fourier series techniques in engineering applications.

CO4 :Understand the Fourier transforms techniques in solving engineering problems.

CO5 :Understand the Z-transforms techniques in solving difference equations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 45th Edition, New Delhi, 2020.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.

REFERENCES:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
2. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5 th Edition, New Delhi, 2017.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
5. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO 1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 5 :	3	3	2	3	1	2	1	1	1	1	1	3

CY23C01 **ENGINEERING CHEMISTRY** **L T P C**

3 0 2 4

UNIT I WATER TECHNOLOGY

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD, BOD, and heavy metals. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, Calgon, and carbonate treatment. External conditioning – demineralization. Municipal water treatment (screening, sedimentation, coagulation, filtration, disinfection-ozonolysis, UV treatment, chlorination), Reverse Osmosis – desalination.

PRACTICAL:

- Estimation of HCl using Na_2CO_3 as the primary standard
- Determination of alkalinity in the water sample.
- Determination of hardness of water by EDTA method.
- Determination of DO content of water sample by Winkler's method.

UNIT II NANOCHEMISTRY

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical, magnetic and catalytic). Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro-spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Applications of nanomaterials – medicine including AYUSH, automobiles, electronics, and cosmetics.

PRACTICAL:

- Preparation of nanoparticles by Sol-Gel method/sonication method.
- Preparation of nanowire by Electrospinning.
- Study of morphology of nanomaterials by scanning electron microscopy

UNIT III CORROSION SCIENCE

Introduction to corrosion – chemical and electrochemical corrosions – mechanism of electrochemical and galvanic corrosions – concentration cell corrosion-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Electrochemical protection – sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (galvanizing, tinning), organic coatings (paints). Paints: Constituents and functions.

PRACTICAL:

- Corrosion experiment-weight loss method.
- Salt spray test for corrosion study.
- Corrosion prevention by electroplating.
- Estimation of corroded Iron by Potentiometry/UV-visible spectrophotometer

UNIT IV ENERGY SOURCES

Electrochemical cell, redox reaction, electrode potential – oxidation and reduction potential. Batteries – Characteristics; types of batteries; primary battery (dry cell), secondary battery (lead acid, lithium-ion battery) and their applications. Emerging energy sources – metal hydride battery, hydrogen energy, Fuel cells – H_2-O_2 fuel cell. Supercapacitors –Types and Applications, Renewable Energy: solar heating and solar cells. Recycling and disposal of batteries.

PRACTICAL:

- Study of components of Lead acid battery.
- Measurement of voltage in a photovoltaic cell.
- Working of $H_2 – O_2$ fuel cell

UNIT V POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: Tg, tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring. Polyamides, Polycarbonates and Polyurethanes – structure and applications. Recycling of polymers.

PRACTICAL:

- Determination of molecular weight of a polymer using Ostwald viscometer.
- Preparation of a polymer.
- Determination of molecular weight by Gel Permeation Chromatography.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

CO1: To demonstrate knowledge of water quality in various industries and develop skills in analyzing water quality parameters for both domestic and industrial purposes.

CO2: To identify and apply fundamental concepts of nanoscience and nanotechnology for engineering and technology applications, and to develop skills in synthesizing nanomaterials and studying their morphology.

CO3: To apply fundamental knowledge of corrosion protection techniques and develop skills to conduct experiments for measuring and preventing corrosion.

CO4: To study the fundamentals of energy storage devices and develop skills in constructing and experimenting with batteries.

CO5: To recognize and apply basic knowledge of different types of polymeric materials and develop skills in preparing and determining their applications for futuristic material fabrication needs.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Dara S.S., “A Textbook of Engineering Chemistry”, Chand Publications, 2004.
4. Laboratory Manual - Department of Chemistry, CEGC, Anna University (2023).

REFERENCES:

1. Schdeva M.V., “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd, 2011.
2. Friedrich Emich, “Engineering Chemistry”, Medtech, 2014.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.
4. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	3	-	-	-	-	-
CO2	3	-	2	-	2	-	3	-	-	-	-	-
CO3	3	3	2	-	2	-	3	-	-	-	-	-
CO4	3	3	-	-	-	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	3	-	-	-	-	-
Avg	3	3	-	-	-	-	3	-	-	-	-	-

1’ = Low; ‘2’ = Medium; ‘3’ = High

CS23C02 **COMPUTER PROGRAMMING IN PYTHON** **L T P C**

3 0 2 4

COURSE OBJECTIVES:

- To understand fundamental structural programming concepts and problem-solving process.
- To solve problems using modular programming and decomposition techniques.
- To solve problems using data structures and abstraction techniques.
- To create programming solutions using libraries and packages.
- To design solutions to domain problems using programming problem-solving techniques.

UNIT I – STRUCTURED PROGRAMMING **9+6**

Problem-Solving Strategies. Basic Problem-Solving Tools: Flowcharts, Pseudocode. Introduction to Programming Languages and Development Environments. Programming. Basic Concepts and Syntax: Variables, Identifiers, Data Types: Primitive Types and Strings, Statements, Operators, Expressions and its evaluation, Operator Precedence, Basic Arithmetic Operations. Principles of Structured Programming – Control Structures: Sequence, Selection, Iteration and Branching.

PRACTICALS:

- Design algorithms for simple computational problems
- Create Pseudo-code and Flow charts for simple computational problems
- Create Python programs using simple and nested selective control statements
- Create Python programs using simple and nested sequence & iterative control statements
- Create Python programs to generate series/patterns using control statements

UNIT II – MODULARITY AND DECOMPOSITION **9+6**

Principles of Modular and Decomposition. Functions: Defining functions –Argument types – Function Name-spaces – Scoping: Global and Non-local. Principles of Recursion: Base case and Recursive cases – Develop and Analyze Recursive functions: Factorial, Fibonacci. Principles of First-Class and Higher-Order functions: Lambda functions – Functions as arguments.

PRACTICALS:

- Create Python programs using functions
- Create python program using recursion
- Create Python programs using lambda functions
- Create Python programs using first-class functions
- Create Python programs using higher-order functions

UNIT III – DATA STRUCTURES AND ABSTRACTIONS **9+6**

Principles of Data Structures and Abstractions. String Methods and Manipulations,.Lists: List Operations and Methods, List comprehensions, Nested List comprehensions, Matrix operations using Lists. Tuples and sequences. Sets and Operations. Dictionaries: Dictionary operations, Dictionary comprehensions, Nested Dictionary comprehensions. Comparing Data Structures. Search and Sort Data Structures. Principle of Functional Programming and Tools : map, filter, and reduce.

PRACTICALS:

- Create Python programs for strings manipulations.
- Design Python programs using Lists, Nested Lists and Lists comprehensions
- Create Python programs using Tuples, Nested Tuples, and Tuple comprehensions
- Create Python programs creating Sets and performing set operations
- Create Python programs using Dictionary, Nested Dictionary and comprehensions
- Create Python programs by applying functional programming concepts

UNIT IV – LIBRARIES AND MODULES 9+6

Exceptions: Syntax errors, Exceptions, Exception types, Handling exceptions, Raising exceptions. Files: File Path, Type of files, opening modes, Reading and Writing text files, Handling other format Data files. Modules: Creating Modules, import and from statements, Executing modules as scripts, Standard modules. Packages and Importing from packages

PRACTICALS:

- Design Python programs to handle errors and exceptions
- Create, import, and use pre-defined modules and packages
- Create, import, and use user-defined modules and packages
- Create Python programs to perform various operations on text files
- Create Python programs to perform various operations on other data file formats.

UNIT V – SIMPLE PROBLEM SOLVING TECHNIQUES IN PROGRAMMING 9+6

Data Structures for Problem Solving: Stack, Queue. Principles of Divide and Conquer: Binary Search. Principles of Greedy Algorithms: Minimum Coin Change Problem. Case studies on programming application of problem-solving techniques in different fields of engineering.

PRACTICALS:

- Create python programs to implement stack and queue.
- Create python programs to implement binary search.
- Create python programs to solve minimum coin change problem.
- Case study on developing python solution to a domain specific problems.

TOTAL = 45 + 30 = 75 PERIODS

COURSE OUTCOMES

1. Understand fundamental structural programming concepts and problem-solving process.
2. Solve problems using modular programming and decomposition techniques.
3. Solve problems using data structures and abstraction techniques.
4. Create programming solutions using libraries and packages.
5. Design solutions to domain problems using programming problem-solving techniques.

TEXT BOOKS

1. Reema Thareja, Python Programming using Problem Solving Approach, Oxford University Press, First Edition, 2017.
2. S. Sridhar, J. Indumathi, V. M. Hariharan, Python Programming, Pearson Education, First Edition, 2023

REFERENCE BOOKS

1. Paul Deitel, Harvey Deitel, Python for Programmers, Pearson Education, 2020.
2. John V Guttag. Introduction to Computation and Programming Using Python, With Application to Computational Modeling and Understanding Data. Third Edition, The MIT Press, 2021
3. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media, Inc.
4. Python official documentation and tutorial, https://docs.python.org/3/
5. Numerical Python official documentation and tutorial, https://numpy.org/

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2		1								1	1	
2	2		2		1								1	1	
3	2	1	2		1								1	1	
4	2	1	2	1	1								1	1	
5	2	1	2	1	1								1	1	
Avg	2	1	2	1	1								1	1	

1 - low, 2 - medium, 3 - **high,** '-' - **no correlation**

ME23C03 **ENGINEERING MECHANICS** **L T P C**

3 1 0 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

Determining the resultant forces acting on a particle in 2D and 3D and for applying methods of equilibrium on a particle in 2D and 3D.

Evaluating the reaction forces for bodies under equilibrium, for determining the moment of a force, moment of a couple, for resolving force into a force-couple system and for analyzing trusses

Assessing the centroids of 2D sections / center of gravity of volumes and for calculating area moments of inertia for the sections and mass moment of inertia of solids.

Evaluating the frictional forces acting at the contact surfaces of various engineering systems and for applying the work-energy principles on a particle.

Determining kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES 9+3

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES AND TRUSSES 9+3

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections – Analysis of Trusses – Method of Joints and Method of Sections.

UNIT III DISTRIBUTED FORCES 9+3

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION AND WORK PRINCIPLES 9+3

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction. Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

UNIT V DYNAMICS OF PARTICLES AND RIGID BODIES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods – Kinematics of Rigid Bodies and Plane Kinetics.

TOTAL : 60 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. To determine the resultant forces acting on a particle in 2D and 3D and to apply methods of equilibrium on a particle in 2D and 3D.
2. Evaluate the reaction forces for bodies under equilibrium, to determine moment of a force, moment of a couple, to resolve force into a force-couple system and to analyze trusses
3. Assess the centroids of 2D sections / center of gravity of volumes and to calculate area moments of inertia for the sections and mass moment of inertia of solids.
4. Evaluate the frictional forces acting at the contact surfaces of various engineering systems and apply the work-energy principles on a particle. evaluate the kinetic and kinematic parameters of a particle.
5. Determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12th Edition, 2019.

2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3									3		
2	3	3	2	3									3		
3	3	3	2	3									3		
4	3	3	2	3									3		
5	3	3	2	3									3		
Avg	3	3	2	3									3		

EE23C03	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		2	0	2	3

UNIT- I BASIC ELECTRICAL CIRCUITS **6**

Basic Elements: R,L,C- DC Circuits: Ohm's Law - Kirchhoff's Laws –Mesh and Nodal Analysis(Only Independent Sources). AC Circuits: Average Value, RMS Value, Impedance Instantaneous Power, Real Power, Reactive Power and Apparent Power, Power Factor-Steady state Analysis of RL,RC and RLC circuits.

UNIT II AC AND DC MACHINES **6**

Magnetic Circuit Fundamentals -DC Machines - Construction and Working Principle, Types and Application of DC generator and Motor, EMF and Torque Equation.

AC Machines: Principle, Construction, Working and Applications of Transformer -Three phase Alternator - Three Phase Induction Motor.

UNIT III ANALOG AND DIGITAL ELECTRONICS **6**

Operation and Characteristics of electronic devices: PN Junction Diodes, Zener Diode and BJT
Applications: Diode Bridge Rectifier and Shunt Regulator.

Introduction to Digital Electronics: Basics Logic Gates-Flip Flops.

UNIT IV SENSORS AND TRANSDUCERS **6**

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, Strain gauge, LVDT, Piezo electric transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

UNIT V MEASUREMENTS AND INSTRUMENTATION **6**

Functional Elements of an Instrument, Operating Principle of Moving Coil and Moving Iron Instruments, Power Measurement, Energy Meter, Instrument Transformers - CT and PT, Multimeter- DSO - Block Diagram Approach.

TOTAL: 30 PERIODS

LAB COMPONENET:

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Single Phase Transformer.
4. Load test on 3 Phase Induction Motor.
5. Uncontrolled diode bridge Rectifiers.
6. Application of Zener diode as shunt regulator.
7. Verification of truth table of logic gates and flip flops.
8. Characteristics of LVDT.
9. Three phase power measurement using two wattmeter method.
10. Study of DSO.

COURSE OUTCOMES:

Students will be able to

CO1 Compute the electric circuit parameters for simple circuits.
CO2 Understand the working principles and characteristics of electrical machines.
CO3 Understand the basic electronic devices.
CO4 Understand the basic operating principles of sensors and transducer.
CO5 Understand the operating principles measuring devices

TEXT BOOKS:

1. Kotharai DP and Nagarath IJ, “Basic Electrical and Electronics Enigneering”, McGraw Hill Education, Second Edition, 2020.
2. Bhattacharya SK, “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.

REFERENCES:

1. Mehta V.K. & Mehta Rohit, “Principles of Electrical Engineering and Electronics”, McGraw Hill Education, Second Edition, 2020.
2. Mehta V.K. & Mehta Rohit, “Principles of Electrical Machines”, S. Chand Publishing, second edition 2006.
3. Albert Malvino & David Bates, “Electronic principles”, McGraw Hill Education, Seventh Edition, 2017.

UC23H02 **தமிழரும் தொழில்நுட்பமும்** **L T P C**

1 0 0 1

அலகு I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III **உற்பத்தித் தொழில் நுட்பம்**: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UC23H02 **TAMILS AND TECHNOLOGY** **L T P C**

1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

MA23C07	NUMERICAL AND STATISTICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand and apply numerical methods for solving systems of linear equations.
- To understand and apply numerical integration and differentiation.
- To solving initial value problems of ordinary differential equations numerically.
- To provide an understanding of the statistical methods and concepts by which real-life problems are analyzed.
- To analyze various data by using Statistical Techniques.

UNIT I ROOT FINDING METHOD AND SYSTEM OF LINEAR EQUATIONS 9+3

Root finding for algebraic and transcendental equations – Newton Raphson method – Simultaneous linear equations – Direct methods – Gauss elimination and Gauss Jordan methods – Iterative methods – Jacobi and Gauss Seidal methods - Matrix Inversion by Gauss-Jordan method – Eigen values of a matrix by Power method.

UNIT II INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Difference table – equal intervals: Newton's forward and backward interpolation – unequal intervals: Newton's divided differences (case) – Lagrange's interpolation – Differentiation formulae for equal and unequal intervals– Trapezoidal, Simpson rules and Gaussian-Quadrature formulae.

UNIT III INITIAL VALUE PROBLEMS FOR DIFFERENTIAL EQUATIONS 9+3

Taylor Series and Euler methods, Fourth order Runge-Kutta method for First order, Second and simultaneous Differential Equations – Predictor-corrector method – Milne and Adam-Bashforth methods.

UNIT IV EMPIRICAL STATISTICS 9+3

Types of Sampling - Description of discrete and continuous data – Measures of Central tendency and dispersion for grouped and ungrouped data – Measures of position – Box and Whisker plot- Correlation and regression analysis.

UNIT V TESTING OF HYPOTHESIS 9+3

Sampling distributions– Type I and Type II errors – Tests based on Normal, t, chi-square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

Suggested Laboratory based exercises / assignments / assessments :

1. Solution of algebraic and transcendental equations
2. Newton-Raphson method
3. Iterative methods of Gauss-Jacobi and Gauss-Seidel
4. Matrix Inversion by Gauss-Jordan method
5. Eigen values of a matrix by Power method and by Jacobi's method
6. Interpolation with equal and unequal intervals
7. Numerical differentiation and integration
8. Solution of ODE by Taylor series and 4^{th} order R-K method
9. Data exploration using R
10. Correlation and regression analysis
11. Testing of hypothesis in R programming
12. Chi square goodness of fit test in R.

CO – PO Mapping:

COURSE OUTCOMES	**PROGRAMME OUTCOMES**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO5 :	3	3	2	3	1	2	1	1	1	1	1	3

CE23C02	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	2	4

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10

Definitions of fluid - Properties of fluids –Fluid pressure and its measurements – Forces on plane and curved surfaces - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian Principle of fluid flow– concept of control volume and system – Continuity equation, energy equation and momentum equation - Applications.

PRACTICALS

- Calibration of Venturimeter

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Reynold's Experiment- Laminar flow through circular conduits- Hagen Poiseuille equation -Darcy Weisbach equation – friction factor- Moody diagram- minor losses- Hydraulic gradient and total energy gradient – Pipes in series and parallel - Boundary layer concepts – types of boundary layer thickness.

PRACTICALS

- Determination of friction factor for flow through pipes

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 7

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 10

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines – Pelton wheel, Francis turbine and Kaplan turbine- Working principles - Work done by water on the runner - Efficiencies – Draft tube - Specific speed - Performance curves for turbines

PRACTICALS

- Characteristics of Pelton wheel turbine

UNIT V PUMPS 9

Classification of pumps- Centrifugal pumps – Working principle - Heads and efficiencies– Work done by the impeller - NPSH – Minimum speed to start the pump - Pumps connected in series and parallel - Performance curves - Reciprocating pump working principle – Indicator diagram and its variations – Air vessels - Work saved by air vessels.

PRACTICALS

- Characteristics of centrifugal pumps
- Characteristics of reciprocating pump

TOTAL: 45 L + 30 P = 75 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand the difference between solid and fluid, its properties and behaviour in static

conditions along with the conservation laws applicable to fluid flow and its application through fluid kinematics and dynamics. Verify and apply Bernoulli's equation for flow measurement like Orifice/ Venturimeter.

CO2 Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel and to understand the concept of boundary layer theory. Measure friction factor in pipes and compare with Moody diagram.

CO3 Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.

CO4 Design of Pelton wheel, Francis and Kaplan turbines and explain the working Principles of each turbine with draft tube theory for reaction turbines. Determine the performance characteristics of Pelton wheels.

CO5 Differentiate pumps and explain the working principle with characteristic curves and design of centrifugal and reciprocating pumps. Determine the performance characteristics of centrifugal and reciprocating pump.

TEXT BOOKS:

1. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics including Hydraulics Machines, 22nd Ed., Standard Book House. New Delhi, 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

REFERENCES:

1. Kumar K.L, Engineering Fluid Mechanics, (8th Ed.) S. Chand Publishing (India) Pvt. Ltd., New Delhi, 2016.
2. Som S.K. Gautam Biswas and Chakraborty S, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2017.
3. Subramanya, K. Fluid Mechanics and Hydraulic Machines,2nd Ed., Tata McGraw- Hill Pub. Co., New Delhi, 2018.
4. Yunus A. Cengel ; John M. Cimbala, Fluid Mechanics,4th Ed., McGraw Hill Education Pvt. Ltd.,2019.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co.,1998.
6. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2023.

MAPPING OF CO'S WITH PO'S

PO/PSO		COURSE OUTCOME					OVERALL CORRELATION OF COS TO POS
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	3	3	3	3	3	3
PO2	Problem analysis	2	3	3	3	3	3

PO3	Design / development of solutions	1	3	3	3	3	3
PO4	Investigation	1	1	2	2	2	2
PO5	Modern Tool Usage	1	1	1	1	1	1
PO6	Individual and Team work	1	1	1	1	1	1
PO7	Communication	1	1	1	1	1	1
PO8	Engineer and Society	2	2	2	3	3	2
PO9	Ethics	1	1	1	1	1	1
PO10	Environment and Sustainability	1	1	1	1	1	1
PO11	Project Management and Finance	1	1	1	1	1	1
PO12	Life Long Learning	2	2	2	3	3	2
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation	2	3	3	3	3	3
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	2	3	2	3	3	3

CE23C04 **PRINCIPLES OF SURVEYING** **L T P C**
3 0 4 5

UNIT I LEVELLING AND THEODOLITE SURVEYING 9 L, 28P

Datum - Benchmarks - Levels and staves - Temporary and permanent adjustments - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking - Reduction Contouring - Methods of interpolating contours - Characteristics and uses of contours - Theodolite - Types - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Trigonometric levelling - Heights and distances - Single plane method - Double plane method - Geodetic observation - Tacheometric surveying - Stadia tacheometry - Subtense method - Tangential tacheometry.

PRACTICALS

- Determination of elevation of given points by fly levelling using a dumpy level.
- Transfer of Bench Mark by Check Levelling using Tilting level.
- Contour Mapping using Grid Levelling and determine the Cut and fill volume.
- Measurement of horizontal angle and its accuracy by Repetition method.
- Measurement of horizontal angles and their weights by the Reiteration method.
- Mapping of Topographic Features by Stadia tacheometry surveying.
- Determination of Length and Reduced Level of points on sloping terrain using tacheometric surveying.

UNIT II CONTROL SURVEYING AND ADJUSTMENT 9L, 4P

Horizontal and vertical control - Methods - Triangulation - Baseline - Instruments and accessories - Corrections - Satellite station - Traversing - Coordinate computation - Gale‘s table - Omitted measurement - Trilateration - Concepts of measurements and errors - The weight of an observation - Law of weight - Adjustment methods - Angles, lengths and levelling network - Simple problems.

PRACTICALS

- Establishment of Horizontal Control Points by Traverse surveying.

UNIT III TOTAL STATION 9L, 20P

Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - Total station: Parts and accessories – classification - Electro-optical system- Microwave system - Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments - Observables - Errors - COGO functions - Field procedure and applications

PRACTICALS

- Study of Total station and measurement of Angle, Distance, and Coordinate measurement.
- To determine the instrument station coordinate: Orientation by back site and Resection methods (Angles only and Distances only). To determine the height of the tower/column/power transmission line by REM method.

- To determine the perimeter of a polygon by MLM / Inverse method and the area of a polygon
- (some points are inaccessible points, that are to be determined by different offset methods).
- Topographic mapping and Preparation of Contour map using Total Station.

UNIT IV GNSS SATELLITE SYSTEM 9L, 8P

Basic concepts of GPS – Resection principle - Historical perspective and development - applications - Geoid and Ellipsoid - satellite orbital motion - Keplerian motion - Kepler‘s Law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept - GNSS - Galileo, BeiDou, GLONASS, IRNSS and GAGAN, QZSS - Different segments - Space, control and user segments - satellite configuration – Signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment – Receivers - Planning and data acquisition - Data processing - Errors in GPS - Field procedure and applications

PRACTICALS

- Navigation and Feature collection using handheld GPS
- GNSS Planning of points with and without obstructions.
- Accuracy evaluation of baseline with different common observation times using GNSS

UNIT V PHOTOGRAMMETRY AND UAV 9

Definition: Types and uses of Photogrammetry-aerial and terrestrial, metric and non-metric - Platform for photogrammetric sensing systems – Perspective Projection - Scale and Coverage - Vanishing points - Image coordinate system - Relief displacement – Parallax – Stereo – UAV – Definition – difference between aircraft and UAV – Types and characteristics of drones

TOTAL: 105 PERIODS (45 (THEORY) + 60 (PRACTICAL))

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Gain a solid understanding of the fundamental principles and concepts of surveying, including measurements, coordinate systems, accuracy, error analysis, and surveying instruments

CO2 Plan and conduct field surveys effectively

CO3 Conduct surveys to accurately measure and map the features, contours, and elevations of a given area of land using appropriate surveying techniques and equipment

CO4 Analyse survey data using appropriate mathematical and statistical techniques, interpret the results, and generate accurate reports, drawings, and maps based on the collected data

CO5 Imparts the knowledge of modern surveying instruments

TEXT BOOKS:

1. T. P. Kanetkar and S. V. Kulkarni, “Surveying and Levelling”, Part 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th edition, 2010, ISBN-10: 8185825114, ISBN-13: 978-8185825113.
2. Dr B. C. Punmia, Ashok K. Jain and Arun K Jain, “Surveying Vol. I & II”, Lakshmi Publications Pvt Ltd, New Delhi, 16th edition, 2016, ISBN-10: 9788170088530, ISBN-13:978-8170088530.

REFERENCES:

1. R. Subramanian, “Surveying and Levelling”, Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13: 978-0198085423.
2. James M. Anderson and Edward M. Mikhail, “Surveying, Theory and Practice”, McGraw Hill, 7th edition, 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. Bannister and S. Raymond, “Surveying”, Longman, 7th edition, 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.
4. S. K. Roy, “Fundamentals of Surveying”, Prentice Hall of India, 2nd edition, 2004, ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K. R. Arora, “Surveying Vol I & II”, Standard Book House, 2019, ISBN-13: 9788189401238.
6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, 2nd edition, 2011, ISBN-10: 9788173717406, ISBN-13: 978-8173717406.
7. Günter Seeber, “Satellite Geodesy”, Walter de Gruyter, Berlin, 2nd revised and extended edition, 2003.

CO-PO & PSO MAPPING: SURVEYING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	3	1	2	3	2	1	2	3	3	3
2	3	3	3	3	2	3	2	2	3	1	1	2	3	3	3
3	3	3	3	2	3	3	2	2	3	1	1	3	3	3	3
4	3	2	3	3	3	3	1	2	3	2	1	3	3	3	3
5	3	3	3	3	3	3	2	1	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

MI23301 MINE DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To demonstrate the importance of mining in national economy.
- To study the fundamentals of mine development prior to the production.
- To study the basic concepts pertaining to the drilling & blasting operations and the mining methods.

UNIT I INTRODUCTION TO MINING 6

Historical overview of mining, role of the mining industry in the modern world and contribution to national economy; Role of mining engineers in industry. Statute related to Mining Industry; Present and future trends of mining industry. Mineral deposit – different types and their classification; Distribution of mineral deposits in India and other countries; Stages in the life of a mine: prospecting, exploration, development, exploitation and reclamation.

UNIT II ACCESS TO DEPOSIT 10

Choice, location and size of mine entries – adit, shaft, incline and combined mode; Sinking methods through soft, strong and water bearing strata, support system, ventilation, lighting and drainage arrangements during sinking, material handling and safety in sinking shafts. Introduction to piling, caisson and freezing methods - cementation method - widening and deepening of shafts.

Modern techniques of shaft sinking – shaft boring, design of shaft insets, pit bottom excavation and shaft raising. Recent developments in shaft sinking.

UNIT III DRILLING AND BLASTING 7

Principles of drilling, Types of drilling methods and equipments, selection, applications and limitations, exploration and production drilling in surface and underground workings, Explosives and accessories, handling and storage, transportation of explosives; Mechanism of rock blasting, Overview of Environmental impacts due to blasting.

UNIT IV DRIFTING AND TUNNEL CONSTRUCTION 6

Drivage of drifts, organisation and cycle of operations; support system, ventilation, lighting and drainage arrangements during development; modern methods of drifting, continuous miners, tunnelling, road heading and tunnel boring, recent developments in tunneling and drifting.

UNIT V INTRODUCTION TO MINING METHODS 6

Outline of mining methods – selection criteria & comparison. Overview of surface mining: Types of surface mines - basic bench geometry, applicability & limitations. Overview of underground mining: Different coal mining methods and their applicability & limitations; Different metal mining methods and their applicability & limitations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will have ability

1. To understand the distribution of mineral deposits, and mining terminology
2. To analyze design requirement of approach to mineral deposits
3, To obtain fundamentals related to the drilling and blasting operations.
4. To acquire basic knowledge on drifting and tunnelling.

5. To learn the overview of mining operations in underground and surface mines.

TEXT BOOKS:

1. Hartman, H.L., Introduction to Mining Engineering, John Wiley and Sons, Second Edition,1999.
2. Deshmukh, D. J., Elements of Mining Technology, Vol.I, Vidyaseva Prakashan, Nagpur,1994.
3. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A. A. Balkema, Rotterdam, 1995.

REFERENCES:

1. Michael Coulson, The History of Mining: The Events, Technology and People Involved in the Industry That Forged the Modern World, First Edition, Harriman House, 2012.
2. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York,2011.
3. Universal Mining School - Lecture notes, cardiff,U.K
4. Tatiya, R.R., Surface and Underground Excavations. A.A. Balkema, Rotterdam,2005.
5. Bhandari, Sushil, Engineering Rock Blasting Operations, A.A.Balkema, Rotterdam, 1997.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	2	3	3	2	2	2	0	0	2	2	2	2
2	2	2	2	3	2	2	2	2	2	2	2	3	2	2	1
3	2	3	2	2	2	3	0	0	2	3	2	2	3	2	2
4	3	2	0	0	2	2	0	2	2	2	2	2	2	3	2
5	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2
Avg	2.2	2.4	1.8	1.8	2.2	2.4	1.2	1.6	1.6	1.8	1.6	2.2	2.2	2.2	1.8

GY23C03 GEOLOGY FOR MINING ENGINEERING – I L T P C
3 0 0 3

OBJECTIVES:

- To familiarize the students with the fundamental concepts of geology
- To teach the importance of geology in mining engineering
- To provide knowledge on landforms, minerals, rocks and structural features

UNIT I GENERAL GEOLOGY & PLATE TECTONICS 9

Geology for mining engineering: branches, scope and applications – internal structure of earth and composition – layers in atmosphere - weathering processes, types and grades and relevance to mining, engineering classification of weathered rocks – seismology and plate tectonics: plate boundaries, continental drifting, earthquake terminologies, earthquake zones - Groundwater: hydrological cycle, porosity and permeability, origin, occurrence, distribution and movement of groundwater, aquifer and types, role of groundwater in mining.

UNIT II GEOMORPHOLOGY & STRATIGRAPHY 9

Geomorphological landforms: Aeolian fluvial, marine and glacial processes, erosional and depositional landforms – sea bottom profile and deposits in ocean - Introduction to Geological time scale – evolution of life based on fossil records - distribution of mineral resources and economic importance of Archaen, Paleozoic, Mesozoic and Cenozoic rocks in India. Geology of Tamil Nadu.

UNIT III MINERALOGY 9

Classification of minerals – Major crystal systems - Physical properties of minerals – Hardness scale - Silicate structures - Properties, composition and uses of Quartz group, Feldspar group, Mica group, Garnet group, Pyroxene, Amphibole, Olivine and Calcite minerals - Clay minerals and their importance.

UNIT IV PETROLOGY 9

Classification of rocks – Origin and mode of occurrence of igneous, sedimentary and metamorphic rocks - Description of Igneous rocks: granite, syenite, dolerite, basalt, gabbro, anorthosite, pyroxenite and dunite – Description of sedimentary rocks: conglomerate, breccia, sandstone, limestone and shale - Description of metamorphic rocks: slate, phyllite, quartzite, marble, charnockite, gneiss and schist. - Engineering properties of rocks: field and laboratory tests.

UNIT V STRUCTURAL GEOLOGY 9

Introduction to geological structures – attitudes of beds: strike and dip, true dip and apparent dip – Description and classifications of folds, faults, joints and unconformities - recognition of geological structures in the field and their significance in mineral occurrence, exploration and mining.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, students should be able to:

- Understand plate tectonics and weathering of rocks
- Know the formation of various landforms

- State the properties of important minerals
- Distinguish the rocks and their engineering properties
- Recognize the structural features and their significance in mining

REFERENCES:

1. Billings, M.P. Structural Geology, Third Edition, Pearson Education Limited, 2016.
2. Nanda, H. Indian Stratigraphy, Anmol Publications Pvt. Ltd, 2014
3. Winter J.D. Principles of Igneous and Metamorphic Petrology,Second edition, Pearson
4. Education Limited, 2014.
5. Parbin Singh. Text book of Engineering and General Geology, S. K. Kataria & Sons, 2013
6. Ford, W.E. Dana's Textbook of Mineralogy (4th edition), CBS Publishers, 2006.
7. Bell F.G. Engineering Geology, Elsevier Publications, 2007
8. Arthur Holmes. Principles of Physical Geology, Thomas Nelson and Sons, USA,
9. 1964.
10. D. K. Todd and L. W. Mays, "Groundwater Hydrology," 3rd Edition, John Wiley & Sons, Inc., New York, 2005.

CO-PO &PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	3	3	2	2	2	0	0	2	2	2	2
2	2	2	2	3	2	2	2	2	2	2	2	3	2	2	1
3	2	2	2	2	2	3	1	1	2	3	2	2	3	2	2
4	3	2	1	1	2	2	1	2	2	2	2	2	2	3	2
5	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2
AVG	2.2	2	2	2	2.2	2.4	1.6	1.8	1.6	1.8	1.6	2.2	2.2	2.2	1.8

GY23C04	GEOLOGY LABORATORY – I & FIELD WORK FOR MINING ENGINEERING	L T P C 0 0 4 2

OBJECTIVES:

- To familiarize the students with identification of minerals and rocks
- To teach the mapping techniques
- To see the geological formations in the field

UNIT I IDENTIFICATION OF MINERALS 12

Megascopic identification of minerals and crystals, study of physical properties of quartz group, feldspar group, mica group, garnet group, hypersthene, augite, hornblende, calcite, olivine, magnesite, asbestos, gypsum, talc, clay minerals, kyanite, silimanite, tourmaline and barite. Study of minerals in Moh's scale of hardness.

UNIT II IDENTIFICATION OF ROCKS 12

Identification and description of igneous rocks - plutonic, hypabyssal and volcanic: granite, syenite, dolerite, basalt, gabbro, pyroxenite, anorthosite and dunite – Sedimentary rocks: conglomerate, breccia, sandstone, limestone and shale - Metamorphic rocks: slate, phyllite, quartzite, marble, charnockite, gneiss and schist.

UNIT III STRUCTURAL GEOLOGY PROBLEMS 12

Strike and dip measurement using Brunton Compass and Clinometer, Strike and dip calculations – Interpretation of 3 point and 4 point borehole problems to decipher the subsurface geological conditions for mining of resources - Determination of strata thickness – true width calculations from borehole data.

UNIT IV GEOLOGICAL MAPPING TECHNIQUES 12

Toposheets and their uses - Map scale and types, preparation and interpretation of contour maps and drainage maps – symbols in geological maps – representation of geological features. Exercises on structural maps of geological/mining sites and interpretation of geological conditions.

UNIT V GEOLOGICAL FIELD WORK 12

Measurement of strike and dip in the field using Brunton Compass and Clinometer. Visit to important geological sites, quarries, mines and industries.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this practical course, students are expected to:

1. Identify important minerals
2. Distinguish important rocks
3. Solve the structural geology problems
4. Interpret the geological maps
5. Measure strike and dip in the field

REFERENCES:

1. Parbin Singh. Text book of Engineering and General Geology, S. K. Kataria & Sons, 2013.

2. Ford, W.E. Dana's Textbook of Mineralogy (4th edition), CBS Publishers, 2006.
3. Gokhale,N. W., Manual of Geological maps CBS publishers, N. Delhi, 2008
4. Lahee, F.H., Field Geology, CBS publishers, N. Delhi, 2002.
5. Butler, B.C.M and Bell, J.D, Interpretation of geological maps, Longman Scientific & technical Publ.,1st ED., New Delhi, 1988.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	-	-	-	3	1	-	1	2		2
2	3	3	3	3	1	-	-	-	3	1	-	1	2		2
3	3	3	3	3	1	-	-	-	3	1	-	1	2		2
4	3	3	3	3	1	-	-	-	3	1	-	1	2		2
5	3	3	3	3	1	-	-	-	3	1	-	1	2		2
Avg	3	3	3	3	1	-	-	-	3	1	-	1	2	-	2

GY23C05 GEOLOGY FOR MINING ENGINEERING - II

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the processes of formation of mineral deposits and their properties
- To educate on subsurface exploration techniques
- To give exposure on geospatial techniques

UNIT I FORMATION OF ORE DEPOSITS 9

Processes of formation of ore minerals: deposits formed from magmatic, hydrothermal, residual, mechanical concentration (placer), oxidation and supergene enrichment, metasomatic, sedimentation, and evaporation processes – ore-suites and types.

UNIT II ORE GEOLOGY 9

Metallic deposits: Properties and varieties of iron ores, copper ores, lead ores, zinc ores, aluminum ores, chromium ores, Nickel ores and manganese ores and their distribution in India. Gold, silver and molybdenum deposits and their distribution in India. Study of industrial minerals: minerals used in ceramic, refractory, abrasive, glass, fertilizer, paint, electric and gem industries.

UNIT III FUEL GEOLOGY 9

Origin, physical properties and process of formation of coal deposits – classification and rank of coal – origin and formation of petroleum deposits – primary and secondary migration of oil and natural gas, accumulation of oil and gas in different types of traps – Introduction to gas hydrates and nuclear minerals - occurrence and distribution of coal, hydrocarbon and nuclear fuels in India.

UNIT IV GEOPROSPECTING 9

Mineral exploration techniques: geological mapping, trenching, pitting, surface drilling and underground drilling, crosscutting, level planning and slice planning, and 3-D modelling - Geophysical prospecting methods: electrical, seismic, magnetic, gravity and radioactive methods of exploration – Subsurface logging and their importance in exploration: GPR surveying. Classification of Mineral Resources & Reserve.

UNIT V GEOSPATIAL TECHNOLOGY 9

Aerial photography and satellite remote sensing: components of remote sensing and EMR – vertical and oblique aerial photography, drone surveying, flight planning, stereoscopes and types, types of remote sensing and satellites, resolution and types, photo recognition elements and interpretation of aerial photos and satellite images – GIS: components, raster and vector, overlay and buffering techniques, DEM and TIN models - GPS and DGPS – Applications of geospatial technology for geological mapping and mineral exploration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, students should be able to:

- Know the formation of mineral / ore deposits
- Understand the properties of ores and industrial minerals
- Get knowledge on fuel deposits and their occurrence in India
- Involve in direct and indirect methods of mineral exploration
- Understand the role of geospatial techniques in mining industry

REFERENCES:

1. Umeshwar Prasad, Economic Geology, second edition, CBS Publishers, 2010.
2. Robb, L. Introduction to ore-forming processes, Blackwell publishing, U.K., 2005.
3. Anthony Evans, Ore Geology and Industrial Mineral, 3rd edition, Wiley & Blackwell, 2013
4. Arogyaswamy, R.N.P. Courses in Mining Geology, Oxford and IBH Co., New Delhi,1988.
5. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, 1956.
6. Chandra, D., Singh, R. M. and Singh, M. P. Text book of coal (Indian context). Tara book agency, Varanasi. 2000.
7. Stach, E. Mackowsky, M. Th., Teichmuller, M., Taylor, G.H., Chandra, D. and Teichmuller, R. Stach's Text book of coal petrology, Gebnudar Borntraeger, Stuttgart, 1982.
8. A. T. Levorsen Geology of Petroleum CBS publishers and distributors, Delhi, II Edition 1999.
9. Lillesand. TM.,Kiefer, R.W and Chipman, K.W. Remote sensing and image imterpretation Fifth Edition. Wiley. 2007.
10. Burrough, PA; and RA McDonnell. Principles of Geographic Information Systems. Oxford Press, U.K., 1998.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	2	1	2	3	1	1	1	2	2	2
2	3	1	2	1	2	-	2	-	3	1	2	1	2	1	2
3	3	2	3	3	1	1	2	2	3	1	-	1	2	2	2
4	3	3	1	3	3	2	1	1	3	1	2	1	2	1	2
5	3	3	3	1	2	-	2	-	3	1	2	1	2	2	2
Avg	3	2.4	2.4	2.2	2	1.67	1.6	1.67	3	1	1.75	1	2	1.6	2

MI23401 **MINE SURVEYING** **L-T-P-C**
3-0-0-3

OBJECTIVES:

- To impart knowledge of carrying out in underground surveying.
- To study the various modern surveying techniques and instruments.
- To learn methods of contouring and curves, layouts.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

UNIT I UNDERGROUND SURVEY **9**

Importance features of Underground Mining surveying with plane surveying, Connecting to mine base line from national grid, Underground traversing using theodolite, level & Total Station and its constraints, Correlation of underground and surface surveys by different methods, by traversing through shafts, assumed bearing, Weiss quadrilateral, Weiss triangle methods, Measurement of shaft depth.

UNIT II ALIGNMENT SURVEY AND TACHOMETRY **9**

Alignment / Gradient control of vertical and inclined shafts sinking and raising shafts; Gradient control in development openings;; Fixing centre lines for shafts, Alignment in Headgears, machinery foundation etc. Illustrative examples: Tachometry –principles, equipment, methods (stadia, substance, tangent), accuracy of stadia work, booking, computations. Transfer of levels to different horizons. Volumetric survey

UNIT III STOPE & SUBSIDENCE SURVEYS AND MINEPLANS **9**

Stope survey – objectives, methods- Tape triangulation, Tying In, Traversing, Radiation, preparation of stope plan, preparation of mine plan subsidence survey, guidelines for subsidence in laying out monitoring stations, methods of subsidence survey, statutory provisions and circulars

Preparation of Mine plans and sections; stepped plan; Allay plan; Joint Survey, Offset survey, extension of centerlines, determination of partition thickness between the sections. Duties and responsibilities of mine surveyor under Mines Act and connected legislations.

UNIT IV DIP & CONTOURING AND CURVE SETTING **9**

Dip/ Strike / Fault interpretation from inclined angle vertical borehole data in dipping and plunging formations; interpretations of borehole maps; borehole deviation; calculation of plunge in folded terrain. Methods of Contouring; contour gradient; uses of contours; Reservoir / Catchment area calculations Illustrative examples: setting out underground of curves; need for curves; types of curves; methods of curve setting.

UNIT V MODERN SURVEYINGMETHODS **9**

Cavity Monitoring System; Electronic Distance Measuring, Electronic theodolite, Electronic Tachometer (Total station); Laser Theodolite; GPS principles & DGPS surveying; GPR application in surveying, Laser Scanning, introduction to surveying softwares and use. Principles of Drone surveying and application in mining

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have knowledge on methods of underground traversing.
2. The students will learn about alignment of survey and tachometry surveying.
3. The students will have knowledge about methods of stope and subsidence surveys. They will have a confident about preparation of mine plans and section.
4. The students will understand the methods of contouring and curve setting.
5. The students will have knowledge on EDM, GPS, DTM, Total station, etc.

TEXT BOOKS:

1. Ghatak., Mining Surveying and levelling Vol I, II & II, Lovely Prakashan, Dhanbad,2008
2. Punmia, B.C., Surveying Vol I and II, Laxmi Publications; seventeenth edition (2016)
3. Kenetkar, T.P., Surveying and Levelling, Vol I and Vol II, United Book Corporation, Poona, 2008.
4. Clark, D., Plane And Geodetic Surveying,Vol I And Vol II, CBS Publishing Co.,1986.

REFERENCES:

1. Winniberg, F., Metalliferous MineSurveying
2. Mason,E., Coal Mining Series, Surveying ,Vol I And Vol II, Virtue And Company Limited, London.
3. Assur,V.L.And Pilatov,A.M., Practical Guide To Surveying MIR Publishers, Moscow 1988.
4. Borshch,V., Komponiets,A., Navitny, G.AndKnysh., Mine Surveying MIR Publishers Moscow,1989.
5. Sahni, Advanced Surveying, Lovely Prakashan, Dhanbad,1992.
6. Alam Chand., Modern Concept Of Mine Survey, Lovely Prakashan,Dhanbad,1992.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	3	2	2	2	3	2	2	3	2	2
2	3	1	2	2	2	2	2	3	2	2	2	2	2	1	3
3	2	2	3	1	2	2	2	3	2	1	2	3	2	3	2
4	2	2	3	2	2	1	3	2	2	1	2	3	2	2	2
5	3	3	2	2	3	3	2	2	2	2	0	2	2	3	2
Avg	2.4	2	2.4	1.8	2.4	2.2	2.2	2.4	2	1.8	1.6	2.4	2.2	2.2	2.2

MI23402 MINE ENVIRONMENT AND VENTILATION L T P C

3 0 2 4

UNIT I MINE GASES 9

Occurrence, properties, physiological effects of various mines gases like methane, carbon monoxide, carbon dioxide and hydrogen sulphide ,detection–types of instruments, construction, measurement and analysis, Introduction to ventilation standards, methane layering, methane drainage.

UNIT II MINE CLIMATE AND CONTROL 9

Psychometric properties of air, Sources of heat and humidity in mines and their effects. Hygrometers and Thermometers, cooling power of mine air and methods of improving cooling power including air conditioning.

UNIT III PRINCIPAL LAWS OF AIR MOVEMENT IN UNDERGROUND 9

Fundamentals of fluid flow and its application in mine ventilation with special reference to Bernoulli's Equation, Reynolds number, Poiseuille's equation, Atkinson's equation, Karman-Brandt equation for rough flows, resistance of mine roadways – Frictional and mine resistance, shock resistance.

UNIT IV NATURAL VENTILATION AND AIR CURRENT DISTRIBUTION IN MINES 9

Natural ventilation, effect of depth, temperature, pressure, etc. distribution of air current in mines –splitting, stopping, regulators, ventilation doors, air crossings, controlled recirculation, etc. accessional, decensional, homotropal and antitropal ventilation systems.

UNIT V MECHANICAL VENTILATION & VENTILATION PLANNING 9

Ventilation methods – Boundary, central and combined. Main mechanical ventilators-Centrifugal and axial flow fans, their selection and installation, performance, characteristics and testing, fans in series and parallel, booster fans and auxiliary fans fan drifts and evasees, reversal of air current, forcing versus exhaust ventilation, ventilation of long headings including overlap systems. Ventilation in deep and hot mines, remedial measures. Ventilation Planning - Calculation of pressure and quantity requirements, network analysis, monitoring of mine environment. Ventilation survey – Instrumentation and methods.

TOTAL: 45 PERIODS

PRACTICALS

EXPERIMENTS:

1. Determination of psychrometric properties of air.
2. Study of mine flame safety lamp, gas testing with flame safety lamp.
3. Mine air sampling and detection of various mine gasses, like, methane and carbon monoxide.
4. Determination of percentage of mine gasses using gas chromatography.
5. Measurement of cooling power by Kata thermometer.
6. Study of centrifugal flow fan and characteristics
7. Study of installation of centrifugal flow fans.
8. Study of installation and positioning of booster fan.

9. Study of axial flow fan and characteristics.
10. Study of installation of axial flow fans
11. Study of central and boundary ventilation system.
12. Study of pressure survey and quantity survey in mines using velometer, anemometer and barometer.
13. Study of mine air-conditioning plant.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

1. The students will obtain a basic knowledge about mine gases their properties and effects.
2. The students will have basic knowledge of underground mine atmosphere, ventilation methods, parameters influencing mine environment, measurement methods and instrumentation.
3. They will have knowledge about the principal laws governing mine ventilation systems.
4. The students will get adequate knowledge about natural ventilation and air distribution in mines.
5. The students will obtain knowledge about ventilation monitoring and planning.

TEXT BOOKS:

1. Mishra, G.B. Mine Environment and Ventilation, Oxford University Press, 1992.
2. Hartman, H.L. and Mutmansky, J.M., Mine Ventilation and Air Conditioning, Wiley Interscience publication, 1997.
3. Ramlu, M.A., Elements of Mine Ventilation, White Falcon Publishing, 2018.

REFERENCES:

1. Hall, C.J., Mine Ventilation Engineering, Society of Mining Engineers, New Engineers, New York, Second Edition, 1992.
2. Vutukuri, V.S., Mine Environment Engineering, Trans Tech Publishers, 1986.
3. McPherson, M.J., Subsurface Ventilation and Environmental Engineering, Chapman and Hall Publication, London, 1993.
4. Panigrahi, D.C., Mine Environment and Ventilation, CRC Press, 2001.TEXTBOOKS:
5. Thakur, Pramod - Advanced mine ventilation_ respirable coal dust, combustible gas and mine fire control- Woodhead Publishing, 2019

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	2	2	2	3	3	2	2	3	2	2
2	2	2	0	0	2	2	1	2	2	2	2	3	2	1	3
3	2	2	2	0	1	2	2	2	2	2	2	2	2	2	2
4	2	0	1	2	2	2	2	2	0	2	2	0	2	1	2
5	2	2	2	2	2	0	1	0	2	2	2	2	2	2	2
AVG	2	1.6	1.4	1.2	1.8	1.6	1.6	1.6	1.8	2.2	2	1.8	2.2	1.6	2.2

MI23403 **MINING MACHINERY - I** **L T P C**
2 0 2 3

OBJECTIVES:

1. To understand the electrical layouts and power distribution in mine.
2. To study the rope haulage layouts, technical details and applications.
3. To study the various modes of transport means and electrical circuits.
4. To study the types of pumps, installations and design calculations.

UNIT I INTRODUCTION 9

Different types of motive power used in mines–their fields of application, relative merits and demerits; transmission and distribution of compressed air in mines, compressed air drills. Elements of the transport system, classification and techno-economic indices.

UNIT II ROPE HAULAGE 9

Wire ropes – classification, construction, fields of application, rope capping and splicing; deterioration of rope in use and its prevention; testing of ropes, selection and maintenance, rope calculations. Rail Track and tubs–gauge; layout, curves, turn outs and cross-over, track maintenance, main features of rolling stock like tubs, mine cars man riding cars and tipplers; Types of rope haulages–merits, demerits and fields of application, constructional features, safety appliances and rope haulage calculations.

UNIT III OTHER TRANSPORT SYSTEMS 9

Locomotives – diesel, trolley-wire, battery locomotives, constructional features and safety devices and comparison of different types; underground and surface battery charging stations and safety measures, locomotive calculations; shuttle cars, underground trucks, load-haul- dumpers, SDL vehicles, aerial ropeways, gravity transport, principles of hydraulic &pneumatic transportation and their fields of application, electric layouts, man-riding systems.

UNIT IV PUMPING & CONVEYING 9

Different types of drives, installation and maintenance of pumps and pipes in shafts and roadways, electrical layouts, various sources of water in mines, design of sumps. Face haulage and conveyors – Scraper chain conveyors, AFCs , belt conveyors, shaking and vibrating conveyors, armoured flexible conveyors, high angle conveying, electrical layouts.

UNIT V MINE ELECTRICAL ENGINEERING 9

Distribution of electric power in mines, types of mine cables and their fields of applications, mining switch gears and their installation in hazardous atmosphere, flame proof enclosures, intrinsically safe circuits, (examples) safety aspects and signalling. Mine telephone system and latest development in mine communications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Obtain basic knowledge on motive power used in mines, pumping,
2. Understand the basic concepts related to rope haulage and face haulage.
3. Learn the design and constructional features of primary equipment used for loading and transportation in the underground mines.

4. Enhance the knowledge on concepts related to pumping & conveying transport systems.
5. Learn fundamental knowledge about mine electrical engineering in all statutory aspects.

TEXT BOOKS:

1. Deshmukh, D. J. Elements of Mining Technology, Vol. I and II EMDEE Publishers, Nagpur,1989.
2. Cherkassky, B.M., Pumps, Fans, Compressors, MIR Publishers, 1980.

REFERENCE BOOKS:

1. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.
2. Karelin N.T., Mine Transport, Orient Longmans, N. Delhi.
3. Mason, E., Coal Mining Series, Mining Machinery, Virtue and Company Ltd., London.
4. Statham, I.C.F., Coal Mining, Vol. I, II, III and IV, Caxton Eastern Agencies, Calcutta.

PRACTICALS:

1. Study and construction of different types of wire ropes and types of rope cappels used for rope haulages & winding,
2. Study of Construction of compressed air operated drill.
3. Study of Tensioning arrangement in endless haulage and different types of haulage clips and other means of attachment of tubs to the rope.
4. Study of haulage track, curves, diamond crossing, construction of mine tubs and cars along with their couplings.
5. Study of safety devices provided on rope haulage roads and locomotives, roadways - Exhaust conditioner and flame traps & underground battery charging station layout
6. Study of Electrical power distribution in mines, electrical layout for rope haulages and pumps, Electrical and hydraulic layouts for longwall faces.
7. Study of aerial rope ways – driving/tensioning/loading/unloading and angle stations their carriages and tightness.

TOTAL : (45 + 15) 60 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	2	2	2	3	3	2	2	3	2	2
2	2	2	1	1	2	2	1	2	2	2	2	3	2	1	3
3	2	2	2	0	1	2	1	2	2	2	2	2	2	2	2
4	2	1	1	2	2	2	2	2	0	2	2	0	2	1	2
5	2	2	2	2	2	0	1	0	2	2	2	2	2	2	2
AVG	2	1.8	1.6	1.4	1.8	1.6	1.4	1.6	1.8	2.2	2	1.8	2.2	1.6	2.2

MI23404	SURFACE MINING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To impart fundamental knowledge on the safe, efficient and environmentally responsible surface mining operations.
- To enable the students to understand the ground preparation techniques, excavation and transportation technology adopted in the surface mining.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars being covered under this course.

UNIT I INTRODUCTION 9

Surface mining – status, concept, applicability, advantages and disadvantages, Surface Mining Systems vis equipment system – classification, applicability, advantages and disadvantages; Stripping ratio – concepts, types and applicability; Concept of ultimate pit limits; Haul roads in surface mines – construction and safety features.

UNIT II DESIGN AND DEVELOPMENT OF SURFACE MINES 9

Surface mine planning – Different systems of opening of deposits, Box cut – objectives, factors affecting the selection of box cut site; Bench Geometry – formation, parameters and factors affecting their selection. Slopes in surface mines – Highwall and waste dumps; Working pit slope and ultimate pit slope, common modes of slope failures, factors influencing stability of slopes, Slope protection, stabilization and monitoring. Development of opencast mine layouts for various mode of deposit with respect to its occurrence. Opencast mining over developed coal seams.

UNIT III GROUND PREPARATION METHODS 9

Preparation of the site – Ripping, Drilling and Blasting; Types, operation, selection, method and cycle of operation, Applications of ground preparation equipments – Rippers-Dozers, Blasthole drills and rock breakers, Estimation of equipment fleet; Concept of Rippability and estimation of ripper's output, Design of blasts in surface mines.

UNIT IV EXCAVATION SYSTEM IN SURFACE MINES 9

Selection criteria for excavation and transport Equipments used in surface mines. Classification, application and limitations of different types of excavating equipments used in surface mining projects; Cycle time and productivity calculation; Estimation of equipment fleet; Dragline - calculation of reach, required bucket capacity for a given handling requirement, Method and cycle of operations of Draglines, Front end loaders, Scrapers, Bucket wheel excavators, Surface miners. Determining the capacity and number of shovels and dumpers for planned production.

UNIT V TRANSPORT AND WASTE DUMPS 9

Scope and application of different modes of transport system in surface mines – Trucks, Synchronization of shovel and dumper capacity for required production; Conveyors (shiftable and high-angle) – mode of operation, applicability and limitations, Scope and application of in-pit crushers in surface mines. Types of waste dump – internal and external; dump formation methods and corresponding equipments; Dump slope - stabilization and monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will have ability

1. To understand various modes of opening up of deposits amenable to surface mining.
2. To plan and design the basic components of a typical surface mine including benches and haulroads according to the deposit formation.
3. To identify the salient points that dictate which is the safest, most efficient, and most versatile extraction method to employ classify and select the suitable surface mining methods and equipment based on site conditions.
4. To understand the concept of waste dump formations and slope failures in surface mines.
5. To discuss the impacts that social and environmental issues have on surface mining from the pre-exploration phase to end-of-mine issues, and how to manage these two increasingly important factors to the benefit of both the mining company and the society.

TEXT BOOKS:

1. Singh, T.N., Surface Mining, Lovely Prakashan, Dhanbad, 2020.
2. Kennedy, B.A., Surface Mining – 2 nd Edition, SME, New York, 1990.
3. Howard L. Hartman and Jan M. Mutmansky, Introductory Mining Engineering, John Wiley and Sons, 2002.

REFERENCES:

1. Nawal Kishore and Roshan Kumar Patel, Recent Methods and Techniques in Surface Mining, Denett Publishers, 2022.
2. Hassan Ali Abdelhak Elsaghier, Mostafa Mohamed Ali Elbeblawi, Mostafa Tantawy Mohamed Amin, Wael Rashad Elrawy Abdellah, Surface Mining Technology, Springer Verlag, Singapore; 1st edition, 2022.
3. James E. Rowe, Coal Surface Mining: Impacts Of Reclamation, Routledge; 1st edition, 2020.
4. Das, S.K., Surface Mining Technology, 3rd Edition, Lovely Prakashan, Dhanbad, 2020.
5. Hartman, H.L. (Ed.), SME Mining Engg. Handbook Vol. I and II, 3rd Edition , Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 2011.
6. Mishra G.B., Surface Mining, 2nd Edition, Lovely Prakashan Publishers, Dhanbad, 2006.
7. Ratan Raj Tatiya, Surface and Underground Excavations: Methods, Techniques and Equipment, CRC Press; 2nd edition, 2018.
8. Rzhevsky V., Open pit Mining Operations, Mir Publications, 1971.
9. Amitosh De, Heavy Earth Moving Machinery, Lovely Prakashan, Dhanbad, 2000.
10. Hustrulid, W. and Kuchta, M, Open Pit Mine Planning & Design, Vol. 1, Fundamentals, 3rd Edition, A.A.Balkema, Rotterdam, 2013.
11. Hustrulid, W. A., Mccarter, M. K., And Van Zyl, D. J. A., Ed., Slope Stability in Surface Mining, Littleton, 2000

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	2	2	2	2	3	3	2	2	3	2	2
2	2	2	0	0	2	2	1	2	2	2	2	3	2	1	3
3	2	3	3	0	1	2	2	2	2	2	2	2	2	2	2
4	2	0	1	3	2	2	1	2	0	2	2	0	2	1	2
5	2	2	2	2	2	0	1	0	2	2	2	2	2	2	2
AVG	2	1.8	1.6	1.4	1.8	1.6	1.4	1.6	1.8	2.2	2	1.8	2.2	1.6	2.2

MI23U01	STANDARDS - Mining Engineering	L	T	P	C
		1	0	0	1

MODULE I OVERVIEW OF STANDARDS 6

Basic concepts of standardization; Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization. Important Indian and International Standards.

MODULE II MINING RELATED STANDARDS 9

Mining Techniques and Equipment (MED 8) - Cage Suspension Gear for Winding in Mines, Skip Suspension Gear for Winding in Mines, Graphical symbol for use on detailed maps, plans and geological cross sections, Rotary Drill Bits for Drilling, hydraulic props, Mine tub couplings and drawbars, Man-Riding Cars, Diesel Locomotives, Technical Requirements for Loaders for use in Underground Mines, Haulage Rope Cappels, Mine haulage tracks, Rock Bolts for Mines, Winding in mines - Design of cages

Mechanical Vibration and Shock (MED 28) - Evaluation of Human Exposure to Whole Body Vibration, Mechanical Vibration and Shocks - Disturbance to Human Activity and Performance, Cranes, Lifting Chains and Related Equipment (MED 14) - Specification Electric Wire Rope Hoist, Lifting Appliances - Range of Maximum Capacities for Basic Models, Safe use of cranes.Wire Ropes and Wire Products (MED 10) - Code of practice for the selection, installation and maintenance of wire ropes, socketing of wire ropes, Small Wire Ropes, Guide and Rubbing Ropes, Locked Coil Winding Ropes.

Continuous Bulk Conveying, Elevating, Hoisting Aerial Ropeways and Related Equipment (MED 6) - Troughed Belt Conveyors, Aerial ropeways, Chain conveyors, Buckets for Bucket Elevators, practice for conveyor safety. Material Handling Systems and Equipment (MED 7) - terms and classification of earth moving machinery, Earth moving machinery - Operation, Volumetric rating and safety. Energy Management Sectional Committee (MED 39) - Energy Management Systems - Requirements with guidance for use. Environmental Assessment and Management of Water Resources Projects (WRD 24) - Glossary of technical terms related to environmental impact.

DGMS Standards on Measures to improve safety in mines: Legislative Measures - Inspection & Enquiries, Enquiry into Accidents, Dangerous Occurrences etc, Permission, Exemptions and Relaxations, Improvement Notices & Prohibitory Orders, Approval and Testing; Developmental Measures -Standard Setting, ILO Conventions; Conduct of Examinations and Award of Statutory certificates of Competency; Promotional initiatives - Conference on safety in mines, National Safety Awards (Mines), Vocational Training and Other Training, Observance of Safety Week, Safety Campaign etc, Holding Rescue Competitions etc, Promoting Participation of workers in safety management, Promoting Self-regulation by management; Technical Measures - Interactions & advisory role, Plan Schemes.
ISI Code on Drilling, Blasting, Loading and Hauling Operations in the Opencast and Underground Mines.

UC23U01 **UNIVERSAL HUMAN VALUES** **L T P C**

1 0 2 2

COURSE OBJECTIVE:

The objective of the course is four-fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Module I: Introduction **(3L,6P)**

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration– Its content and process; 'Natural acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Practical Session: *Include sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking*

Module II: Harmony in the Human Being **(3L,6P)**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Practical Session: *Include sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.*

Module III: Harmony in the Family and Society **(3L,6P)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals,

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practical Session*: Include sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives*

Module IV: Harmony in the Nature and Existence (3L,6P)

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

Practical Session: *Include sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.*

Module V: Implications of Harmony on Professional Ethics (3L,6P)

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

Practical Session: *Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.*

TOTAL: 45 (15 Lectures + 30 Practicals) PERIODS

COURSE OUTCOME:

By the end of the course, the students will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

REFERENCES:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews.
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

Web URLs:

1. Class preparations: https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	1	1	3			3
CO2						1	1	1	3			3
CO3						3	3	2	3		1	3
CO4						3	3	2	3		1	3
CO5						3	3	3	3		2	3

GY23C06	GEOLOGY LABORATORY-II & FIELD WORK FOR MINING ENGINEERING	L T P C 0 0 2 1

COURSE OBJECTIVES:

- To familiarize the students with identification of ores
- To teach ore reserve calculations
- To give field exposure in quarries / mines

UNIT I IDENTIFICATION OF ORES 6

Identification and description of various ores: iron ores, manganese ores, lead ores, zinc ores, copper ores, chrome ores and aluminum ores. Identification and description of Industrial minerals: minerals used in ceramic, refractory, abrasive, glass, fertilizer, paint, electric, fuel and gem industries.

UNIT II ENGINEERING GEOLOGY AND ORE RESERVE ESTIMATION 6

Preparation of weathering profile, RQD calculations, Ore reserve estimation problems, Demo for major laboratory instruments like Petrographic microscope, SEM, ICP-MS, IC, AAS, TOC, CHNSO etc.

UNIT III GEOPHYSICAL EXPLORATION 6

Electrical resistivity problems: Wenner and Schlumberger method problems; Seismic survey – reflection and refraction problems. Field demo using electrical resistivity imaging system.

UNIT IV GEOSPATIAL TECHNIQUES 6

Visual interpretation of aerial photographs and satellite imageries - 3-D from stereo pair aerial phots using Stereoscopes - Preparation of thematic maps from toposheets and satellite images. Basic applications of GIS software.

UNIT V GEOLOGICAL FIELD WORK 6

Identification of minerals, rocks and ores in the field site / quarries / mines - Recognition of geological structures in the field. GPS / DGPS demo in the field.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On completion of this practical course, students are expected to:

- Identify important ores and industrial minerals
- Compute ore reserve from the borehole data
- Solve geophysical problems
- Interpret satellite images and aerial photos
- Identify the mineral deposits in the field

REFERENCES:

1. Umeshwar Prasad, Economic Geology, second edition, CBS Publishers, 2010.
2. Gokhale,N. W., Manual of Geological maps CBS publishers, N. Delhi, 2008.
3. Lahee, F.H., Field Geology, CBS publishers, N. Delhi, 2002.
4. Bell F.G. Engineering Geology, Second edition Elsevier Publications, 2006
5. Wolf. P. R. Elements of Photogrammetry. Mc Graw Hill, Japan, 1993.
6. S N Pandey, Principles and Applications of Photogeology: New Age International (P) Ltd., New Delhi. 1988.
7. Dobrin, Geophysical prospecting, McGraw hill, New Delhi ,1981.
8. Chaussier, J.B., and Mores, J Mineral Prospecting manual, North Oxford Academic press,1987.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	2	1	2	3	1	1	1	2	2	2
2	3	1	2	1	2	-	2	-	3	1	2	1	2	1	2
3	3	2	3	3	1	1	2	2	3	1	-	1	2	2	2
4	3	3	1	3	3	2	1	1	3	1	2	1	2	1	2
5	3	3	3	1	2	-	2	-	3	1	2	1	2	2	2
Avg	3	2.4	2.4	2.2	2	1.67	1.6	1.67	3	1	1.75	1	2	1.6	2

MI23501 **MINING MACHINERY - II** **L T P C**

3 0 2 4

COURSE OBJECTIVES:

- To understand the functioning of winding engines and other winding accessories
- To study surface and pit bottom layouts, various coal face machinery
- To study the design and construction details of excavating & transporting equipments used in surface mines.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars being covered under this course.

UNIT I WINDING ENGINES **9**

Winding systems, drum winders, drives, mechanical and electrical braking of winders, safety devices in winding, over wind and over speed protection, Koepe and multi-rope friction winding, Duty cycles of drum winders of different drum cross sections

UNIT II WINDING ACCESSORIES AND LAYOUTS **9**

Head gear and their design, head sheave, cages and skips, suspension gear, shaft fittings and appliances – guides, keps, signaling system, winding calculations relating to rope size & numbers, capacity & power requirement for cage, skip in drum and Koepe winding systems. Surface and Pit-bottom layouts - skip winding – loading and discharge arrangements. railway sidings and layouts.

UNIT III COAL FACE MACHINERY **9**

Construction, salient mechanical and electrical features and operations of coal drills coal cutters, different types of mechanical loaders coal ploughs, cutter loaders and continuous miners; development road headers, longwall mining equipment, electrical and hydraulic layouts; condition monitoring of mining machinery for underground and surface mines

UNIT IV EXCAVATION AND LOADING MACHINERY IN SURFACE MINES **9**

Classification. Hydraulic systems. Design and Construction details of Front end loaders, hydraulic excavators and Electric Rope shovel, Dragline, Bucket Wheel Excavator. Bucket Chain Excavator and Surface Miners. Battery electric vehicles for sustainable development in mining - Technical & cost analysis.

UNIT V OTHER MACHINERY IN SURFACE MINES **9**

Classification of transport equipments; construction and technical specifications of Haul Dumpers, Dozers, Rippers, Motor Graders, Bull Dozers, Rock breakers, Road Compacters, Water Tankers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The students will be able

1. To learn the function of winding engines, winding accessories, pit-top and bottom mine circuits.
2. To know about working of various coal face machinery and understand the concept of underground transport system
3. To learn the application and features of cutting and mining machines
4. To enhance the knowledge on constructional features, operation, applicability and limitations of various excavating and loading equipments used in surface mines.
5. To obtain knowledge on the design & construction details of other prominent machinery including battery operated vehicles used for sustainable mining.

TEXT BOOKS:

1. Amitosh Dey, Heavy Earth Moving Machinery, Lovely Prakashan Publications, Dhanbad, 2000.
2. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.

REFERENCES:

1. Cherkassky, B.M., Pumps, Fans, Compressors, MIR Publishers, 1980.
2. Deshmukh, D.J., Elements of Mining Technology, Vol. I, II and III, EMDEEE Publishers, Nagpur, 1979.
3. Alemgren G., Kumar U., and Vagenas N., Mine Mechanisation and Automation, A.A., Balkema Publication, 1993.
4. Mason, E., Coal Mining Series, Surveying, Vol I and II Virtue and Company Limited, London, 1985.
5. Statham, I.C.F., Coal Mining, Vol. I, II, III and IV, Caxton Eastern Agencies, Calcutta.

PRACTICALS: 15 PERIODS

1. Study of head gear, fleet angle, shaft fittings, suspension gear, safety hooks, protective roofing, guides– methods of support and tensioning arrangements.
2. Construction of cages, skips with their fittings and brakes of winders & haulers
3. Study of different types of conveyors (components & safety devices) like armored face conveyors, belt conveyors, gate belt conveyors, shaker & vibrating conveyors, high angle conveyors
4. Study of rotary-percussive drill used in surface mines
5. Study of pit top & pit bottom layouts
6. Study of different types of loading machines
7. Study of coal plough and shearer.
8. Study of continuous miner and road headers.
9. Study of electric rope shovel and hydraulic excavators.
10. Study of Bucket Wheel Excavators and Draglines.
11. Study of Haul Trucks (Dumper).
12. Study of Dozers and Front-end Loaders.

TOTAL (45 + 15): 60 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	3	3	2	2	3	2	2	3	2	2
2	3	1	2	2	2	2	2	3	2	2	2	2	2	1	3
3	2	2	3	2	2	2	2	3	3	1	2	3	2	3	2
4	2	0	3	2	2	0	3	2	2	0	2	3	2	2	2
5	3	3	2	2	3	3	2	2	2	2	0	2	2	3	2
AVG	2.4	1.6	2.4	2	2.4	2	2.4	2.4	2.2	1.6	1.6	2.4	2.2	2.2	2.2

MI23502 UNDERGROUND MINING METHODS - COAL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the conventional and advance systematic coal extraction methods
- To study and update of the mine criteria as per various legislation of India.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

UNIT I INTRODUCTION 7

Global and national statusofcoalindustryandenergy demands, theories of coal formation, Indian coalfields and its reserves, factors affecting choice of mining methods, classification of coal mining methods, grading and analysis of coal.

UNIT II BORD AND PILLAR METHOD-DEVELOPMENT 9

Designanddevelopmentofadistrict / panel, sizes and shapes of galleries and pillars, bord and pillar, room and pillar methods, with conventional and continuous mining techniques with various equipment.

UNIT III BORD AND PILLAR METHOD – EXTRACTION 8

Pillarextractionbycavingandstowingmethods;mechanisedextractionofpillars,shaftpillarextraction, systematic supports, surface, underground and face arrangements for stowing, partial extraction.

UNIT IV LONGWALL METHOD 8

Advance and retreat methods, continuous and cyclic systems, extraction with different machines-ploughs, shearers, design of longwall workings, optimum length of face, size of panel, gates, support system, personnel, organisation and safety measures, salvaging and relocations of equipment, Punch longwall.

UNIT V SPECIAL METHODS OF WORKING 13

Problems of working thick&thin seams, multislices, sublevelcaving, horizonmining, gallery blasting method, contiguous seam working, working steeply inclined seams, working under surfaces tructures and seams liable to spontaneous heating, outburstandbumps, etc. Hydraulic mining, Wongawalli, shortwall, highwall mining, underground coal gasification, coal bed methane, shield mining. Support designing and various types of support.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Gain exposure on Global and National level demand of coal production and reserves availability
2. Acquire the scientific design skill on coal district development of Bord and Pillar method
3. Get the safety manner of planning skill on coal district depillaring of Bord and Pillar method
4. Gain the knowledge continuous and cyclic manner of coal extraction with different capacity and cutting-edge technology machineries

5. Explore the novel methods of coal winning in order to tackle the problems associated with thick and thin seams extraction methods.

TEXTBOOKS:

1. Singh, R.D. Principles and Practices of Modern Coal Mining, NewAge International (P) Ltd., Chennai, 1994.
2. Peng S.S., and Chiang,H.S., Longwall Mining, John Willey and Sons, NewYork,1992.

REFERENCES:

1. Singh,T.N.Singh,UndergroundWinningofCoal–Oxford&IBHPublishingCo.Ltd.,1992.
2. Mathur, S.P., Coal Mining in India, M.S. Enterprises, Bilaspur, 1999.
3. Das S.K., Modern Coal Mining technology, Lovely Prakashan, Dhanbad 1994.
4. Singh T.N., Dhar, B.B. Thick Seam Mining, Problems and Issues, Oxford &IBH Publishers, 1992.
5. Mathur, S.P., Mining Planning for Coal., M.G. Consultants, Bilaspur, 1993.
6. Szwilski and Richards M.J., Underground Mining Methods andTechnology, 1987..S

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	3	3	2	2	3	2	2	3	2	2
2	3	1	2	2	2	2	2	3	2	2	2	2	2	1	3
3	2	2	3	2	2	2	2	3	3	1	2	3	2	3	2
4	2	0	3	2	2	0	3	2	2	0	2	3	2	2	2
5	3	3	2	2	3	3	2	2	2	2	0	2	2	3	2
Avg	2.4	1.6	2.4	2	2.4	2	2.4	2.4	2.2	1.6	1.6	2.4	2.2	2.2	2.2

MI23503 ROCK MECHANICS AND GROUND CONTROL

L	T	P	C
3	0	2	4

OBJECTIVES:

- To study about application of Rock Mechanics in mining and allied engineering.
- To study Physico-Mechanical properties of rocks, non-destructive testing methods, time dependent properties of rock
- To study different types of underground supports, etc.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course**.**

UNIT I INTRODUCTION 9

Definition of some important terms used in rock mechanics, application of rock mechanics in mining, introduction to stress analysis, stresses in two and three dimensions~~, Mohr's circle~~.

UNIT II PHYSICAL AND MECHANICAL PROPERTIES OF ROCKS 9

Physical properties of rocks — density, porosity, moisture content, permeability, water absorption various indices of rocks like swell index, slake durability index, impact strength index, protodynakov index, etc., thermal conductivity, hardness, durability. Preparation of test specimens, laboratory determination of mechanical properties of rocks — compressive strength, tensile strength, flexural strength, shear and triaxial strength, modulus of elasticity, Poisson's ratio, Mohr's envelope, effect of various parameters on the strength of rocks, in-situ strength, post failure behaviour of rocks.

UNIT III NON-DESTRUCTIVE TESTING METHODS AND TIME DEPENDENT PROPERTIES OF ROCKS 9

Dynamic wave velocities, dynamic elastic constants, their determination in the laboratory, application in mining, time dependent properties of rocks, creep, mechanism of creep of rocks — different stages, rheological models.

UNIT IV ROCK MASS CLASSIFICATION 9

Introduction, TERZAGHI'S rock mass classification, Rock quality designation (RQD),Classification based on UCS, Geomechanics classification, Tunnelling qualityindex (Q), Rock structure rating (RSR), The geological strength index (GSI), Rock mass classification in support design.

UNIT V UNDERGROUND SUPPORTS 9

Various methods of roof examination, objectives and limitations of supports, ground forces and in situ stresses, pressure arch theory, evolution of supports , conventional supports — timber and steel supports, arches, yielding supports; rock and cable bolting, shotcreting, roof stitching, support of shaft bottoms, galleries, junctions and places of roof falls, freshly exposed roof supports, design of supports, longwall powered supports. Design of systematic support rules for B & P and longwall - development, depillaring, etc.

TOTAL : (45 + 15)60 PERIODS

PRACTICALS;

DETERMINATION OF

1. Moisture content of rock sample by ISRM standard method
2. Protodyaknov index of rocks.
3. Point load index strength of rocks
4. Porosity of rocks.
5. Uni-axial compressive strength of dry and water saturated rock samples.
6. Tensile strength of rock using Brazilian test method.
7. Shear strength of rocks.
8. Tri-axial strength of rock and drawing of Mohr's envelope.
9. Slake durability index of rocks.
10. Determination of longitudinal wave velocities of rocks using NDT.
11. Time dependent properties of rocks
12. Drillability index of rocks.
13. Young's Modulus of Elasticity and Poisson's ratio.
14. Determination of shear strength of soil
15. Determination of tri-axial strength of soil.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

1. The students will have fundamental knowledge on rock mechanics.
2. The students will have basic knowledge about physico- mechanical properties of rocks.
3. The students will obtain a adequate knowledge about mechanical properties of rock.
4. Enhance the knowledge in non-destructive tests and creep mechanisms.
5. The students will learn about different types of underground supports.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	3	2	2	2	3	2	2	3	2	2
2	3	1	2	2	2	2	2	3	2	2	2	2	2	1	3
3	2	2	3	1	2	2	2	3	2	1	2	3	2	3	2
4	2	0	3	2	2	0	3	2	2	0	2	3	2	2	2
5	3	3	2	2	3	3	2	2	2	2	0	2	2	3	2
Avg	2.4	1.6	2.4	1.8	2.4	2	2.2	2.4	2	1.6	1.6	2.4	2.2	2.2	2.2

MI23504 UNDERGROUND MINING METHODS - METAL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce concepts of metal mining and metal mining terminology.
- To study development and operations of metal mines.
- To study about special methods of metal mining methods.

UNIT I BASICS 9

Metal Mining Terminology; Typical modern metal mine features; exploration, estimation of block wise and mine wise reserves and actual production, typical pre-stoping ore block constructional features; classification of methods;

UNIT II GENERAL MINE DESIGN 9

Mode of mine and stope entry; Layouts; Determination of optimum production level; sequence of extraction, production scheduling; Basic design – Level Intervals, ore pass, common ore pass, size of blocks ore handling in stope and other openings, overview of constructional features – X cuts, Raises, Winzes etc.

UNIT III DEVELOPMENT OF STOPING 9

Techno economic characteristics impacting choice of method; Typical unit cost parameters; optimum size of mine and stope. Stope layout, design, equipment selection; Preparing a stoping block; sequence of stoping; organization; production cycle; unit cost calculation; comparison of various methods and costs

UNIT IV STOPING OPERTIONS 9

Unsupported methods – Stope and pillar, shrinkage, sublevel stoping etc. Supported stopes– Cut and fill, stull, square set etc. Caving methods – Top slicing, sublevel caving, block caving.Case studies of Indian and foreign underground metal mines. Comparison of various methods of stoping and costs.

UNIT V NOVEL INNOVATIVE TECHNIQUES & SPECIAL APPLICATIONS 9

Deep mining Problems; mining of narrow contiguous veins; shaft and remnant pillars extraction; Hydraulic mining, slurry mining, solution mining, Tunnel Boring Machine; Rapid excavation; Radial – axial splitter; Thermal fragmentation; shock wave breaking; VCR; Ring drilling; Large Blast hole stoping.

Note: All the above are to be studied with emphasis on MMR and the relevant circulars.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have basic concept on metal mining methods.
2. Enhance the knowledge on mine design, development and operations of metal mines.
3. The students will get basic knowledge about stoping techniques.
4. The students will understand the concepts of methods of stoping.
5. They will also know about novel methods of metal mining and its applications.

REFERENCES:

1. Cummings, A.B. and Given, I, V., SME Mining Engg. Handbook Vol. I And II, Society of Mining Engineers of American Institute Of Mining, Metallurgical, Petroleum EngineersInc., New York 2011.
2. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 2007.
3. Hustrulid, W.A., Underground Mining Methods Handbook Society of Mining Engineering, AMIE, New York, 1982.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	2	2	2	1	2	2	2	2	2
2	2	0	2	3	2	2	2	2	2	2	1	2	2	2	2
3	2	1	2	2	2	2	2	2	2	3	2	2	2	2	3
4	2	3	0	2	2	2	2	2	2	1	2	2	2	2	2
5	2	2	2	2	1	2	1	2	2	2	2	3	2	3	3
Avg	2	1.6	1.6	2.2	2	2	1.8	2	2	1.8	1.8	2.2	2	2.2	2.4

MI23U02 PERSPECTIVES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
2	0	2	3

MODULE I INTRODUCTION 6

Principles & Historical perspectives, Importance and need for sustainability in engineering and technology, impact and implications. United Nations Sustainability Development Goals (SDG), UN summit – Rio & outcome, Sustainability and development indicators.

MODULE II ENVIRONMENTAL SUSTAINABILITY 6

Climate change, Biodiversity loss, Pollution and waste management, Renewable vs. non-renewable resources, Water and energy conservation, Sustainable agriculture and forestry. National and international policies, Environmental regulations and compliance, Ecological Footprint Analysis

MODULE III SOCIAL & ECONOMIC SUSTAINABILITY 9

Equity and justice, Community development, Smart cities and sustainable infrastructure, Cultural heritage and sustainability, Ethical considerations in sustainable development.

Triple bottom line approach, Sustainable economic growth, Corporate social responsibility (CSR), Green marketing and sustainable product design, Circular economy and waste minimization, Green accounting and sustainability reporting.

MODULE IV SUSTAINABILITY IN MINING 9

Mining Value Chain; Environmental, social and economic sustainability framework, Tool kit for local & Community development and socio-economical assessment, Net Zero and decarbonisation in Mining industries; Health and Safety management in mining and energy resources industries; Circular economy for mining industry.

Case studies on sustainability assessment and reporting, sustainable mine closure and post-mining land use.

MODULE V SUSTAINABILITY PRACTICES IN MINING 30

- 'Best Mining Practices' in the areas of drilling, blasting, excavation, transportation, and green belt development for sustainability in surface mines.
- Explosives/Fuel/Chemical use and storage - the choice of Explosives/Fuel/Chemicals being procured, the safe disposal of leftover chemicals, the impact of chemicals on the environment and long-term health impacts on humans.
- Star rating system of Ministry Mines and Ministry of coal
- Tools for Sustainability - Environmental Management System (EMS), ISO14000, life cycle assessment (LCA)
- Tool kit for socio-economical assessment
- The carbon budget and implications for energy systems
- Carbon pricing approaches
- Greenhouse gas accounting in the context of material value chains
- Decarbonisation pathways and implications for mining and materials value chains
- Mining operations' energy and emissions intensity and drivers of sustainability in mining operations
- Digitalization and its impact at mine sites

- Energy efficiency – how to save energy (energy efficient equipment, energy saving behaviours).
- Ecological footprint assessment using the Global Footprint Network spreadsheet calculator
- National/Sub national Status of Sustainable Development Goals

TOTAL: 60 PERIODS

REFERENCES:

1. Allen, D., & Shonnard, D. R. (2011). Sustainable engineering: Concepts, design and case studies. Prentice Hall.
2. Munier, N. (2005). Introduction to sustainability (pp. 3558-6). Amsterdam, The Netherlands: Springer.
3. Blackburn, W. R. (2012). The sustainability handbook: The complete management guide to achieving social, economic and environmental responsibility. Routledge.
4. Clini, C., Musu, I., & Gullino, M. L. (2008). Sustainable development and environmental management. Published by Springer, PO Box, 17, 3300.
5. Bennett, M., James, P., & Klinkers, L. (Eds.). (2017). Sustainable measures: Evaluation and reporting of environmental and social performance. Routledge.
6. Seliger, G. (2012). Sustainable manufacturing for global value creation (pp. 3-8). Springer Berlin Heidelberg.
7. Stark, R., Seliger, G., & Bonvoisin, J. (2017). Sustainable manufacturing: Challenges, solutions and implementation perspectives. Springer Nature.
8. Davim, J. P. (Ed.). (2013). Sustainable manufacturing. John Wiley & Sons.

MI23505 **INDUSTRIAL TRAINING - I** **L T P C**

0 0 0 2

OBJECTIVES:

- To learn various unit operations carried out in the surface mine.
- To expose the basic operations of different heavy earth moving machinery (HEMM) deployed in the surface mine.
- To impart practical experience to the student for gaining deeper understanding of the various activities and principles related to the surface mining.

Gaining practical experience is an important aspect of the mining engineering programme having many characteristic features of its own. The students have to undergo training in surface coal mines/highly mechanized open pit mines/ Government Research Institutes (or) Scientifc Organisations under various Ministry **during the summer vacation at the end of the IV Semester for a period of 3 to 4 weeks** and obtain a valid certificate from the competent authority from the organization for the training undergone. The students have to submit a report on the practical training which would be evaluated during the ensuing V Semester. This carries a total of two credits during the V Semester. Evaluation would be done by a faculty or a group of faculties on different marking heads such as training, viva voce report etc., or other accepted evaluation systems as per the approved regulations.

Normally a student is not permitted to withdraw from the practical training. In case of any unforeseen circumstances / valid reasons if he could not undergo the training as scheduled, on the recommendation of the Head of the Department and approval by the competent authority the student may be permitted to undergo Practical Training-I subsequently without affecting the academic schedule before undergoing Practical Training-II. The decision of the competent authority is final.

OUTCOMES:

The students will be able to

1. Understand the geology of the deposit amenable for surface mining.
2. Learn the preparation of various plans and design of the surface mine.
3. Acquire adequate knowledge on bench geometry and other significant parameters associated with mine construction.
4. Comprehend the knowledge on working of various HEMM deployed for different unit operations in the surface mines.
5. Understand the methods of stockpiling, dumping and reclamation techniques, mine dewatering, processing facilities and safety aspects related to mining.`

MI23601 MINE ECONOMICS AND INVESTMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Study of estimation and valuation of mineral deposits.
- Study of project appraisal.
- Study of finance and accounting.

UNIT I INTRODUCTION 9

Mineral industry and its role in national economy; world and national mineral resources; Mining A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy.

UNIT II ORE RESERVE ESTIMATION 9

Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, introduction to geo-statistical methods, classification of reserves.

UNIT III MINE VALUATION 9

Time value of money; annuity; redemption of capital, net present value; depletion allowance; depreciation; inflation; escalation; rates of return; Hoskold's Two rate method; capital and operating cost including wages, incentives, material, etc.; assets; liabilities; cash flows and discounted cash flow – their implications in mine economic evaluation.

UNIT IV PROJECT APPRAISAL 9

Methods of project valuation–payback, annual value, benefit/ cost ratio, ARRandIRR, NPV, Profitability Index etc., Cost-Volume-Profit Analysis; evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; mine taxation; critical impact of depreciation depletion, type of funding, reserves, life, etc. on mine profitability

UNIT V FINANCE AND ACCOUNTING 9

Sources of mine funds–shares, debentures, fixed deposit, sinking fund, capital gearing, Trading Account. P& L account, balance-sheet, Income Statement, Cash flow and Funds low statement; typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will have knowledge on

1. Mine Economics
2. Reserve Estimation
3. Estimation and valuation of mineral deposits.
4. Project appraisal
5. Finance and accounting

TEXTBOOKS:

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Arogyaswamy,R.N.P.CoursesinMiningGeology,OxfordandIBHPublishingCo.,1994.
3. I M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018

REFERENCES:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO
   1992.
5. Indian MiningYear Book 1994 – MMRDAct and Mineral Concession Rules.
6. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8th edition, 2017
7. T.S. Reddy & A. Murthy, Financial Accounting, Margham Publications, 2014

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23602 **MINERAL PROCESSING** **L T P C**
3 0 2 4

AIM:

The students will possess the knowledge needed to design a mineral processing operation that ensures maximum profitability for a mining company while achieving the required product quality specifications.

COURSE OBJECTIVES:

- The students will possess the knowledge needed to design a mineral processing operation that ensures maximum profitability for a mining company while achieving the required product quality specifications.
- The students will understand the methodology used to select the appropriate unit operations, determine the optimum operating conditions and select the required size of the unit.
- The students will acquire adequate knowledge of tailing disposal and the preparation of flow sheet for a concentrator plant.

UNIT I INTRODUCTION 6

Scope, objectives, minerals/ores for mineral processing, methods of treatment, choice of methods, sequence of operations, product, flow sheets, ore sorting – hand mechanical, electronic, removal of harmful materials, ore transportation.

UNIT II COMMINUTION 10

Introduction to comminution, reduction ratio, primary/secondary/tertiary crushing, purpose, duty, theory of crushing, types of crushers and comparison, general crushing flow sheet, wet/dry grinding, mechanism and various affecting parameters. Power consumption for crushing & grinding.

UNIT III LABORATORY & INDUSTRIAL SIZING AND SAMPLING 9

Objectives of sizing and scale of sizing, factors governing particle behaviour, laboratory and industrial screens, trommels, vibrating screens, etc. wet and dry screening, classification and classifiers. Laboratory size analysis and interpretation. Metallurgical accounting and control - sampling and its significance, methods of sampling practiced in mills, automatic control in mineral processing.

UNIT IV CONCENTRATION TECHNIQUES 10

Newton's and Stoke's Laws of particle settlement, different concentration techniques-gravity, chemical froth flotation, wet & dry magnetic separation, electromagnetic, electro-static, amalgamation, heavy media, jigging, shaking tables, sluicing, spirals, thickeners, filtration, etc.; Colour based sorting of minerals – optical sorter; Coal washing and washability curves

UNIT V SPECIAL METHODS 10

Chemical extraction, cyanide process, leaching, use of ion exchange, solvent extraction, pilot plant studies on ores, tailing dams – mode of disposal, construction and design & other solid waste (other than overburden) management in mines; flow sheets for

coal and typical ores such as copper, aluminum, lead, zinc, gold, uranium, iron, limestone, magnesite and beach sand minerals with special reference to Indian deposits.

TOTAL: 45 PERIODS

PRACTICALS:

1. Study of grab sampling and different sample division techniques like coning and quartering, riffle sampling techniques, etc.
2. Determination of crushing characteristics of a given mineral sample using jaw crusher
3. Determination of the grinding characteristics of a given mineral sample using ball mill
4. Sieve analysis of a given sample and to calculate (a) percentage sample retained on screens (b) average size of sample material and (c) to plot sizing curves
5. Concentration of a given mineral sample using mineral jig
6. Concentration of a given mineral using Wilfley table
7. Concentration of a given mineral using froth flotation cell
8. Concentration of a given mineral using magnetic separator
9. Study of washability characteristic of a coal sample using float and sink test.
10. Study of flow sheets for various mineral concentration techniques.

TOTAL: 15 PERIODS
TOTAL (45 + 15): 60 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Know the basic principles of mineral processing.
2. Obtain adequate knowledge for the typical process circuits used to treat aggregates and ores containing one or more valuable minerals.
3. Comprehend the basic concepts on various separation/concentration techniques and special methods adopted to process the minerals.
4. Develop processing flow sheets for the production of aggregates and mineral concentrates from raw ore material.
5. Identify the suitable site and adequate area for constructing the tailing dams for storing the refuse coming out of a typical processing plant.

TEXT BOOKS:

1. Wills, B.A, Mineral Processing Technology, 8th edition, Butterworth Press, 2015, 512p.
2. Jain, S.K, Ore Dressing, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1986, 518p.

REFERENCES:

1. Gaudin, A.M, Principles of Mineral Dressing, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 2003.

2. Leonard, J. W. and Hardinge, B. C., Coal Preparation, Society for Mining, Metallurgy and Exploration, Inc., Littleton, 1991.
3. Maurice C. Fuerstenauand Kenneth N. Han (Editor), Principles of Mineral Processing, Society for Mining, Metallurgy, and Exploration, 573p, 2003.
4. Prayor, E.J, (1974), Mineral Processing, 3rd Edition, Applied Science Publishers, London, p.844.
5. Richards, R.H, Charles E. Locke, S.B and Schuhmann, R, (1953), Textbook of Ore Dressing, McGraw-Hill Book Company Inc, Newyork, p.608.
6. Taggert, A.F, Handbook of Mineral Dressing, Chapman and Hall, New York, 1945.
7. Vijayendra, H.G, Handbook on Mineral Dressing, Vikas Publishing House Pvt. Ltd., New Delhi, 2001.
8. Weiss, N. L., SME Mineral Processing Handbook, Volumes I &II, Society for Mining, Metallurgy and Exploration, Inc., Littleton, 1985.
9. Morrell S, Morrison R D & Kojovic T, Mineral Comminution Circuits: Their Operation and Optimisation. (Series: JKMRC Monograph Series in Mining and Mineral Processing No. 2). Series Editor, T J Napier-Munn, published by Julius Kruttschnitt Mineral Research Centre, University of Queensland, 1996.
10. Deepak Malhotra, Patrick Taylor, Erik Spiller, and Marc Lavier, Recent Advances in Mineral Processing Plant Design, S.M.E Publications, Colorado, USA, 2009.
11. Corby G. Anderson, Robert C. Dunne and John L. Uhrie, Mineral Processing and Extractive Metallurgy – 100 Years of Innovation,S.M.E Publications, Colorado, USA, 2009.

TOTAL (45 + 15): 60 PERIODS

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	2	2	2	1	2	2	2	2	2
2	2	0	2	3	2	2	2	2	2	2	1	2	2	2	2
3	2	1	2	2	2	2	2	2	2	3	2	2	2	2	3
4	2	3	0	2	2	2	2	2	2	1	2	2	2	2	2
5	2	2	2	2	1	2	1	2	2	2	2	3	2	3	3
AVG	2	1.6	1.6	2.2	2	2	1.8	2	2	1.8	1.8	2.2	2	2.2	2.4

UC23E01 ENGINEERING ENTREPRENEURSHIP DEVELOPMENT L T P C

2 0 2 3

COURSE OBJECTIVES:

1. Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2. Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

MODULE – I: ENTREPRENEURIAL MINDSET **4L,8P**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economies – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

MODULE – II: OPPORTUNITIES **4L,8P**

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

MODULE – III: PROTOTYPING & ITERATION **4L,8P**

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

MODULE – IV: BUSINESS MODELS & PITCHING **4L,8P**

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest Assumptions in Business Model Design – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

MODULE – V: ENTREPRENEURIAL ECOSYSTEM **4L,8P**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1: Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types

CO2: Comprehend the process of opportunity identification through design thinking, identify market potential and customers

CO3: Generate and develop creative ideas through ideation techniques

CO4: Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP

CO5: Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

REFERENCES:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition
2. Bill Aulet (2024). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons.
3. Bill Aulet (2017). Disciplined Entrepreneurship Workbook. John Wiley & Sons.

4. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
5. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch
6. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons
7. Marc Gruber & Sharon Tal (2019). Where to Play: 3 Steps for Discovering Your Most Valuable Market Opportunities. Pearson.

MI23603 ADVANCED ROCK BLASTING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To study the various properties of explosives for designing the blasts according to the field conditions.
- To monitor the ground vibration induced due to blasting & operation of HEMM.

LIST OF EXPERIMENTS:

1. Study of various blasting accessories
2. Measurement of ground vibration produced due to blasting by seismograph
3. Measurement of body vibration of HEMM used in the mines
4. Development of predictor equation from the recorded data
5. Measurement of VOD of Explosives and Detonating Fuse by VOD mate and its analysis
6. Measurement of fragmentation using various assessment tools
7. Measurement of Delay Interval of Pyrotechnic Delay Detonators by using Delay Timer
8. Design of blasts for underground mine
9. Design of blasts for bench blasting
10. To determine the inter-hole and inter-row delay in a surface mine blast by using Signature Hole Analysis.
11. Study of magazine constructed for storage of explosives and accessories

TOTAL: 60 PERIODS

OUTCOMES:

The student will be able

1. To understand the characteristics and applications of various explosives and accessories used in the mines.
2. To design the blasts in surface and underground mines
3. To monitor the environmental impacts produced due to blasting such as flyrock.
4. To monitor, measure and predict the blast-induced ground vibrations created in surface and underground mines.
5. To assess the fragmentation of blasted muck by using various tools and techniques

REFERENCES:

1. Bhandari,Sushil,EngineeringRockBlastingOperations,A.A.Balkema,Rotterdam, 1997.
2. Pradhan, G.K., and Sandhu, G.S., Manual of Rock Blasting, IME Publications, 1996.
3. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A.A.Balkema, Rotterdam, 1995.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	2	2	2	1	2	1	2	2	2
2	2	0	2	3	2	2	2	2	2	2	1	2	2	1	2
3	2	1	2	2	2	2	2	2	0	3	0	1	2	1	2
4	2	3	0	2	2	2	2	2	2	1	2	1	2	2	2
5	2	2	2	2	1	2	1	2	2	2	2	2	2	3	2
AVG	2	1.6	1.6	2.2	2	2	1.8	2	1.6	1.8	1.4	1.4	2	1.8	2

MI23604 **MINE SURVEY CAMP** **L T P C**
0 0 0 1

OBJECTIVE:

To learn survey practice adopted in underground mines in confined and restricted environment.

The course of mine surveying is sharply demarcated into general principles and surveying practices in mines. The subject of Surveying is applied in nature and is best learnt in an operating mine. This is done during the mine survey camp organized in an open pit or underground coal/metal mine or suitable place as part of the curriculum.

The students have to undergo the survey camp during the winter holidays at the end of the V semester or during the VI semester depending on the permission granted by the respective mining companies **for a period of 7 to 10 days** and submit a report which will be evaluated during the ensuing VI semester. This carries one credit in during VI semester. Evaluation would be done by one or more faculty of different aspects surveying in mines.

Normally a student is not permitted to withdraw from the survey camp. In case of any unforeseen circumstances / valid reasons if he / she could not undergo the survey camp as scheduled, on the recommendation of the Head of the Department and approval by the competent authority the student may be permitted to undergo survey camp along with subsequent batch(es) of students when organized. The decision of the competent authority is final in this regard.

OUTCOMES:

The students will be able to understand the difficulties of carrying out survey practice in the field.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	2	2	2	1	2	2	2	2	2
2	2	0	2	3	2	2	2	2	2	2	1	2	2	2	2
3	2	1	2	2	2	2	2	2	2	3	2	2	2	2	3
4	2	3	0	2	2	2	2	2	2	1	2	2	2	2	2
5	2	2	2	2	1	2	1	2	2	2	2	3	2	3	3
Avg	2	1.6	1.6	2.2	2	2	1.8	2	2	1.8	1.8	2.2	2	2.2	2.4

MI23701 MINE MANAGEMENT, LEGISLATION AND GENERAL SAFETY L T P C

3 1 0 4

COURSE OBJECTIVES:

- To study various acts, rules and regulations relating to the mineral industry
- To study accidents, diseases & their prevention and mine safety.
- To learn the safety management system being adopted in the mines.

UNIT I INTRODUCTION TO MINE MANAGEMENT AND LEGISLATION 10

Introduction to Mine Management – Scientific management, Personal management, Production management and Environmental management. General principles of mining laws, development of mining legislation of India. Overview of enactment of various statutes and Bye-laws.

UNIT II ACTS, RULES APPLICABLE TO MINING - I 18

Mines Act, 1952 and Regulations framed under Mines Act (The Coal Mines Regulations, 2017, The Metalliferous Mines Regulations, 1961, The Oil Mines Regulations, 1984, The Mines Rules, 1955, The Mines Vocational Training Rules, 1966, The Mines Rescue Rules, 1985, Bylaws, DGMS Circulars, standing orders (Except the ones which are collected in course Drilling & Blasting, Surface Mining, Mining Machinery I & II, Mine Environmental Engineering, Underground Mining methods (Coal & Metal).

UNIT III ACTS, RULES APPLICABLE TO MINING - II 16

General provisions of Mines and Minerals Regulation and Development Act, Coal mines (conservation and development) Act & Rules, Mineral Concession (Other than Hydrocarbon Energy Minerals) Rules, MCDR 2017, Mineral Auction Rules 2016, Mineral's (Evidence of Mineral Content) Rules 2015, Environmental Protection Act, EIA Notification 2006; Explosives Act 1884 & Rules 2008; The Indian electricity Act 1910 & Rules 1956, Offshore Area Mineral Development & Regulation Act, Rules 2002.

UNIT IV ACCIDENTS & RESCUE IN MINES 10

Classification of accidents, causes and prevention of accidents, accident enquiry reports, cost of accidents, Notified and occupational diseases and their social effects. Rescue and recovery – selection and training for rescue work.

UNIT V SAFETY & HEALTH IN MINES 6

Role of management, labour and government, Safety audit, instrumentation, Safety management system – risk identification and management; organization for disaster management in mines, safety conferences, Pit safety committee.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

The students will able

1. To provide an insight to various laws, rules and Acts related to Mines Safety and mining legislation applicable to the mineral industry.

2. To learn the procedures to obtain necessary permission from the regulatory agencies for opening, operation and closure of mines in respect of mine safety.
3. To analyze the accidents and prepare the accident enquiry reports
4. To understand the significance of mine diseases affecting the health of persons working in the mine.
5. To carry out the risk assessment, safety audit process and prepare the safety management plan for the mines.
6. To get prepared for the DGMS certification for qualifying in the exam of Mines Manager.

REFERENCES:

1. Mines Act 1952, Lovely Prakashan, Dhanbad, 1995.
2. Coal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.
3. Metal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.
4. DGMS Circulars, By National Council of Safety in Mines, Dhanbad, 1995.
5. Mines rules, 1955, Lovely Prakashan, Dhanbad, 1995.
6. The Mines Rescue Rules, 1986, Lovely Prakashan, Dhanbad, 1995.
7. The Indian Electricity Rules, 1995, Lovely Prakashan, Dhanbad, 1995.
8. The Payment of WagesAct, 1936, Ram NarainLalBeni Prasad, 1995.
9. VocationalTraining Rules, Lovely Prakashan, Dhanbad, 1995.
10. TheWorkmen'scompensationAct,1923,Ram Narainlal Beni Prasad, Allahabad, 1995.
11. Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	2	2	2	2	2	2	2	1	2	2	2
2	2	3	1	1	3	3	3	3	2	2	2	2	2	2	2
3	2	2	2	0	3	3	2	2	3	2	2	2	2	1	1
4	2	1	2	2	2	2	2	2	0	2	1	0	2	2	1
5	2	2	2	2	2	1	2	1	2	2	2	2	2	3	2
Avg	2	2	2	1.4	2.4	2.2	2.2	2	1.8	2	1.8	1.4	2	2	1.6

MI23702	MINE DIGITALIZATION AND AUTOMATION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- This course aims to create a workforce with skills of machine learning, and simulation that can handle the unforeseen changes in the mining industry
- landscape brought about by technology and climate change.
- This course will go through the entire asset lifecycle to emphasize where digitalization has taken place, how has it been achieved and what have been the benefits in terms of maximized production, increase asset reliability, and improve workforce safety etc.
- This course will cover different automation techniques including virtual reality applicable to mining systems for the betterment productivity and safety in today's competitive world. The Students will understand the concepts and purpose of Digitalization in the mining industry

UNIT I INTRODUCTION TO DIGITALIZATION IN MINING 9

Introduction to digitization and digitalization in mining industry; Cyber physical systems; Industry 4.0; Industrial IoT architecture; Integration of digital technologies into the mining processes and operations such as exploration, excavation and logistics.

UNIT II INTELLIGENT LEARNING TECHNIQUES 9

Fundamentals of support vector machines, random forest, clustering and classification, text analysis, etc. ML models to solve mining related problems such as prediction of spontaneous combustion, pillar stability, rockburst, flyrock etc.

UNIT III DATA VISULIZATION AND VIRTUAL REALITY APPLICATIONS 9

Data Visualization using Tableau Converting raw data to insightful diagrams and charts to make informative decisions. Visual representation of mining company's key performance indicators (KPIs) Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations.

UNIT IV DEEP LEARNING MODELS AND ROBOTICS IN MINING 9

Types and their applications in mining processes; Predictive maintenance of mining HEMM; Image analysis for safety inspection & rescue support Fleet Management System: TDS, CMMS, ERP for Mining Industry; Mining Remote Operations & Control: Robotics & Armchair Mining; Use of robotics in mining for production and disaster management purpose.

UNIT V BASIC ELEMENTS OF AN AUTOMATION IN MINING 9

Automation in Production System, Principles and Strategies of Automation, Autonomous mining systems - Operations Centre, Autonomous haulage systems, Automation of drilling and drill rig, drilling process. Automation of underground loading and transportation systems. Automation in tunnelling projects. Automation in monitoring of environments in longwall and continuous mining system, Automation of transportation system in surface mining.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will:

1. The students will understand about the significance of digital technologies and their applications in the mining industry
2. The students will be able to apply digital technologies to solve real-world problems in mining, think critically and creatively, and continuously adapt to new and emerging technologies.
3. The students will be able to identify and develop business opportunities in current mining scenario and utilizing digital technologies come up with solutions
4. The students will be aware about the comprehensive overview of state of the art mining automation used in mining industries including virtual platform for safe mine operations
5. The students will learn automation system in material transport and handling.

TEXT BOOKS:

1. Applications of Artificial Intelligence in Mining, Geotechnical and Geoengineering, 1st Edition - November 1, 2023, Editors: Hoang Nguyen, Xuan Nam Bui, Nasser Khalili, Yosoon Choi, Wengang Zhang, Jian Zhou
2. Advanced Analytics in Mining Engineering, Editors: Leverage Advanced Analytics in Mining Industry to Make Better Business Decisions, Ali Soofastaei, Edition 2022
3. G. Almgren, U. Kumar, N. Vagenas : Mine Mechanization & Automation 1st Edition

REFERENCE BOOKS:

1. Introduction to Data Mining 2e Paperback -: Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, 2e - 30 May 2021
2. Develop machine learning and deep learning models with Python – Sebastian Raschka , Yuxi (Hayden) Liu, 23 December 2022
3. J. O'Shea M. Polis : Automation in Mining, Mineral and Metal Processing (1st Edition), Proceedings of The 3Rd Ifac Symposium, Montreal, Canada 18-20 August 1980
4. Peter V. Golde : Implementation of Drill Teleoperation in Mine Automation

Software Required: Power BI (2.116. 404.0)**, Python** (3.11. 0), **MATLAB** (2022a)

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23703 **MINE ENVIRONMENTAL ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study about spontaneous heating, mine fires, inundation and explosions
- To study about mine rescue and first aid

UNIT I SPONTANEOUS HEATING AND MINE FIRES 9

Causes, detection and precautions against spontaneous heating in underground and surface coal mines including coal benches, surface coal stocks, and dumps. Incubation period of coal. Detection, prevention and control of underground fires. Study of atmosphere behind sealed- off fire areas for reopening, methods of reopening sealed off fire areas. Methods of fighting fires.

UNIT II EXPLOSIONS 9

Causes, prevention and control of underground fire-damp and coal dust explosions Methods of controlling coal dust explosions like stone dusting, stone dust barriers, water barriers and triggered barriers, investigation after an explosion.

UNIT III INUNDATION 9

Surface and underground inundation, their causes and preventive measures, precautions to be taken while approaching old waterlogged workings, design and construction of water dams and barriers, recovery of flooded mines, dewatering of old workings, layout of drainage systems and sumps. Safety boring apparatus- construction and usage.

UNIT IV MINE RESCUE AND FIRST AID SAFETY 9

Classification of rescue apparatus various types of rescue and escape apparatus, rescue organization of a mining company, layout of a modern rescue station including personnel, first aid to the persons injured in mine-accidents like electric shock, asphyxiation and other accidents. Different methods of artificial respiration. Rescue and recovery work in mines including rescue through boreholes, Mine rescue rules; 1985 Miner's diseases and their social and economic impact.

UNIT V MINE ILLUMINATION 9

Electric safety lamps, their construction usage and maintenance, lamp room design and organization, lighting on mine roadways, mechanised Longwall faces and gassy mines, Physics of illumination, photometry and illumination survey, legislations related to illumination survey.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will have knowledge on spontaneous heating, mine fires, etc.
2. The students will learn about explosions, their causes prevention and control measures.
3. The students will get knowledge about mine inundation, their causes and preventive measures.
4. They will know about mine rescue and first aid.

5. Obtain adequate knowledge about mine illumination.

TEXT BOOKS:

1. Ramlu, M.A., Mines Fires, Explosion, Rescue, Recovery and Inundations, Mukhertu Publishers, Kharagpur, 1989.
2. Ramlu, M.A., Mine Disasters and Mine Rescue, Oxford and IBH Publishers, 1991.

REFERENCES:

1. Misra, G.B., Mine Environment and Ventilation, Oxford University Press, 1993.
2. The Mine Rescue Rules, 1985, Lovely Prakashan, Dhanbad, 1992.
3. Sarkar, S.K. and Sarkar, S., State of Environment and Development in Indian Coalfields, Oxford and IBH, 1996.
4. Classified Circulars by D.G.M.S., Dhanbad.
5. Kaku, L.C. Fires in Coal Mines.
6. McPherson, M.J., Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993.
7. Thakur, Pramod - Advanced mine ventilation_ respirable coal dust, combustible gas and mine fire control- Woodhead Publishing, 2019

PRACTICAL:

1. Determination of air borne dust by gravimetric dust sampler, personal dust sampler and high volume sampler.
2. Noise survey.
3. Determination of crossing point temperature and index of inflammability.
4. Study of self rescuers.
5. Study of self contained breathing apparatus
6. Proximate analysis of coal
7. Measurement of vibrations due to various sources.
8. Illumination survey.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

IE23C08	PROJECT MANAGEMENT	L T P C
		3 0 0 3

COURSE OBJECTIVES:

1. To understand the complete structure of project management and select the most desirable projects.
2. To identify the resources needed for each stage, including involved stakeholders, tools and supplementary material.
3. To describe the time needed to successfully complete a project, considering factors such as task dependencies and task lengths.
4. To analyse the project and provide internal stakeholders with information regarding project and project control.
5. To develop a project scope while considering factors such as customer requirements and internal/external goals

UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9

Objectives of Project Management- Importance of Project Management- Types of Projects Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility- Steps in feasibility study. Analytical skills - Benefit analysis techniques - Elements of a project charter - Estimation tools and techniques -Strategic management.

UNIT II PROJECT PLANNING 9

Change management planning - Cost management planning - Project budgeting tools and techniques - Communications planning - Contract types and selection criteria - Estimation tools and techniques - Human resource planning - Lean and efficiency principles - Procurement planning - Requirements gathering planning - Scope deconstruction tools and techniques (WBS, Scope backlog) - Scope management planning - Stakeholder management planning -Time management planning, including scheduling tools and techniques - Workflow diagramming techniques.

UNIT III PROJECT IMPLEMENTATION 9

Continuous improvement processes -Contract management techniques - Elements of a statement of work - Interdependencies with project elements - Project budgeting tools and techniques - Quality standard tools - Vendor management techniques - Basic Scheduling Concepts - Resource Levelling – Resource Allocation.

UNIT IV PROJECT MONITORING AND CONTROL 9

Performance management and tracking techniques (EV, PERT, CPM, Trend Analysis) - Process analysis techniques (Lean, Kanban, Six Sigma) - Project control thresholds and tolerance - Project

finance principles - Project monitoring tools and techniques - Project quality best practices and standards (BS, CMMI, IEEE, ISO) - Risk identification and analysis techniques -Quality validation and verification techniques.

UNIT V PROJECT CLOSURE **9**

Archiving practices and statutes – Compliance - Contract closure requirements - Closeout procedures - Feedback techniques - Performance measurement techniques (KPI, key success factors) - Project review techniques - Transition planning technique. Scrum and Agile Management – Critical success factors for IT Projects – Case Studies.

TOTAL:45PERIODS

COURSE OUTCOMES:

The students will be able to

CO1. Evaluate and select the most desirable projects.

CO2. Create appropriate approaches to plan a new project.

CO3. Develop appropriate methodologies to develop a project schedule.

CO4. Practice new techniques to monitor and control the project.

CO5. Identify important risks facing a new project.

TEXT BOOKS:

1. Project Management Institute, “PMBOK Guide”, Seventh Edition.
2. Arun Kanda, “Project Management A Life Cycle Approach”, Prentice Hall of India, 2011.

REFERENCES:

1. Panneerselvam R and Senthilkumar P, “Project Management”, Prentice Hall of India, 2009.
2. Khanna R B, “Project Management”, Prentice Hall of India, 2011
3. Harald Kezner, “Project Management Case Studies” 5th Edition, Wiley, 2017.

CO's - PO's & PSO's MAPPING

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	2		1		1	1	-	-	1	-	3	-
2	1	2	1	1		2		1	-	-	1	-	3	-
3	1	2	-	1	1	1	2	-	-	-	1	-	3	-
4	1	1	3	-	1	2	-	-	-	-	1	-	3	-
5	1	1	1	1		2	-	-	-	-	1	-	3	-
Avg.	1	1	1	1	1	2	2	1	-	-	1	-	3	-

MI23704	COMPREHENSION	L T P C
		0 0 2 1

OBJECTIVE:

To sharpen the knowledge and clarify the ideas acquired by the students during the degree programme.

One of the most important requirements from mining engineering programmes is to develop a comprehensive understanding of Mining Engineering principles such that after graduation they have skills to plan, design, implement and manage both surface and underground mines.

The students work in groups and solve a variety of field-related mining problems given to them. The problems given to the students are in the form of quiz, lectures, test and group discussion.

Effective comprehension instruction is instruction that helps students to become independent, strategic, and metacognitive professionals who are able to develop, control, and use a variety of comprehension strategies to ensure that they carry out the work systematically.

MI23705 **INDUSTRIAL TRAINING - II** **L T P C**
0 0 0 2

OBJECTIVES:

- To learn various unit operations carried out in an underground mine.
- To expose the basic operations of various equipment deployed in the underground mine.
- To impart practical experience to the student for gaining deeper understanding of the various activities and principles of underground mining.

Gaining practical experience is an important aspect of the mining engineering programme having many characteristic features of its own. The students have to undergo training in underground coal or metal mines/allied industry/ Government Research Institutes (or) Scientifc Organisations under various Ministry **during the summer vacation at the end of the VI Semester for a period of 3 to 4 weeks** and obtain a valid certificate from the competent authority of the organization provide training. The students have to submit a report on the training which would be evaluated during the ensuing VII Semester. This carries a total of one credit during the VII Semester. Evaluation would be done by a faculty or a group of faculties on different marking heads such as training, viva voce report etc., or other approved evaluation systems.
Normally a student is not permitted to withdraw from the practical training. In case of any unforeseen circumstances / valid reasons if he could not undergo the training as scheduled, on the recommendation of the Head of the Department and approval by the competent authority the student may be permitted to undergo Practical Training-II subsequently without affecting the academic schedule. The decision of the competent authority is final.

OUTCOMES:

The students will be able to

1. Understand the geology of the deposit amenable for underground mining.
2. Understand the site selection and method for assessing the deposit (shaft/incline/adit).
3. Acquire adequate knowledge on mine development, ground control and other significant parameters associated with mine construction.
4. Comprehend the knowledge on working of various equipment deployed for different unit operations in the underground mines along with its safety aspects.
5. Understand the methods of stockpiling and transportation techniques, mine dewatering, mineral handling/processing facilities.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	2	2	2	1	2	2	2	2	2
2	2	0	2	3	2	2	2	2	2	2	1	2	2	2	2
3	2	1	2	2	2	2	2	2	2	3	2	2	2	2	3
4	2	3	0	2	2	2	2	2	2	1	2	2	2	2	2
5	2	2	2	2	1	2	1	2	2	2	2	3	2	3	3
AVG	2	1.6	1.6	2.2	2	2	1.8	2	2	1.8	1.8	2.2	2	2.2	2.4

MI23801	PROJECT WORK / INTERNSHIP WITH PROJECT WORK	L T P C 0 0 16 8

OBJECTIVE:

To carry out a study or to solve a practical problem of the mining industry

The Project may consist of design and fabrication, working models, software development / application, field studies on unit operations in the mines & industrial plants and innovative solutions / strategies for the field oriented issues in mines, etc. **The project work involving entirely theoretical studies alone will not be accepted.** .

The progress of the project is evaluated based on minimum of three reviews. The review committee may be constituted by the Head of the Department to monitor the progress of the project.

A project report is required to be submitted at the end of the semester. The project work is evaluated jointly by team of external and internal examiners constituted by the Head of the Department with approval of Chairman based on oral presentation and the project report.

OUTCOME:

1. The students will be able to carry out a project and write a report related to mining or allied field of engineering.

GY23C08 **APPLIED ROCK ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Introducing the various instrumentation and measurement methods.
- To study the theories of failure and approaches used for open pit and underground designs.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

UNIT I ROCK MECHANICS INSTRUMENTATION 6

Convergence indicators, load cells, strain gauges, flat jacks, LVDT, dial gauges, pressure cells and recorder, anchorage testing equipment, laboratory and in situ measurements, hydraulic fracturing rock mechanics instrumentation for B & P and longwall workings

UNIT II PIT SLOPE STABILITY& SUBSIDENCE 10

Approach to slope stability, slope parameters, different types of slope failures, factors affecting slope stability, introduction to methods of failure, analysis, determination of factor of safety,. Introduction to different rock slope stabilsation techniques.

Theories of subsidence, factors affecting subsidence, subsidence surveys, subsidence prediction techniques, subsidence control – surface and underground measures, pseudo-mining damage.

UNIT III THEORIES OF FAILURE OF ROCKS & PILLAR DESIGN AND ROCK BURST 12

Different theories of failure of rocks, modes of failure - Griffith, Coulumb-Navier, Mohr's, Hoek- Brown, empirical criteria, etc. and their field of applications.

Strength of pillars, barrier and shaft pillar design – load estimation, factor of safety, various formulae, rock burst and bumps — phenomena, causes, prediction, monitoring and control, gas outbursts

UNIT IV DESIGN OFUNDERGROUND WORKINGS 9

Stress distribution in underground workings including bord and pillar and longwall workings, rock load assessment, introduction to numerical methods of geomechanics; scaled model studies – principles of modeling.

UNIT V STOWING/FILLING 8

Selection and preparation of stowing materials, principal methods of stowing, collection, fields of application and limitations, preparation and transport of materials, surface, underground and face arrangements, design of stowing plants.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will have knowledge on rock mechanics instrumentation.
2. The students will learn about pit slope stability, theories of subsidence.
3. The students will understand the theories of failure of rocks, rock burst and pillar design.

4. They will also know about design of underground openings and numerical methods of Geo mechanics.
5. The students will learn about methods of stowing.

TEXT BOOKS:

1. Obert,L.andDuvall,W.I.,RockMechanicsandDesignofStructureinRockJohnWiley and Sons Inc., New York, 1967.
2. Vutukuri, V.S. and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol.I, II, III and IV, Transtech Publication Berlin,1974/78.

REFERENCES:

1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience,1985.
2. Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London,1980.
3. Peng, S.S. Ground Control, Wiley Interscience, New York,1987.
4. Jumkis, A.R. Rock Mechanics, Transtech Publications, Berlin, 1983.
5. Stacey,T.R.andPage,C.H.,PracticalHandbookforUndergroundRockMechanics Transtech Publications, Berlin, 1986.
6. Whittaker, B.N. and Reddish, D.J., Subsidence – Occurrence, Prediction and Control – Elsevier Science Publishers, the Netherlands,1989.

CO-PO & PSO MAPPING

CO	PO												**PSO**		
	1	**2**	**3**	4	5	6	7	8	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23001 **SUBSIDENCE ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know the basic subsidence mechanics and its influencing parameters
- To study the control measures of subsidence and its impact on structure

UNITI INTRODUCTION **9**

Strata movement at the mining horizon, convergence in mine working, factors influencing convergence in mine workings.

UNIT II SUBSIDENCE MECHANISM **9**

Zones of movement in the overlying beds, vertical and horizontal movement, subsidence trough, angle of draw, angle of break, sub-surface subsidence.

UNIT III SUBSIDENCE PREDICTION **9**

Different methods of surface subsidence prediction – graphical, analytical, profile function, empirical and theoretical models.

UNIT IV TIME INFLUENCE AND IMPACTON STRUCTURES **9**

Influence of time on subsidence, example from longwall and bord and pillar workings.

Calculation of ground movement over time. Types of stress on structures, stress-strain behaviour of soils, mining damage to buildings, industrial installations, railway lines, pipes, canals, etc.

UNIT V SUBSIDENCE CONTROL, GOVERNING LAWSANDSTANDARDS **9**

Measures to reduce mining damage, mining methods to minimize damage, laws governing mining damage, different standards suggested for mining and building ground in respect of subsidence.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will understand the basic concepts of strata movement, convergence, etc.
2. The students will have knowledge about the subsidence mechanism.
3. The students will learn about subsidence prediction and influencing parameters.
4. The students will obtain a knowledge about influence of time and subsidence impacts on structures.
5. They will know about subsidence control, governing norms and regulations.

TEXT BOOKS:

1 Kratzsch, H., Mining Subsidence Engineering, Springer Verlag Publications, Berlin,1983
2 Singh, B. (Ed)., Mine Subsidence, Parijat Mudranalaya Publications, Dhanbad,1982.

REFERENCES:

1. Whittaker, B.N., and Reddish, D.J. Subsidence, Occurrence, Prediction and Control, Elsvier Publications, Amsterdam, 1989.
2. Brauner, G., Subsidence Due to Underground Mining, Part I, II and III, U.S. Department of Interior, Bureau of Mines,1973.
3. Peng, S., Surface Subsidence Engineering, SME, New York,1992

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23002 ROCK REINFORCEMENT ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the rockmass classification and mechanism of rockreinforcement
- To learn the typical and special methods of rockreinforcement

UNIT I ROCKMASS CLASSIFICATION 12

Basic concepts of rockmass classification; Rock Quality Designation (RQD); Norwegian Geomechanics Classification i.e. Q-system; Rock Mass Rating (RMR); CMRI system; Application of rockmass classification in assessing the support requirement for underground caverns.

UNIT II GROUTING, GUNITING AND SHOTCRETING 6

Mechanisms of rock reinforcement by grouting; selection of optimum pressure and water-cement ratio for grouting; layout for grouting, working principle and field of application for grouting; Guniting and shotcreting operations and their field of application; fibre reinforced shotcreting.

UNIT III ROCK BOLTS 10

Elements of rock bolts; types of rock bolts and their fields of application; rock bolting machines and installation of rock bolts; pre-tensioning of rock bolts; principles of rock bolting; anchorage test and factors affecting anchorage strength of bolts; modes of failure; Design of rock bolting system for underground excavation i.e. determination of bolt length and bolt pattern.

UNIT IV CABLE BOLTS ANDROCKANCHORS 8

Classification of cable bolts; installation and testing; modes of failure; different type of grouting materials; types of anchors; use of anchors for stabilising rock slope, dam etc. ; testing of anchors.

UNIT V SPECIAL METHODS OF ROCK REINFORCEMENT 9

Ground freezing for slope stabilisation; berms for slope stabilisation; fore-poling; resin grouted rock bolts of fibre glass; geo-textiles and it's area of application; water drainage and rock reinforcement; dump stabilisation by vegetation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have the concept about the rockmass classification.
2. The students will learn about mechanism of rock reinforcement, grouting, etc.
3. The students will get a basic knowledge on rock bolts and their applications.
4. The students will learn about cable bolts and rock anchors.
5. The students will know about special methods of rock reinforcement.

TEXTBOOKS:

1 Schach, R., Garshael, K. and Heltzen, A. M., Rock Bolting – A Practical Handbook, Pergamon Press,1979.

2 Peng, S.S. Ground Control, Wiley Interscience, New York,1987

REFERENCES:

1 Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience,1985.

2 Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23003	ROCK SLOPE ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic mechanics of rock slope failures
- To learn the types of rock failure and its influencing parameters

UNIT I BASIC MECHANICS OF ROCK SLOPE FAILURE 8

Rock slope economics; continuum mechanics approach to slope stability; slope parameters; effect of water pressure; factor of safety of slopes; slope height vs slope angle; design of slopes.

UNIT II GEOLOGICAL AND ROCK STRENGTH PROPERTIES 12

Geological parameters affecting slope stability; graphical representation of geological data; plotting and analysis of field measurements; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.

UNIT III PLANE FAILURE AND WEDGE FAILURE 10

Plane failure analysis; graphical analysis of stability; influence of ground water on stability; influence of tension crack; analysis of failure on a rough plane; rock reinforcement of slopes; Analysis of wedge failure; wedge analysis including cohesion and water pressure; Wedge stability charts for friction only; case studies. Numerical problems.

UNIT IV CIRCULAR AND TOPPLING FAILURE 10

Conditions for circular failure; derivation of circular failure analysis; effect of ground water; circular failure charts; Bishop's and Janbu's methods of failure analysis; case studies. Types of toppling failure; secondary toppling modes; analysis of toppling failure; limit equilibrium analysis of toppling failures; Influence of slope curvature on stability; slope depressurisation; protection of slopes; control of rock falls; measurement and monitoring and interpretation of slope displacements. Numerical problems.

UNIT V ROCK SLOPE FAILURE MONITORING AND SLOPE STABILIZATION 5

Types of slope movement, Surface and Sub-surface monitoring methods including instrumentation and techniques & Guidelines for monitoring programs. Causes of rock falls; Rock slope stabilization programs – stabilization by rock reinforcement & rock removal; protection measures against rock falls.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters.
2. The students will know about parameters affecting rock slope stability.
3. The students will have adequate knowledge on plane and wedge failure.
4. The students will have enhanced knowledge on circular and toppling failure.

5. They will also know about techniques & Guidelines for monitoring programs.

TEXT BOOKS:

1. Duncan C.Wylie and ChristopherW. Mah, Rock Slope Engineering, 4th Edition, CRC Press, 456p, 2004.
2. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.

REFERENCES:

1. John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1st Edition, CRC Press, 510p, 2009.
2. William A. Hustrulid (Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Slope stability in Surface Mining, Society for Mining, Metallurgy, and Exploration, 442p, 2001.
3. John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4th Edition, Wiley-Blackwell; 4 edition, 488p, 2007.
4. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989.
   Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction, A.A. Balkema, Netherlands, 2006

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23004	ROCK EXCAVATION ENGINEERING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the rock mechanics, rock cutting technology.
- To learn about the rock cutting tools and rock excavating machine.

UNIT I INTRODUCTION 9

Concepts, historical developments in rock excavation systems, factors affecting the rock fragmentation, mechanism of rock breakage and fracture; their application to rock fragmentation methods– explosive action, cutting, ripping and impacts.

UNIT II ROCK PROPERTIES 9

Rock properties related to excavation process; application of compressive, tensile and tri- axial strengths, index tests and abrasivity, anisotropy, elasticity, porosity, laminations, bedding and jointing in rock fragmentation process.

UNIT III ROCK CUTTING TECHNOLOGY 9

Mechanism of drilling – rotary, percussive, rotary percussive, mechanics of rock cutting, theory of single tool rock cutting, crack initiation and propagation, breakage pattern, rock excavation by cutting action – picks, discs, roller cutters, water jet cutting, methods of evaluation of drillability and cuttability index of rocks.

UNIT IV ROCK CUTTING TOOLS 9

Rock cutting tool materials, different types, relative applications and their choice, tool shape and size, specific energy consumption, tool wear, effect of operational parameters on tool performance, maintenance and replacement of cutting tools of excavating machines.

UNIT V ROCK EXCAVATING MACHINES 9

Excavating machines, principles, operation, applicability and technical indices of road headers, TBM'S coalface machines and bucket wheel excavators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have basic knowledge about factors affecting rock fragmentation, breakage and fracture.
2. The students will have knowledge about mechanism of rock excavation process, influences of rock properties in excavation, etc.
3. The students will learn about rock cutting technology and mechanics of rock cutting, etc.
4. The students will get adequate knowledge about rock cutting tool materials, different types, relative applications, etc.
5. They will also learn about the different types of excavating machines.

TEXT BOOKS:

1. Hartman,H.L.,IntroductoryMiningEngineering,JohnWileyandSons,NewYork,1987.
2. Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York,1987

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23005 DRILLING AND BLASTING ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the principles and mechanism of different drilling methods, novel drilling techniques.
- To learn the basic mechanism of rock fragmentation by blasting
- To know the various types of explosives and accessories used in the blasting operation
- To learn the different methods of blasting adopted in surface and underground coal / noncoal mines.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars being covered under this course.

UNIT I EXPLORATION AND PRODUCTION DRILLING 11

Exploratory drilling – drills, core recovery and Interpretation of borehole data; Production drilling; Operating variables; Various methods of drilling - percussive, rotary, rotary percussive; mechanics of different methods of drilling; Down-the-hole drilling & Top hammer drilling; Inclined Drilling; Factors affecting drilling & drillability studies - micro-bit drilling; selection of drilling equipment; different types of bit & selection of drill bits; bits wear; Introduction to novel and special drilling techniques.

UNIT II EXPLOSIVES, ACCESSORIES AND TOOLS 9

Various type of explosives and Blasting Agents - ANFO, slurry, emulsion, permitted explosives and their development; Bulk explosives; Selection of explosives; Initiation systems, Blasting accessories, Storage, transportation and handling of explosives; Destruction of explosives and accessories. Mechanics of rock fragmentation by explosive action.

UNIT III BLASTING IN UNDERGROUND MINES 7

Blasting techniques for coal and metal Underground mines – VCR, gallery blasting, solid blasting and its evaluation. Drilling pattern for tunneling and shaft sinking; smooth blasting techniques. Blasting in underground coal mining – Present status & future trends.

UNIT IV BLAST DESIGN IN SURFACE MINES 8

Methods of blasting in surface mines - Primary and secondary blasting, Blast design for surface mines; Alternatives to blasting; Rock fragmentation studies, Controlled blasting techniques.

UNIT V ADVERSE EFFECTS OF BLASTING AND INSTRUMENTATION 10

Dangers associated with blasting in opencast mines and underground mines – misfires, blown out shots, incomplete detonation; Environmental impacts due to blasting - fly rock, ground vibrations, air blast and air & water pollution and its controlling measures; Introduction to instrumentation in blasting –V.O.D probe, vibration monitoring, high speed video camera, etc; Introduction to blasting concepts related to road constructions, trench cutting, demolition of buildings, dimensional stone quarries, underwater blasting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will able to

1. Understand the principles and basic mechanism of different drilling methods and novel drilling techniques.
2. Select the suitable explosives and accessories in mining and construction projects.
3. Design the blasting pattern for surface mines, dimensional stones, road constructions and underground mines.
4. Use modern tools for providing solutions for optimum fragmentation.
5. Understand the environmental effects due to blasting and to adopt the required controlling measures involving modern monitoring tools during the blasting as per the statutory provisions.

TEXT BOOKS:

1. Gokhale, B.V., Rotary Drilling and Blasting in Large Surface Mines, 2nd Edition, CRC Press, 2011.
2. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A.A.Balkema, Rotterdam, 1995.
3. Rao, K.U.M, and Misra, B., Principles of Rock Drilling, Oxford & IBH Publications, New Delhi, 1998.

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1. Antipas Massawe, Drilling and Blasting Part I: Blasting Lectures and Tutorials, 1st Edition, LAP Lambert Academic Publishing, 2010.
2. Antipas Massawe, Drilling and Blasting Part II: Drilling Manual, 1st Edition, LAP Lambert Academic Publishing, 2010.
3. Bhandari,Sushil, Engineering Rock Blasting Operations, A.A.Balkema, Rotterdam, 1997.
4. Clark, G.B., Principles of Rock fragmentation, Wiley Interscience Publication, 1987.
5. Chugh, C.P., Diamond Drilling, Oxford & IBH Publications New Delhi, 1999.
6. Hustrulid, W.A. Blasting Principles of Open Pit Mining,Vol.1- General Design Concept, A.A. Balkema, Rotterdam, 1999.
7. Janusz Reś, Krzysztof Wladzielczyk and Ajoy K. Ghose., Environment-friendly Techniques of rock breaking, CRC Press, 2003.
8. Konya, C.J. and Walter, E.J. Surface Blast Design, New Jersey, 1990.
9. Langefors, U., and Kihlstrom, (1973), B., The Modern Techniques of Rock Blasting, URMO Publications.
10. Per-Anders Persson, Roger Holmberg, and Jaimin Lee. Rock Blasting and Explosives Engineering, CRC Press, 1994. 11. Pradhan, G.K., and Sandhu, G.S., Manual of Rock Blasting, IME Publications, 1996.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23006 **INNOVATIVE MINING SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand unique mining methods and practices
- To acquire the knowledge about mining in challenging environment
- To understand application of latest techniques and tools in mining

UNIT I TECHNOLOGICAL INNOVATIONS AND TECHNOLOGY DEVELOPMENT 9

Technology, invention, innovation, research and development - definitions, Types of Innovations and their impact on society. Technology life cycle curve, Long wave economic theory and its impact on development of technology. A case study on hierarchical process of innovation. Classical methods for stimulating creativity in an organization.

UNIT II SYSTEM CONCEPTS FOR INNOVATIVE MINING 9

Current technological needs for improving organization performance: Innovations and business organization; New methods for stimulating creativity in mining and other organizations with case studies: Need pull and technological push, Unexpected occurrences, Incongruities, Process needs, Industry market changes, Demographic changes, Change in perception, New knowledge.

UNIT III INNOVATIONS IN MINING OPERATIONS 9

Innovations in unit operations in surface and underground mining; New developments in longwall mining; Design of underground metal mining methods: Design of stoping layouts for mining of different types of ore deposits. Unit operations of stoping. Mining in rockburst prone areas. Novel and innovative mining methods: hydraulic, thermal, hydrochemical and biochemical methods; marine mining and nuclear device mining systems.

UNIT IV GEOGRAPHICAL INFORMATION SYSTEM APPLICATIONS 9

Recent trends in RS&GIS and Environmental assessment & monitoring, Land Use and Land cover classification, Vehicle tracking system, Application of Geo-statistical methods and GIS in mineral prospecting and ore reserve estimation, Applications of GPS in Mineral Resource Surveys, Mapping and Navigation. Role of DGPS surveys in mining leases and identifying illegalities.

UNIT V ROBOT APPLICATION IN MINING 9

Mining cycles such as drilling, blasting, loading, transportation in opencast mines; and its application in underground mining methods board and pillar, blasting gallery, continuous miner and long wall, Mine ventilation: mine gas monitoring, ventilation survey and others. Rescue and recovery works.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will:

1. To have a broad understanding of the need of innovation mining and allied industries.
2. To have detailed understanding of all the methods for stimulating creativity in mining organizations. ·
3. To be able to understand the current technological needs for improving organization performance. ·
4. To understand novel mining methods including the application GIS technique
5. To be in a position to visualize the new frontiers of mining including automation and robotics.

TEXT BOOKS:

1. W. Hustrulid and M. Kuchta, *Open Pit Mine Planning and Design*, A.A. Balkema
2. Alan B. Craig and William R. Sherman, *Understanding Virtual Reality: Interface, Application, and Design*, Elsevier
3. Technological innovation and forces for change in the mineral industry, National Academy of Sciences, Washington D. C. 1978
4. Technological policies in the Canadian Mineral Industry, Centre for Resources Studies, Queen's University; 1986.

REFERENCES:

1. Alan Wexelblat, *Virtual Reality: Applications and Explorations*, Academic Press
2. Rahul Sharma, *Deep-Sea Mining: Resource Potential, Technical and Environmental Considerations*, Springer
3. Anji Redddy M. Remote sensing and geographical information systems. 3rd edition. 2008.
4. Kaplan ED. Understanding GPS: principles and application. British Library Catalogue. 2006
5. Lillesand TM and Kiefer RW. Remote sensing and image interpretation. John Wiley and Sons, New York, 2004.
6. ML and Chouhan TS. Remote sensing and photogrammetry: principles and applications. Vigyan Prakashan, Jodhpur. 1998.
7. Proceedings of 1st, 2nd and 3rd International Conferences on Innovative Mining Systems.
8. Proceedings of 12th, 13th, 14th, 15th World Mining Congress.
9. Proceedings of 1st, 2nd, 3rd and 4th International Mine Congress.
10. Twiss, B. C., Managing Technological Innovation, Longman, 1974.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23007 **MATERIAL HANDLING** **L T P C**
2 1 0 3

COURSE OBJECTIVES:

- To introduce the basic principles in material handling
- To study the conveyor system and its advancement
- To study various material handling methods and its applications in the mines.

UNIT I BULK HANDLING SYSTEMS 9

Basic principles in material handling and its benefits. Classification of material handling equipment. Stacking, blending, reclaiming and wagon loading, machinery and systems used at the stack yards; stock piles, silos, bunkers – their design, reclamation from them, various types of weigh bridges. Segregation - size wise and grade wise, Railway sidings.

UNIT II SHORT CONVEYORS AND HAULAGE SYSTEMS 9

Roller conveyor, overhead conveyor, screw conveyor, auger conveyor, apron feeder, bucket elevators, scraper haulage, conveyors in steep gradient, Armoured face conveyor, Off-highway Trucks, haul roads, In-pit crushers and modular conveyors, electric trolley assisted haulage, shuttle cars, skip hoist, winders, LHD's, pneumatic conveying, hydraulic transport.

UNIT III BELT CONVEYOR SYSTEM 9

Design, capacity, calculations with respect to the size, speed, troughing, power requirement, tension requirement, belt selection, factor of safety; developments in the design, of various components of belt conveyor systems such as; structures, rollers, gear boxes and motors, drums and pulleys, belting, ancillary components and safety gadgets.

UNIT IV NEW TYPES OF BELT CONVEYOR SYSTEMS 9

Curved conveyors, cable belts, pipe conveyors, rock belts – mine-run-rock conveyor, steel belt conveyors, steel slot conveyor, chain belt conveyors, etc., and other new developments, High Angle Conveyors (HAC); New inventions in HAC , Mobile or fixed installations; Woven wire belts, En Masse conveyor, Vibrating conveyor, gravity bucket conveyor.

UNIT V MATERIAL HANDLING IN MINES, PLANTS AND WORKSHOPS 9

Mobile cranes, derrick cranes, pillar cranes, tower cranes, radial cranes, bridge cranes, fork lifters, over head gantry material handling in workshops. Mineral handling in dimensional stone quarries, Mineral handling plants (coal, etc.,) Locomotives, rail tracks, rail cars, railways wagons; Aerial ropeways, gravity ropeways; Containers and shipping; Rope haulage - different types.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will get adequate knowledge on

1. Design and application of hoisting system
2. Application of men and material transport system

3. Design concept of scraper haulage, aerial ropeway and belt conveyor system in mines.
4. Design and constructional features of existing and modern belt conveyors
5. Material handling methods and systems and its principle to convey the minerals or materials from mines, plants and workshops.

TEXT BOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Delhi, 1987.
2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers

REFERENCES:

1. Deshmukh, D.J., Elements of Mining Technology, Vol.I, II and III, EMDEE Publishers, Nagpur, 1979.
2. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol.I and II, Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992.
3. Vorobjev, B. M., and Deshmukh, R.T. Advanced coal Mining, Vol.I and II, Mrs Kusum Deshmukh, P.O. Indian School of Mines, 1966.
4. Sinclair, J., Winding and Transport in Mines, Sir Isaac Pitman and Sons, Ltd., London, 1959.
5. Jacob Fruchtbaum, Bulk Materials Handling Handbook, CBS Publishers and Distributors, New Delhi,1997.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23008 SMALL SCALE MINING AND MARINE MINING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To introduce the small scale mining methods with case studies
2. To introduce the marine geology and its exploitation techniques

UNIT I INTRODUCTION TO SMALLSCALE MINING 9

Concept of small scale mining, small scale mines – world wide, Indian Policy in small scale mines – practices, policies and perspectives, problems of small scale mines – finance, legislative support, technical expertise, environmental obligations, safety, health and training, environmental impacts and protection.

UNIT II SMALLSCALE MINING METHODS 9

Classification and mode of occurrence of granite and other minor minerals, physical, mechanical and chemical properties, geological aspects of mining, granite and dimensional stonemining – manual, semi mechanised and mechanised mining methods, conventional & noveltechniques, recenttrends, processing, finishing, quality control ,marketing & export of minerals. Case studies of mining of other minerals like sandstone, marble, beach sands, alluvial mining, mica, barytes, diamond and gemstones, etc.

UNIT III INTRODUCTION TO MARINE MINING 9

Introduction to marine environment, development & status of ocean resources of mining in India and Mother parts Of the world, Ocean profile, ocean floor topography, economic exclusive zone & fundamentals of law of the sea, coastal zone & its characteristics.

UNIT IV MARINE GEOLOGYAND RESOURCES 9

Physical and chemical properties of seawater, overview of marine mineral deposits, beach placers, deep-sea bed mineral resources, polymetallic nodules, polymetallic sulphides, Cobalt rich crust, chemicals from the ocean, dissolved and undissolved mineral deposits, sea water as resource ~~and beach placers~~

UNIT V EXPLOITATION OF MARINE DEPOSTS 9

Shallow and deep sea bed, oceanographic instruments, mining of polymetallic nodules, polymetallic sulphides, deep sea drilling methods, ocean bottom samplers, drag buckets, grab buckets, coring systems, ocean bathymetry, temperature measurement systems, water samplers, ocean dynamic analysis, beach placer mining, under water photographs, vehicles and transportation, offshore oil platforms.

TOTAL:45 PERIODS

COURSE OUTCOMES:

1. The students will have basic knowledge on small scale mining.
2. The students will have adequate knowledge on methods of small scale mining.
3. The students will have basic knowledge on marine mining.
4. The students will get knowledge about physical and chemical properties of sea water.
5. The students will understand about exploitation of marine deposits, machineries used, etc.

REFERENCES:

1. Chatterjee, S.K.,An Introduction to Mineral Resources, Wiley Eastern Ltd., 1983.
2. Ghose,A.K.,(Ed).SmallScaleMining–AGlobalOverview,Oxford-IBHPublishers,1991
3. Shepherd, F.P., Sub-marine Geology, Harper and Row, NewYork, 1963.
4. Graff,W.J.,IntroductiontoOffshoreStructures:Design,FabricationandInstallation, Gulf Publishing Company, London, 1961.
5. Herbich, J.B., Coastal and Deep Ocean Dredging, Gulf Publishing Co. Houston, 1975.
6. Murthy,T.K.S.,MiningtheOcean,CSIRGoldenJubileeSeries,CSIRPublications,New Delhi, 1995.
7. Rahul Sharma Deep-Sea Mining: Resource Potential, Technical and Environmental Considerations, Springer, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23009 COMPUTER APPLICATIONS IN MINING L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on hardware and software issues concerned with computers in mining industry.
- To develop algorithms and programs on various mining related problems
- To impart knowledge on high-end simulation methodologies
- To study modern techniques on solving mining problems.

UNIT I INTRODUTION TO COMPUTERS 9

Configuration of computers and servers, evolution of operating systems; Networking Concepts, MIS Concepts – Cloud computing / grid computing in mining, Big Data analytics.

UNIT II PROGRAMMING & DBMS CONCEPTS 9

Algorithm, flow charts and Programming of mining application like pillar design, blast design, subsidence, - Database and Relational database - development of software packages for mining companies – forms, queries and reports, Enterprise resource planning for material managements

UNIT III COMPUTERISED MINE PLANNING 9

Introduction of Geostatistics, Reserve Estimation, kriging, block modeling and orebody modelling, Optimization and mine design, mine scheduling.

UNIT IV PROBLEM SOLVING – APPLICATIONS IN MINING 9

Ventilation network analysis; support design, Applications of CAD in mining, GIS in Mining, online and offline monitoring and control, TDS, FEM and CFD Concepts and basics of modeling and simulation.

UNIT V RECENT TRENDS & MINING SOFTWARE 9

Artificial intelligence, expert system, neural networks, robotics and their applications in mining Functionalities of mine planning software, fragmentation software, and numerical software applicable to mining. Case studies of mining applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1 The students will have basic programming knowledge and its applications on various mining related problems.
2 The students will have familiarity with hardware and software issues during development of programs.
3 The students will understand about geostatics, kriging, orebody modelling, mine optimization, etc
4 The students will have a perspective on high-end simulation methodologies and modern techniques to solve mining problems.
5 The students will learn about recent numerical software applicable to mining industries.

TEXT BOOKS:

1 KadriDagdelen, Editor, Computer Applications in the Minerals Industries, Colorado School of Mines,1999.
2 Ramani R.V., et al. Computers in Mineral Industry, Oxford and IBH Publishers,1994.

REFERENCES:

1 R.V.Ramani – Editor, APCOM Proceedings Application of Computers and Operations Research in the Mineral Industry, The Society of Mining, Metallurgy and Exploration,Inc.,1996
2 Fytas, K. and Singhal, R.K. Computers Applications in Mineral Industry, A.A.Balkema Publication, 1988.
3 E Balagurusamy , Fundamentals of Computers , McGraw Hills Publication,2004
4 Basandra S K, Computers Today Fourth Edition, Galgotia Publications Pvt. Ltd,2004

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23010 ADVANCED SURFACE MINING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the various techniques for mine planning, geotechnical investigation and equipment management.
- To appreciate the modern trends in opencast mines, safety and environment

UNIT I PIT PLANNING 10

Development of economic block model; Pit cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method. Addition of haulroad on pit plan; Pit layouts. Open-pit optimisation techniques for mine geometry and output, mine development phases, quality control Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system; Feasibility Report, DPR-contents and preparation.

UNIT II GEOTECHNICALPARAMETERS 7

Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; stability analysis and design methodology for waste dumps; Application of geotechnical investigation for design of ultimate pit slopeandotherdesign parameters. Numerical problems on slope stability analysis including mine waste rock dumps and tailing dumps.

UNIT III PRODUCTION AND EQUIPMENT PLANNING 10

Determination of mine size and sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing; Production scheduling. Stockpiling and blending, Spreaders and Reclaimers; computerized truck dispatch. Selection of mining system vis-à-vis equipment system; Computations for the capacity and number of machines vis-à-vis mine production. Machine availability, productivity, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT IV HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT 9

Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Impact of surface subsidence; Accidents in Surface mining and their prevention; Sources of water, assessment of drainage requirements, sump design and drainage patterns – pumping systems. Pre-drainage through diversion channels and boreholes; Water pollution, Methods of reclamation of mined out areas, dumps and tailing ponds, environmental audit. Socio-economic factors in surface mines.

UNIT V MODERN TRENDS IN OPENCAST MINES 9

Recent developments in mining methods and layouts. Inpit crushing& conveying, continuous surface mining. Selective extraction and dumping. Extraction of seams developed/extracted by underground methods. Deep Open pit Mining; Placer mining and solution mining–scope of applicability, sequence of development and machinery; Closure of surface mines.

TOTAL:45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management.
2. Know about mine scheduling and production scheduling.
3. Know about the maintanence of equipments and availability of equipments
4. Understand health, safety and environmental management in surface mines
5. Update the modern trends related to opencast mines.

TEXT BOOKS:

1. Cummings,A.B.andGiven,I.V.,SMEMiningEngg.HandbookVol.IandII,NewYork, 1994
2. Hustrulid,W.andKuchta,M.,(eds).,FundamentalsofOpenPitMinePlanning&Design, Elsevier, 1995

REFERENCES:

1. Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta,
2. 1995
3. Das, S.K., Surface MiningTechnology, Lovely Prakashan, Dhanbad, 1994
4. Das, S.K., Modern Coal MiningTechnology, Lovely Prakashan, Dhanbad,
5. 1994
6. Kennedy, B.A., Surface Mining – 2nd Edition, SME, NewYork, 1990

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23011 ADVANCED ROCK BLASTING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiar with the recent developments in various blasting technology used in surface and underground mines.
- To learn the various theories of rock fragmentation by blasting and use the suitable modern tools for predicting fragmentation in the blasting operation.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars being covered under this course.

UNIT I EXPLOSIVES AND ACCESSORIES 7

Emerging trends in explosives, initiating system and blasting techniques; Bulk Blasting agents & Mode of Bulk Delivery System; Performance testing of explosives and accessories; Scattering in Delay timing of delay detonator.

UNIT II TRENDS IN SURFACE AND UNDERGROUND BLASTING TECHNIQUES 10

Theories of rock breakage - Mechanics of rock fragmentation due to blasting; Recent advances in blasting techniques in both underground and surface mines; Cast blasting for improved mine economics; Blast optimization in surface mines. Blasting in opencast coal mines of developed galleries. Economic evaluation of blasting operations. Tunnel blast designs.

UNIT III INSTRUMENTATION FOR BLAST PERFORMANCE MONITORING 9

Fragmentation prediction and assessment, Instrumentation and software application for design of blast round, Deep hole blasting and shot hole blasting. Instrumentation in Blasting – V.O.D probe, Laser Profiler, Vibration monitoring, High speed video camera, Stemming plug etc.

UNIT IV ENVIRONMENTAL CONTROL AND SAFETY IN BLASTING 9

Ground vibrations, flyrock and air over pressure. Influence of Blasting on surface structures and underground workings; Safety during blasting operation. Preparation of SoP for blasting operation in Cluster of Mines.

UNIT V EMERGING BLASTING TECHNIQUES 10

Special Blasting techniques – Road Construction, Dimension stone blasting, Underwater Blasting; Air-Decking & Baby-decking techniques; Novel Blasting Techniques in Surface and underground construction; Demolition blasting; Shaft sinking in Populated area (City), Underground storage construction. Intelligent blast design and computer applications in blasting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will able to:

1. Understand the recent developments in blasting techniques adopted in surface and underground mines.

2. The students will learn about theories of rock breakage, mechanics of rock fragmentation, etc.
3. Learn the usage of modern instrumentation and software for monitoring and analyzing the blast performance.
4. Control the environmental effects due to blasting and design the blast accordingly as per the statutory provisions.
5. Understand the basic concepts of novel blasting techniques adopted surface and underground construction projects.

TEXT BOOKS:

1. Agne Rustan, Claude Cunningham, William Fourney, Alex Spathis, K.R.Y. Simha, Mining and Rock Construction Technology Desk Reference: Rock Mechanics, Drilling & Blasting, CRC Press, 2010.
2. Johansen, John and Mathiesen, C.F., Modern Trends in Tunnelling and Blast Design, AA Balkema, 154p, 2000.
3. Pal Roy, Piyush, Rock Blasting: Effects and Operations, CRC Press, 380p, 3rd Edition, 2015.

REFERENCES:

1. William A, Hustrulid, Blasting Principles for Open pit mining, 3rd Edition, A.A.Balkema, 2005.
2. Bhandari S., Engineering Rock Blasting Operations,AA Balkema Rotterdam, Netherlands, 1997.
3. Dowding, C.H., Blast Vibration Monitoring and Control, Prentice-Hall International London, 1985.
4. Dowding, C.H., Construction Vibrations, 2nd, Edition, ISEE Publications, 2000.
5. Ghose, A.K and Joshi, A (Ed), (2013), Blasting in Mining – New Trends, CRC Press, 2013.
6. Jha, Ajay Kumar, Impact of Surface Blasting on Underground Workings and Structures, LAP Lambert Academic Publishing, 2015.
7. Morhard, R.C., Explosives and rock blasting. 1987: Atlas Powder Company.
8. Per-Anders Persson,Roger Holmberg,Jaimin Lee, Rock blasting and explosives Engineering, CRC Press, 1993.
9. Richard A. Dick, Larry R. Fletcher, Dennis V. D'Andrea, Explosives and Blasting Procedures Manual, Schunnesson, Hakan and Johansson, Daniel (Ed), Rock fragmentation by blasting(FRAGBLAST 12), Lulea University of Technology, 2018.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
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3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23012 HAZARD ANALYSIS AND RISK ASSESSMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn the various techniques for hazard identification, reliability analysis, estimation of frequency of occurrence of hazards, consequence analysis, risk quantification and human reliability analysis.
- To provide knowledge in Quantitative Risk Analysis Process Industries and risk Control and Management
- To familiarize the student with various types of Hazard Identification techniques related to the work practices and activity using various technique.

UNIT I HAZARD IDENTIFICATION AND RISK ANALYSIS 9

Hazard and risk, Types of hazards - fire, explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards : Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, The Mond Index, Plant layout and unit hazard rating, Preliminary hazard analysis, Hazard and Operability study (HAZOP), What If analysis, Case studies.

UNIT II RISK CONTROL & MANAGEMENT 9

Plant availability and process reliability: ways of improving plant availability, MTBF and MTTF, the reliability function, failure rate, bathtub curve, probability relationships, simple reliability estimation. Estimation of frequency of occurrence of a hazard: The logic tree approach, set theory and Boolean algebra, application to probability, Boolean manipulation. Fault tree analysis – logic symbols, minimal cut set, logic gates, fault tree quantification. Event tree analysis - notation, event tree construction, advantages and disadvantages of ETA. Failure mode and Effect Analysis (FMEA) - methodology, criticality analysis, corrective action and follow-up.

UNIT III ENVIRONMENTAL HEALTH RISKS 9

Consequence modeling: Source models - discharge rate models, flash and evaporation, dispersion models. Explosions and fires -vapour cloud explosions, flash fires, physical explosions, BLEVE and fire ball, confined explosions, pool fires, jet fires. Effect models - dose-response functions, probit functions, toxic gas effects, thermal effects, explosion effects - Software application for effect and damage calculations.

UNIT IV HAZARDS MONITORING AND EMERGENCY MANAGEMENT 9

Quantification of risk: QRA, Vulnerability analysis, accepted and imposed risk, perception of risk,risk indices, individual risk and societal risk, acceptance criteria for risk, ALARP, Presentation of measures of risk - risk contour, F-N curve. Calculation of individual risk and societal risk.Human reliability nalysis (HRA): factors leading to human error, characteristics of HRA techniques, Technique for Human Error Rate Prediction (THERP), Accident SequenceEvaluation Program (ASEP), Techniques using expert judgment, Operator Action tree (OAT).

UNIT V DISASTER MANAGEMENT IN INDIA AND RELIEF 9

History of disasters - various disasters in various countries - Disasters in India Relief and rehabilitation in disasters at local, national and global levels, Gaps in disaster management identified on analysis, Worldwide Aid and Agencies, Study of different case studies on natural disaster & manmade disaster.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the student would be able to:

1. Attain the ability to use the hazard indices, HAZOP, PHA and What if analysis for the identification of hazards in a process
2. Attain the ability to assess probability of occurrence of an event using fault tree and event tree analysis
3. Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models
4. Quantify the risk involved in a process
5. Identify various Hazards related to the work practices and activity using various technique.

REFERENCES:

1. Geoff Wells, “Hazard Identification and Risk Assessment”,1997.
2. Marvin Rausand ,” Risk Assessment”, John Wiley & Sons, Inc,2011
3. AIChE/CCPS. ”Guidelines for Hazard Evaluation Procedures”. (Second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 1992.
4. AIChE/CCPS.”Guidelines for Chemical Process Quantitative Risk Analysis”. (Second edition).Centre for Chemical Process Safety, American Institute of Chemical Engineers, NewYork,2000.
5. Sam Mannan (Editor).”Lee´s Loss Prevention in the Process Industries”. (Fourth edition).Butterworth-Heinemann Ltd., UK,2012.
6. Government of India, Ministry of Home Affairs, National Disaster Management Division, DisasterManagement in India – A Status Report,2004
7. National Policy on Disaster Management, NDMA, Government of India,2009.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23013 **MINE SAFETY ENGINEERING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To learn the level of risk associated with mining, risk assessment and management
- To know the occupational diseases, mine disasters and mitigation
- To understand various procedure risk management

UNIT I MINE ACCIDENTS 9

Accident in mines;- different types, accident investigations; accident analysis; accident prevention and corrective action, accident proneness, creating and maintaining safety awareness, ZAP and MAP, job safety analysis, safety meeting and committee.

UNIT II HEALTH AND MINE SAFETY 9

Definition of health and safety, management's role – function; evolution of management involvement, management's training, responsibility, cost of health and safety, role of labour organizations – Union impact and involvement, role of government – statutory controls and directions, spot and regular inspections, enforcement of standards, penalties for violations, collection and distribution of statistical data.

UNIT III FAULT TREE ANALYSIS 9

Introduction – methodology, symbols and Boolean techniques, qualitative analysis, computerized methods, statistical analysis, safety information, systems design.

UNIT IV RISK ASSESSEMENT AND DISASTER MANAGEMENT 9

Principles, risk and hazard control, risk and hazard evaluation and data collection for identified health risks, exposure assessment and risk characterization, probabilistic risk analysis, risk management, safety culture, human factors, reliability evaluation, safety audit. Identification of causes of mine disasters, preventive action, disaster management and mitigation, typical cases of mine disasters in India

UNIT V MINER'S OCCUPATIONAL DISEASES AND ENQUIRY COMMITTEE 9

Miner's occupational health and diseases, preventive medical examinations, various types of injuries, compensable diseases, medical attention and removable of causative factors in the mines. Recommendations of inquiry committee carried out for safety and health issues in India.

TOTAL :45 PERIODS

COURSE OUTCOMES:

The students will have

1. Deep knowledge about the mine accidents
2. Various health and safety related to mining operations
3. Tools for safety engineering
4. Procedure of risk assessment
5. Knowledge of occupational diseases

TEXT BOOKS:

1. Brown, D.B., System Analysis and Design for Safety, Prentice Hall, 1976.
2. Stranks, J., Management Systems for Safety, Pitman Publishing, 1994.

REFERENCES:

1. DeReamer, R., Modern Safety Practices, John Wiley and Sons.
2. Wahab Khair. A., New Technology in Health and Safety, SMME, 1992.
3. Zyl, D.A., Koval, M, Li Ta, M. (Ed.). Risk Assessment / Management Issues in the Environmental Planning in Mines, SMME, 1992.
4. Prasad, S. D. and Rakesh., A Critical Appraisal of Mine Legislations. Lovely Prakashan, 1995. Dhanbad.
5. Mine Disasters of India, NCSM Publication.
6. Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23014 RISK AND WORKPLACE SAFETY MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand comprehensively philosophy of risk-based safety management at workplace.
- To acquire the knowledge of risk-based safety management system and different elements of SMP.
- To understand process of safety management at workplace including accident investigation, emergency response system and safety audit.

UNIT I OCCUPATIONAL HEALTH AND ERGONOMIC HAZARDS 9

Occupational health hazards – Dust, Noise, Diesel overview of different types exhaust and Diesel Particulate Matter; Notified and of occupational hazards occupational diseases; Ergonomics and its impact on health and safety at workplace.

UNIT II INTRODUCTION TO RISK MANAGEMENT 9

Risk Management related terms and definitions; Basic concept of risk; Difference the need for self-regulatory between hazards and risks; Need for risk based concept for safety workplace safety management. management at workplace**.**

UNIT III RISK ANALYSIS METHODS 9

Hazard and Operative about (HAZOP) Analysis; Failure Mode and Effect different methods of risk Analysis (FMEA); Failure Mode Effect and assessment Critical Analysis (FMECA); Job Safety Analysis (JSA); Fault Tree Analysis (FTA); Bow Tie Analysis, Workplace Risk Assessment and Control process.

UNIT IV RISK MANAGEMENT 9

Risk management objectives, Risk Management Principles, Probability, identify workplace Exposure, Likelihood and Consequence of hazards, hazards, carryout risk Qualitative, Quantitative and Semi-quantitative assessment and identify risk assessment techniques, Risk Management appropriate controls Options, Risk Control methods, Hierarchy of against identified hazards Control.

UNIT V WORKPLACE SAFETY MANAGEMENT 9

Duty of Care, Due Diligence, Workplace Safety and Health Management System (SHMS) or Safety Management Plan (SMP), Features of risk-based SHMS / SMP, Elements of SHMS / SMP. Elements of Safety Audit, Steps in Safety audit. Importance of emergency response plan (ERP), Purpose of ERP.

COURSE OUTCOMES:

Upon successful completion of this course, students will:

1. To have a broad understanding of the latest and modern concept of risk-based safety management.
2. To learn the Systematic and risk-based emergency preparedness and response plan
3. To get to know the entire spectrum of workplace safety management which will help them to build their confidence to handle safety issues at workplace efficiently.

4. To learn new aspects such as accident investigation, emergency response plan, safety audit and impact of working conditions in workplace safety.
5. To develop safety management plan based on risk assessment of workplace hazards.

TEXT BOOKS:

1. Workplace Safety by Randall Ferris and Daniel Murphy, Elsevier
2. Mine Health and Safety Management – Edited by Michael Karmis
3. Safety Engineering by B. S. Dhillon, Springer
4. Mine Safety by B. S. Dhillon, Springer
5. Health and Safety: Risk Assessment by Tony Boyle, Routledge; 1 edition (July 24, 2015).

REFERENCES:

1. Managing the Risk of Workplace Stress: Health and Safety Hazards by Sharon Clarke and Cary Cooper, Routledge; 1 edition (December 29, 2003)
2. Occupational Health and Safety of Construction Workers by Pratibha Joshi, Industrial Safety Management: Hazard Identification and Risk Control by L. M. Deshmukh.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23015 OCCUPATIONAL HEALTH ASPECTS IN MINES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand hazards associated with mining operations
- To understand the mechanism of various types of hazards associated with underground coal mining
- To understand the mitigation measures to be taken to face the various types of hazards in mines

UNIT I INTRODUCTION 9

Various types of Mine hazards encountered during mining including Blasting, use of mining machinery, Roof fall, and Side fall.

UNIT II OCCUPATIONAL HEALTH AND ERGONOMIC HAZARDS 9

Occupational health hazards – Dust, Noise, Diesel overview of different types exhaust and Diesel Particulate Matter; Notified and of occupational hazards occupational diseases; Ergonomics and its impact on health and safety at workplace.

UNIT III HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT 9

Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Impact of surface subsidence;

UNIT IV ACCIDENTS IN SURFACE AND UNDERGROUND MINING 9

Sources of water, assessment of drainage requirements, sump design and drainage patterns - pumping systems. Pre-drainage through diversion channels and boreholes; Water pollution, Methods of reclamation of mined out areas, dumps and tailing ponds, environmental audit. Socio-economic factors in surface mines.

Rock Bursts, Coal Mine Bumps, detection, prevention, and control technology used in mines.

UNIT V HAZARD CONTROL 9

Hazard control by engineering approach, Hazard control by system approach. Economics of safety and cost-effectiveness - cost of accidents, occupational diseases and their social effects. Ergonomics and its application in mining.

COURSE OUTCOMES:

Upon successful completion of this course, students will: ·

1. The students will know about the types of hazards present in underground coal mines like fire, explosion, roof fall, side fall, rock bursts, coal bumps, and inundation
2. To students will learn how to monitor, investigate, and control the hazards
3. The students will gain knowledge on the rescue and recovery operations to be conducted in emergency situations in underground coal mines

TEXT BOOKS:

1. M A Ramlu, Mine Disasters and Mine Rescue,, Universities Press (India), private Limited , 2nd edition
2. Mine Health and Safety Management – Edited by Michael Karmis
3. Safety Engineering by B. S. Dhillon, Springer
4. Mine Safety by B. S. Dhillon, Springer
5. Health and Safety: Risk Assessment by Tony Boyle, Routledge; 1 edition (July 24, 2015).

REFERENCES:

1. R. McADAM and D. davidson, Mine Rescue work, Oliver and Boyd, Edinburgh: Tweeddale Court, London , 39 a Welbeck Street W.I
2. Occupational Health and Safety of Construction Workers by Pratibha Joshi, Industrial Safety Management: Hazard Identification and Risk Control by L. M. Deshmukh.
3. Ridley, J & Channing, J.; Safety at Work; Butterworth-Heinemaan, Oxford, 2001.
4. L.C. Kaku: A Study of Mine management, Legislation & General Safety
5. S. Ghatak: A Study of Mine management, Legislation & General Safety
6. C.P. Singh: Occupational safety and health in Industries and mines

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23016	ECO-FRIENDLY MINING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To make the students familiar with the concepts of eco friendly mining practices and their application
- To understand the impact of mining on water and soil, and the remediation techniques.
- Understand the process of rehabilitation and mine closure and its implementation.

UNIT I OVERVIEW 9

Basic concept of eco-friendly mining. Selection of eco-friendly equipment and exploitation operations, Environmental Parameters Water quality – physical, chemical, biological, criteria and standards. Classification and chemistry of major air pollutants, Soil chemistry – nature and importance of soil, soil properties, soil amendments.

UNIT II AN INTRODUCTION TO SUSTAINABLE DEVELOPMENT FOR MINING SECTOR 9

Environmental and social perception about mining; Impact of mining on the environment; Definition of sustainable development in mining and need for sustainable development in mining; Overview of sustainable development framework for mining and principles of sustainable development framework; Legal and institutional framework.

UNIT III WASTE MANAGEMENT 9

Wastewater management **–** sources characteristics, techniques of treatment. Acid mine drainage – occurrence, effects and treatment techniques Solid waste management for mine spoils.

UNIT IV ECO-FRIENDLY MINING LEGAL PROVISIONS 9

Environmental legislation and policies. Environmental Management Plan. Environmental Impact Assessment. Risk Analysis. Disaster management.

UNIT V MINE CLOSURE AND POST CLOSURE 9

Environmental problems due to mines and quarries. Land degradation. Pollution due to mining in terms of air and water. Acid Mine Drainage, Socio- economic impacts. Control measures. Systematic / concurrent mine closure; Final mine closure and post mine closure activities. Mine Reclamation & Mine Closure: Mine Reclamation strategies, Principles, planning, financial provisions, implementation, and standards for closure criteria, systems approach for mine closure and development of closure plan, Socio-economic Aspects of Mining.

COURSE OUTCOMES:

Upon successful completion of this course, students will:

1. To understand the basic concepts of eco-friendly mining and its application.
2. Select and adopt appropriate technologies for better environmental conditions in mines.

3. Estimate the extent of environmental impact due to mining and decide the management options.
4. Understand the process of rehabilitation and mine closure and its implementation.
5. To know the responsibility of mine operators towards practicing systematic mine closure for the benefit of future mining activities through adequate reclamation & rehabilitation.

TEXT BOOKS:

1. H. S. Peavy, D. R. Rowe and G. Tchobanoglous, Environmental Engineering, McGraw-Hill Publishing Co. , 7th Rev Ed edition, 2000
2. C. J. Barrow, Environmental Management: Principles and Practice (Routledge Environmental Management Series),, Routledge , 1st edition, 1999
3. Dhar, B.B., Environmental Management of Mining Operations, Ashish Publication House, New Delhi, 1991.
4. Chadwick et al., Environmental Impacts of Coal Mmining and Utilization, Pergamon Press,1992.

REFERENCES:

1. H. S. Peavy, D. R. Rowe and G. Tchobanoglous, Environmental Engineering, McGraw-Hill Publishing Co. , 7th Rev Ed edition, 2000.
2. C. J. Barrow, Environmental Management: Principles and Practice (Routledge Environmental Management Series),, Routledge , 1st edition, 1999.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23017 ENVIRONMENTAL MANAGEMENT IN MINES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the various environmental pollution occurring in mineral industry.
- To study various methods of managing environmental pollution.
- To study various statute related to environment.

UNIT I ENVIRONMENT & ECOLOGY 9

Concept of Ecology, ecological principle, nature of the environment ecology and man. Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guidelines – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation – desertification – Industrialization, importance of environmental legislation. Objectives of Sustainable Development.

UNIT II AIR POLLUTION-I 9

Environmental Pollutants due to surface and underground mining – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants includingdust, Controland preventive measures for airpollution including for dust, Structure of the atmosphere – ozone layer depletion – Acid rain – Green house gases and global warming Ambient Air quality and emission standards, Air quality Sampling and monitoring, Dispersion of air pollutants,

UNIT III WATER, LAND & NOISE POLLUTION-II 9

Environmental Pollution due to Water – Sources, Classification and measurements of pollutants and their effect on human health, hazards, sampling and analysis, Water pollution, measurement standards, . Pollution due to equipment vibrations & their monitoring, prevention and control, Land pollution, land for alternation dealing with mind outland, re-vegetation, land use plan, Textural classification and properties of soil. Impact of pollution on human health, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution.

UNIT IV ENVIRONMENTAL MANAGEMENT 9

Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 – – Siting of Industries – Environmental management plans, Environmental impact assessment, Environmental management system audits, Environmental economics – Principles of cost benefit analysis – Valuing the Environment – Environmental Accounting, Environmental administration-training awareness and competence.

UNIT V ENVIRONMENTAL LEGISLATIONS 9

Environmental laws, the Environmental (Protection) Act, 1986, Environmental Protection rules 1986. The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, , EIA Notification 2006; wild life protection act and rules , Environmental clearance procedure for a mining Project.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have basic knowledge on concepts of ecology.
2. The students will have knowledge about various pollutants including acid rain, green house gases, etc
3. The students will have knowledge about impacts of pollution.
4. The students will have adequate knowledge on cost benefit analysis, environmental administration, etc.
5. The students will have knowledge on, pollution its control and ecological systems along with related laws

TEXT BOOKS:

1. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications, London, 1998.
2. Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Oxford University Press, New Delhi.(2001).

REFERENCES:

1. Hartman, H.L. Mine Ventilation and Air Conditioning, Wiley Interscience publication, 1999.
2. Mishra, G.B. Mine Environment and Ventilation, Oxford University Press,1992.
3. McPherson, M.J. Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993.
4. Manahan S.E. Environmental Science andTechnology.
5. Gregor I. Mcgregor. Environmental Law and Enforcement, Lewis Publishers, London,1994.
6. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York,1995
7. Anjaneyulu,Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India,2002.
8. Nick Hanley, Jaison F. Shogren and Ben White.Environmental Economics - In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
9. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addision Wesley Longman Ltd, Singapore,1997.
10. Christopher Sheldon and Mark Yoxon, Installing Environmental Management System –a step by step guide, Earthsecan Publications Ltd, London,1999.
11. Lee Kuhre, ISO 14001 Certification –Environmental Management Systems ,Prentice

CO-PO & PSO MAPPING

CO	PO												PSO		
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3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23018 MINE ECONOMICS AND INVESTMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Study of estimation and valuation of mineral deposits.
- Study of project appraisal.
- Study of finance and accounting.

UNIT I INTRODUCTION 9

Mineral industry and its role in national economy; world and national mineral resources; Mining A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy.

UNIT II ORE RESERVE ESTIMATION 9

Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, introduction to geo-statistical methods, classification of reserves.

UNIT III MINE VALUATION 9

Time value of money; annuity; redemption of capital, net present value; depletion allowance; depreciation; inflation; escalation; rates of return; Hoskold's Two rate method; capital and operating cost including wages, incentives, material, etc.; assets; liabilities; cash flows and discounted cash flow – their implications in mine economic evaluation.

UNIT IV PROJECT APPRAISAL 9

Methods of project valuation–payback, annual value, benefit/ cost ratio, ARRandIRR, NPV, Profitability Index etc., Cost-Volume-Profit Analysis; evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; mine taxation; critical impact of depreciation depletion, type of funding, reserves, life, etc. on mine profitability

UNIT V FINANCE AND ACCOUNTING 9

Sources of mine funds–shares, debentures, fixed deposit, sinking fund, capital gearing, Trading Account. P& L account, balance-sheet, Income Statement, Cash flow and Funds low statement; typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will have knowledge on

1. Mine Economics
2. Reserve Estimation
3. Estimation and valuation of mineral deposits.
4. Project appraisal
5. Finance and accounting

TEXTBOOKS:

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Arogyaswamy,R.N.P.CoursesinMiningGeology,OxfordandIBHPublishingCo.,1994.
3. I M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018

REFERENCES:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO
   1992.
5. Indian MiningYear Book 1994 – MMRDAct and Mineral Concession Rules.
6. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8th edition, 2017
7. T.S. Reddy & A. Murthy, Financial Accounting, Margham Publications, 2014

CO-PO & PSO MAPPING

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3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23019 ENERGY CONSERVATION AND MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES :

At the end of the course, the student expected to :

- Understand and analyze the plant energy data.
- Energy audit and suggest methodologies for energy savings.
- Energy accounting and balance.
- Able to utilize the available resources in optimal way.

UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 9

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing : methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

UNIT II ELECTRICAL SYSTEMS 9

AC / DC current systems, Demand control, power factor correction, load management, Motor drives: motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

UNIT III THERMAL SYSTEMS 9

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

UNIT IV ENERGY CONSERVATION 9

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

UNIT V ENERGY MANAGEMENT, ECONOMICS 9

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will understand the importance of energy conservation and management.
2. The students will have knowledge about AC /DC current systems, distribution systems, etc.
3. The students will understand about thermal systems.
4. The students will learn about techniques of energy conservation.
5. They will also learn about computational energy management including life cycle costing.

REFERENCES:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. O. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23021 MINE PLANNING AND ECONOMICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the planning of opencast mining, underground mining and equipment utilization
- To study project implementation and monitoring

UNIT I INTRODUCTION 7

Technical factors in mine planning, methodology of mine planning, short range & long range, Optimization Techniques in Mine Planning; Choice between surface and underground mining.Economic importance of the mineral industry; mining economy, risky nature of the mining industry, Demand and Supply, Elasticity of Demand, national mineral policy.

UNIT II OPENCAST MINING 12

Development of Ultimate Pit Configuration (openpitlimits) and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm and computer assisted hand method; Selection of initial mine cuts and geometrical considerations; location of surface structures, division of mining area into blocks,minedesign,Impact of various parameters like depth, dip, stripping ratio, geology and strength of mineral and overburden on mine planning; Selection of Mining Systems; Determination of optimum mine size and sequencing by nested pits; Lanes algorithm for estimation of optimum mill grade and production planning; calendar plan, production scheduling, economic productivity indices. Quality Control-Ore Blending; Planning for mine closure.

UNIT III UNDERGROUND MINING 10

Design of mine entries – shafts, inclines, design of stopes – size, level interval, etc, design of coal mining district, mine boundaries; designofshaft pillars and protective pillars, planning of production capacity , optimization of mine size – mine production capacity, layout of development drives / raises/winzes etc, length off aces, etc, planning of support systems, ventilation, lay out of drainage system; Production planning & Production scheduling, selection of depillaring /stoping method,manpower management economic /productivity indices, Productivity and quality control;Techno- economic analysis, Planning for mine closure.

UNIT IV EVALUATION OF MINERAL DEPOSITS AND MINING COSTS 8

Mineral resource concept, classification and estimation of ore reserves, applications of Geostatistics and different Kriging methods.Mine sampling: Definition, purpose and scope, methods: groove/channel sampling; Chip sampling; grab sampling; Bulk sampling; Application of statistical methods in sampling.Cost of mining: Capital and operating costs; Factors affecting operating cost; Methods of estimating future costs; standard cost and forecast.

UNIT V INVESTMENT APPRAISAL AND PROJECT IMPLEMENTATION 8

Mine Valuation: Basic concept, recent approaches to valuation; Time value of money, Price information – revenue estimates, annuity, Accounting profits and cash flows.Pre-projectactivities–feasibilityreport,environmentalclearance,detailedprojectreport, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Elements of investment appraisal, Static methods of investment appraisal, Dynamic methods of appraisal, discounted cash flow analysis.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able

1. To gain knowledge on concept of mine planning process is required for the student for developing surface as well as underground metal mining project.
2. To understand different methods of extraction applicable to different types of mineral deposits.
3. To select proper types of equipment for improving the productivity in surface mining operations,
4. To optimize the production capacities in surface mining operations covering different types of mineral deposits.
5. To understand project implementation and monitoring methods adopted in the mineral industry.

TEXT BOOKS

1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid,W.andKuchta,M.,(eds).,FundamentalsofOpenpitMinePlanningand Design, Elsevier, 1995.

REFERENCE BOOKS

1. Ehrenburger, V and Fajkos,A., Mining Modelling, Elsevier, 1995.
2. Bawden,W.F.,andArchibald.,J.F.,InnovativeMineDesignforthe21stCenturyElsevier, 1993.
3. Christoper J. Bise, Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy, and Exploration, 313p, 2003.
4. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.
5. Swilski, and Richards, Underground Hard Coal Mines, Elsevier, 1986.
6. Singh,B.andPalRoy,P.,BlastinginUndergroundexcavationsandmines,CMRS Dhanbad, 1993.
7. Peng, S.S. and Chaing, H.S., Longwall Mining, John Wiley & Sons, NewYork, 1984.
8. Rzhevsky,V.V.,OpencastMining–TechnologyandIntegratedMechanisation,MIR Publishers, Moscow, 1987.
9. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
10. T. J. Hoover, The Economics of Mining.
11. Alwyn E. Annels, Mineral Deposit Evaluation: A practical approach.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	2	2	2	2	2	2	2	1	2	2	2
2	2	3	1	1	3	3	3	3	2	2	2	2	2	2	2
3	2	2	2	0	3	3	2	2	3	2	2	2	2	1	1
4	2	1	2	2	2	2	2	2	0	2	1	0	2	2	1
5	2	2	2	2	2	1	2	1	2	2	2	2	2	3	2
Avg	2	2	2	1.4	2.4	2.2	2.2	2	1.8	2	1.8	1.4	2	2	1.6

MI23021	MINING, ENERGY AND CLIMATE CHANGE	L T P C 3 0 0 3

COUSE OUTCOMES:

- This course will emphasize on the importance of global warming and its effect on the society.
- It will also discuss on different mining and energy scenarios and their contribution for increasing the carbon footprint which in turn produces global warming.
- All important research and development contributing to reduction of its effect will be presented in the class.
- In addition, India's commitment for reduction of carbon footprint and the actions planned for implementation will be the subject of discussion for energizing the young students for their contribution in thoughts and actions for fulfilling the international commitments for saving the Mother Earth.

UNIT I BASICS OF GLOBAL WARMING AND CLIMATE CHANGE 9

Global warming and glacial change, the rise of carbon, Alpine "Hot Box" experiment, the atmosphere as a dam built across a river, Royal Institution Laboratory and findings of John Tyndall, Guy Callendar, Arrhenius etc., the age of discovery: findings of Roger Rivelle, Keelings Curve, large scale geophysical experiments, modelling of climate and road to Rio, journey to Paris protocol.

UNIT II INDIA'S INITIAL AND SECOND NATIONAL COMMUNICATION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC) 9

National Circumstances, GHG Inventory Information, Vulnerability Assessment and Adaptation, Research and Systematic Observations, Education, Training and Public Awareness, Programmes Related to Sustainable Development, Constraints and Gaps, and Related Financial, Technical and Capacity Needs.

UNIT III COAL MINING FOR ENERGY SECURITY & ROLE OF RENEWABLE ENERGY 9

Coal mining and electrical age, Wizards of Menlo Park, Battle of the currents, Metering of the energy, Regulatory bargain, The growth of electrical age, Growth of India's coal mining industry; Role of renewable energy -
Solar, Wind, Biofuels, Biomass, Geothermal, Hydropower and other renewable energy options.

UNIT IV OIL AND NATURAL GAS – ADVENTURE IN ENERGY RESOURCES 9

Growth of world's liquid fuel production, Fluctuation of demand, supply and prices, Fear of running out of oil, Gulf war – Desert storm, Pipeline battle, Influence of different nations in the Persian Gulf, Major discoveries of oil and innovations in the oil and gas industry for higher recovery

UNIT V CARBON DIOXIDE SEQUESTRATION AND REDUCTION OF CARBON FOOTPRINT 9

Different methods for carbon dioxide sequestration: Geological reserves, marine water and other methods for sequestration, other uses of carbon dioxide for reduction of global warming; Paris protocol, India's commitment for reduction of global warming and actions envisaged

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will know:

1. The Facts of global warming and its significance; the need for addressing the emerging environmental issues.
2. The Role of coal and uranium mining for energy security and potential dangers and disasters with nuclear options.
3. The Role of gas and oil, associated issues and their impact on environment.
4. The Role of Renewable energy and its share in energy basket
5. The Different methods for Carbon dioxide sequestration and reduction of carbon footprint , India's commitment for augmenting global warming.

TEXT BOOKS:

1. Future of Energy : Brian F. Towler (2014)
2. The Quest: Energy, Security, and the Remaking of the Modern World : Daniel Yergin (2011)
3. Environmental Economics & the Mining Industry, Wade E. Martin, Springer Dordrecht, 2012.

REFERENCE BOOKS:

1. Introduction to Modern Climate Change, Andrew E. Dessler, Cambridge University Press, 2021
2. Climate Change- A Call for Action, Om Prakash Pareek, National Paperbacks, new Delhi 2021.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23022 SYSTEM ENGINEERING IN MINING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know basic of system engineering concept and analysis
- To study the various techniques of operations research, simulation and network analysis

UNIT I INTRODUCTION 9

Introduction to systems engineering, systems concept and analysis, models in systems analysis, tools and methodology of system analysis.

UNIT II OPERATIONS RESEARCH 9

Introduction to operations research, introduction to linear programming, application to mineral industry.

UNIT III SIMULATION TECHNIQUES 9

Introduction to Monto-carlo sampling and deterministic simulation of different mining subsystems and total system, simulation application for equipment selection and production scheduling. Transportation and assignment model, Queuing theory.

UNIT IV NETWORK ANALYSIS 9

Network analysis, monitoring and control of developmental activities in mining project by CPM and PERT.

UNIT V MISCELLANEOUS 9

Inventory of mineral resources, basic models and optimization, introduction to statistical decision theory and its application in mineral industry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The students will learn the concept of system engineering and applicability in mining field.
2. The students will learn the concept of operational research and applicability in mining field.
3. The students will learn about simulation techniques.
4. The students will have knowledge about CPM, PERT, etc.
5. They will also know about basic models, statistical theory, etc.

TEXT BOOKS:

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Zambo, J., and Kiado, A., Optimum Location of Mining facilities, Springer Verlag, Budapest, 1968.

REFERENCES:

1. Syal, I.C., and Gupta, B.P., Computer Programming and Engineering Analysis, A.B., Wheeler and Company, Madras 1986.

2. Anon., Management by Network Analysis, The Institution of Engineers (India),1976.
3. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press,1982.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

MI23023	SUSTAINABLE MINING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- Mining industry is often regarded as polluting sector as it involves extensive resource exploitation by degradation of land and environment.
- The industry should be responsible enough to provide sincere effort to reduce the environmental impact of mining to its minimum level following the principle of sustainable development and acquiring operation excellence through scientific methods of exploitation and use of technologies in mining.
- The present course is designed to incorporate various aspects of sustainable mining to provide deeper understanding of various parameters affecting the sustainability of mining operation.

UNIT I BASICS OF RESPONSIBLE MINING 9

Introduction; A lunchroom model of corporate social responsibility; All the elements have to be adequately responsible to sustain a system – A conceptual framework; Making responsible mining happen: a theory.

UNIT II AN INTRODUCTION TO SUSTAINABLE DEVELOPMENT FOR MINING SECTOR 9

Environmental and social perception about mining; Impact of mining on the environment; Definition of sustainable development in mining and need for sustainable development in mining; Overview of sustainable development framework for mining and principles of sustainable development framework; Legal and institutional framework

UNIT III SUSTAINABLE MINING METHODS AND OPERATIONAL EXCELLENCE 12

Mine planning process, components of mine planning, mine development strategy, mine planning horizons; Surface mining methods for sustainable mining operations (Mining methods, modes of transportation, haul road maintenance, dust pollution system etc.); Underground mining methods for sustainable mining operations.

UNIT IV TECHNOLOGICAL ASPECTS OF SUSTAINABLE MINING 9

Mine planning and execution technologies; Mine surveying technologies; Mine closure and post closure: Systematic / concurrent mine closure; Final mine closure and post mine closure; Legal implications in Mine Closure activities.

UNIT V RESPONSIBLE MINING 6

India's commitment for reduction of global warming; SDF performance reporting and star rating; Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will :

1. Know about the school-of-thought of the responsible activity/operation in a system like mining.
2. Gather knowledge about the need for sustainable development in mining and also will come to know the overview & principle of sustainable development framework for mining.
3. Learn about the responsibility of the mine operators to select as well as practice the right methods and right operations for the sustainability of mining competitive world.
4. Know the responsibility of mine operators towards practicing systematic mine closure for the benefit of future mining activities through adequate reclamation & rehabilitation.

TEXT BOOKS:

1. SME Mining Engineering Hand Book (Third Edition) – Peter Darling.
2. Mining and Environmental Sustainability, Roonwal, G S, K Shahriar & H Ranjbar, Daya Publishing House, 2014.

REFERENCE BOOKS:

1. Sustainable mining in India – Overview of legal and regulatory framework, technologies and best process practices – Indian Chamber of Commerce and Cuts – Centre for International Trade, Economics and Environment, 2018.
2. Open Pit Mine Planning & Design – W. Hustrulid and M. Kuchta 3. Surface Mining (Second Edition) – Bruce A. kennedy.
3. Sustainable Mining Practices, Gorai, Narosa, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

GY23C09 APPLIED HYDROGEOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To teach the occurrence and distribution of groundwater in various geological formations.
- To provide knowledge on groundwater flow and groundwater resources estimation
- To educate on estimation of various aquifer parameters in the field.
- To give knowledge on groundwater quality assessment and sources of contamination.
- To teach various techniques of groundwater resources development.

UNIT I GROUNDWATER OCCURRENCE AND DISTRIBUTION 9

Introduction and scope; hydrologic/water cycle; hydrographs; origin and source; distribution of groundwater; porosity and types; hydraulic conductivity and transmissivity; specific yield and specific retention; storage coefficient; aquifers – types of aquifers; groundwater occurrence in various geological formations.

UNIT II GROUNDWATER FLOW AND RESOURCES ESTIMATION 9

Darcy's law – validity of Darcy's law – hydraulic gradient; Field and laboratory tests to find out hydraulic conductivity; flow nets; homogeneity and heterogeneity; isotropic and anisotropic formations; Water budgeting - groundwater resources estimation – static and dynamic reserve.

UNIT III ESTIMATION OF AQUIFER PARAMETERS 9

General groundwater flow equations – steady and unsteady radial flow towards wells – confined and unconfined aquifers; effect of aquifer boundaries; estimation of aquifer parameters by recovery tests; slug tests; introduction to groundwater modelling techniques.

UNIT IV GROUNDWATER QUALITY EVALUATION 9

Physicochemical parameters of groundwater – major ions and trace elements; water quality standards; groundwater quality representation charts and diagrams; suitability of groundwater for various uses; calculation of ion balance error; sources of contaminants – geogenic and anthropogenic; radiation in groundwater; groundwater pollution vulnerability mapping; seawater intrusion – causes and remediation; Groundwater quality case studies.

UNIT V GROUNDWATER RESOUCES DEVELOPMENT 9

Well construction and completion - shallow and deep well design; horizontal wells; infiltration galleries and collector wells; rainwater harvesting and artificial recharge of groundwater; hydrogeology of India; land subsidence. Groundwater development case studies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of this course, students are expected to:

- Understand various types of aquifers and groundwater occurrence.
- Compute groundwater flow and fluctuation and also groundwater resources.
- Estimate aquifer parameters using various field methods.
- Evaluate the suitability of groundwater for various needs.
- Plan for groundwater resources development and management.

REFERENCES:

1 Domenico P.A. and F.W. Schwartz, Physical and chemical hydrogeology. John Wiley 1997.
2 Fetter,C. W., Applied Hydrogeology, New York, Macmillan, 2001.
3 Freeze, R.A and Cherry, J.A, Groundwater, Prentice Hall, 1979
4 Elango, L and Jayakumar, R (Eds.) Modelling in Hydrogeology, Unesco-IHP Publications, Allied Publ, 2001
5 Elango, L (Ed.) Hydraulic conductivity – Issues, Determinations and applications, Intech Open Acces Publishers, ISBN 978-953-307-288-3, 434 P. 2011.
6 D. K. Todd and L. W. Mays, “Groundwater Hydrology,” 3rd Edition, John Wiley & Sons, Inc., New York, 2005.
7 Hiscock, K, Hydrogeology: Principles and Practice, Wiley-Blackwell, 2005
8 Goyal Manish Kumar, Engineering Hydrology, PHI Learning Pvt Ltd.2016

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

GY23C10 GEOSPATIAL TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To teach principles and concepts of Photogrammetry, Remote Sensing and visual interpretation of satellite images.
- To teach various GIS techniques.
- To give training on GPS measurements and digital image processing.
- To learn the applications of geospatial techniques in geological and geomorphological mapping
- To provide knowledge on role of geospatial techniques in geo-hazards and geo-environmental projects.

UNIT I PHOTOGRAMMETRY AND REMOTE SENSING 9

Introduction to aerial photography, Aerial and space borne platforms; Photogrammetry – principles and concepts, Scale of vertical aerial photography, Parallax and vertical exaggeration, Flight / Drone mission; Introduction to remote sensing; Types of remote sensing and types of satellites; Global and Indian space missions; Types of resolution; Multispectral and hyperspectral remote sensing; Scanning mechanism; Spectral signatures of natural and geologic features. Visual interpretation of satellite images – importance of image interpretation keys.

UNIT II GEOGRAPHICAL INFORMATION SYSTEM 9

Types of maps, Map scale, Various georeferencing and map projection systems; Introduction to GIS. Various Components of GIS; Types of data – spatial and non-spatial data; Vector and raster data; Digitization and scanning; Geo database – data input – retrieval – data presentation; Buffering and overlay analysis; Edge matching and rubber sheeting; DEM / DTM and TIN models; Assigning ranks and weights for geologic studies.

UNIT III DGPS AND DIGITAL IMAGE PROCESSING 9

Introduction to GPS and DGPS, Global and Indian GPS programmes; Applications of GPS. Digital image processing - Pre-processing / image rectification and restoration, Image Enhancement techniques; Image classification – unsupervised and supervised.

UNIT IV GEOLOGICAL AND GEOMORPHICAL APPLICATIONS 9

Geospatial technology for lithological and structural mapping; Geomorphological mapping; Land use/land cover change detection; Mineral targeting, Groundwater prospecting and artificial recharge; Hydrocarbon exploration. Case studies for the above.

UNIT V GEOHAZARDS & GEO-ENVIRONMENTAL APPLICATIONS 9

Geospatial technology for Route alignment; Site selection for various geological engineering projects. Landslides and earthquake studies, Coastal erosion and Coastal Zone Management; Marine exploration; Surface water and groundwater pollution; Case studies for the above. Application in Mining. Volume Calculation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student can

1. Understand the techniques of acquisition of data using airborne and space borne platforms.
2. Prepare various thematic maps using GIS techniques.
3. Enhance the quality of satellite images to extract more details
4. Interpret satellite images for geological and geomorphological studies
5. Apply remote sensing, GIS and GPS for various geo-hazards and geo-environmental studies.

REFERENCES:

1. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Private Limited, 2005 ISBN 8173715351, 9788173715358
2. Lillesand. TM.,Kiefer, R.W and Chipman, K.W. Remote sensing and image imterpretation Fifth Edition. Wiley. 2007.
3. Ravi P. Gupta, Remote Sensing Geology, Springer-Verlag New York, 2002.
4. Burrough, PA; and RA McDonnell. Principles of Geographic Information Systems. Oxford Press, U.K., 1998.
5. Wolf. P. R. Elements of Photogrammetry. Mc Graw Hill, Japan, 1993.
6. G. Rees. Physical Principles of Remote Sensing. Cambridge University Press, U.K., 2000.
7. SN Pandey, Principles and Applications of Photogeology: New Age International (P) Ltd., New Delhi. 1988.
8. Bai Tian GIS Technology Application in Environmental and Earth Sciences, CRC press, Taylor and Francis group LLC. ISBN 13: 978-1-4987-7604-2. 2017.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	2	2	3	2	1	2	2	2	2	2	3	2	1
3	3	1	2	1	2	3	1	1	2	2	2	1	2	2	2
4	2	2	2	1	2	2	1	2	2	2	2	2	2	1	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	1.8	2	1.6	2.2	2.4	1.4	1.8	1.6	1.8	1.6	1.8	2.2	2	1.6

GY23C11 GEOPHYSICAL EXPLORATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the physical properties of earth and application of physics in geology,
- To understand subsurface features and structures for better understanding of subsurface geology.
- To Familiarize the students on geophysical techniques and their field setup, data processing and interpretation.

UNIT I INTRODUCTION & ELECTRICAL METHODS 9

Scope of exploration geophysics – physical properties of the earth – Electrical methods – SP, IP, and resistivity methods - methods of electrode arrangement – field methods – interpretation – application electromagnetic methods – case studies.

UNIT II GRAVITY METHODS 9

Principle – field methods – gravimeters –calibration - corrections – interpretation of gravity data – determination of shape and depth of ore bodies –– corrections & applications – GRACE mission – case studies.

UNIT III MAGNETIC METHODS 9

Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys – Factors affecting magnetic anomalies - case studies.

UNIT IV SEISMIC METHODS 9

Seismic waves – travel velocity in various geological formations – principles – field operation – refraction and reflection survey – correction of seismic data – methods of interpretation – determination of attitude and depth of formations – applications- various types of shooting – case studies.

UNIT V RADIOACTIVITY METHODS AND WELL LOGGING 9

Fundamentals of radioactivity – principle of radioactivity methods –instruments – field methods, interpretation and Applications – Well logging - Self potential – resistivity – radioactivity logging methods – caliper and other miscellaneous logging methods – field procedure and interpretation of data – case studies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students are expected to be able to:

1. Have better understanding on the physical properties of earth and its layers
2. Understand the geophysical anomalies and their significance in subsurface exploration
3. Acquire skills on various geophysical methods and their field surveys
4. Collect data using various geophysical techniques and do analysis
5. Interpretation of data for exploration for minerals, oil and groundwater

REFERENCES:

1. Burger, H.R., Exploration Geophysics of the Shallow Subsurface, Prentice Hall, 1992.
2. Dobrin, M.B An introduction to geophysical prospecting, McGraw Hill, New Delhi,1984
3. Mamdouh R. Gadallah Ray Fisher. Exploration Geophysics , Springer 2009
4. John M. Reynolds , An Introduction to Applied and Environmental Geophysics Reynolds Geo-Sciences Ltd, UK, 1997
5. Ramachandra Rao, M.B. Outline of geophysical prospecting. Wesley press, Mysore, 1975
6. Rama Rao, B.S and Murthy I.B.R Gravity and magnetic methods of prospecting. Arnold Heinmann Pub. New Delhi, 1978.
7. Robinson, Edwin S., Cahit Coruh, Basic exploration geophysics. New York : Wiley, 1988.
8. Surface Geophysical Methods Volume 1, Fall 2004
9. Darling and Toby Well Logging and Formation Evaluation.Oxford UK, Elsevier. p 5p.2005 ISBN 0-7506-7883-6

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

GY23C12 MARINE EXPLORATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the Ocean features, geological resources, Ocean environment, and Ocean geology.
- To understand the exploration and exploiting methods
- And to understand the various instrumentations and its techniques.

UNIT I PHYSICAL FEATURES OF THE OCEAN 9

Introduction to Geological Oceanography. Classification of coasts. Ocean floor morphology. Description of Continental shelf, slope, rise and abyssal plains. Mid-oceanic ridge, Subduction zone and description of trenches, Ocean basins, Island arcs, Hot spots, Transform faults and Triple junction. Plate tectonics and Neotectonic processes.

UNIT II OCEANIC CRUST, SEDIMENTS 9

Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Ocean sediments, classification, digenesis, Ocean tectonics. Factors controlling the deposition and distribution of oceanic/marine sediments - Biogenous, Cosmogenous, Hydrogenous, Terrigenous and Authigenic.

UNIT III OCEAN RESOURCES 9

Classification of marine mineral deposits. Origin and depositional system of marine resources; beach placers, shelf deposits, deep ocean Phosphatic, Polymetallic nodules, sulfate deposits, hydrocarbon deposits, Ocean-energy resources, Tidal energy-potential, Wave energy-potential, Ocean Thermal Energy Conversion (OTEC), Sea water as a resource.

UNIT IV OCEANOGRAPHIC INSTRUMENTATIONS 9

Descriptions of research vessels, cruise, position fixing in the sea; sampling devices – Grab samplers, bottom samplers, dredges, sediment traps, boomerang samplers, water samplers, Winches, temperature measurement instruments, tools for studying ocean floor topography. POD, COD, GOD and BOD tools kit.

UNIT V OCEAN POLLUTION AND LAW OF THE SEA 9

Concept of sea level changes, physical and chemical properties of seawater. Marine pollution- pathways, residence time, pollutants in the marine environment. Law of the sea, Law of the Sea Treaty: EEZ. Fundamentals of Remote sensing applications to ocean science.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- Students will understand the physical features of the ocean
- Students will able to understand the morphologic and tectonic domains of the ocean floor
- Students will learn about the various ocean resources
- Students will understand the various oceanographic instrumentations used for marine exploration
- Students will able to understand the law of the sea

REFERENCES:

1. J.J. Bhatt. Oceanography – Exploring the Planet Ocean. D. Van. Nostrand Company, New York, 1994.
2. Shepard, F. P. Submarine Geology, Harper and Row Publ. New York, 1994.
3. Kerth. S, Ocean Science, John Wiley and Sons. Inc. New York. 1996.
4. James, K, Marine geology Prentice Hall, Inc. Englewood Clifs. N. J. 07632., 1981.
5. Eric. C. Bird Coasts: An Introduction to Coastal Geomorphology, III ed. Basil Black well Publ. 1984.
6. Suzy Bullock, Marine Geology,2017
7. Jon Erickson, Marine Geology: Exploring the New Frontiers of the Ocean, Facts On File Inc; Revised edition , 2002

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	2	2	3	2	1	2	2	2	2	2	3	2	1
3	3	1	2	1	2	3	1	1	2	2	2	1	2	2	2
4	2	2	2	1	2	2	1	2	2	2	2	2	2	1	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	1.8	2	1.6	2.2	2.4	1.4	1.8	1.6	1.8	1.6	1.8	2.2	2	1.6

GY23C13 COAL AND PETROLEUM GEOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the origin of Coal, petroleum and Nuclear minerals.
- To teach Indian occurrences of hydrocarbons.
- To teach students geological and geophysical exploration techniques.

UNIT I ORIGIN OF COAL AND ITS PROPERTIES 9

Origin of coal and its type. Coalification. Coal and its properties; proximate and ultimate analysis. Different varieties and rank of coal. Concept of coal maturity, peat, lignite, bituminous and anthracite coal. Lithotypes, microlithotypes and maceral groups of coal, mineral and organic matter in coal.

UNIT II INDIAN COAL FIELDS 9

Lithology, stratigraphy and structures of Gondwana coal fields and Tertiary coal fields of India and its properties. Coal utilization, Combustion, carbonization, gasification and hydrogenation.

UNIT III ORIGIN AND PROCESS OF HYDROCARBON FORMATION 9

Fundamental concepts of organic and inorganic theories of hydrocarbon. Sedimentary processes and accumulation of organic matter-diagenesis, catagenesis and metagenesis of organic matter. Generation, migration and accumulation of oil – short and long migration - primary and secondary migration – various traps - crude oil types, Oil fields of India.

UNIT IV GEOLOGICAL, GEOPHYSICAL AND GEOCHEMICAL METHODS 9

Sedimentary basin analysis to its Petrophysical properties, depositional environment and time line and bathymetry analysis. Seismic method of hydrocarbon reservoir exploration. Seismic reflection patterns and to decipher the depositional and structural features. Well logging techniques, interpretation of logs, geochemical parameters; determination of TOM, TOC, VRO, TTI, and TAMR

UNIT V NUCLEAR MINERALS 9

Geological characteristics of and genesis of major types of Uranium deposits. Distribution of Uranium deposits in India and its stratigraphy and structure and properties. Placer minerals properties, distribution. Origin, physical and chemical properties of Monazite, Thorium deposits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students expected to be able to:

1. Understand the processes of formation of coal, petroleum and nuclear minerals.
2. Have knowledge on different rank of coals and Indian occurrence
3. Do independent geological mapping for hydrocarbon exploration
4. Gain skills on geophysical and geochemical exploration methods.
5. Understand the scope of geology in strategic mineral exploration

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	2	2	3	2	1	2	2	2	2	2	3	2	1
3	3	1	2	1	2	3	1	1	2	2	2	1	2	2	2
4	2	2	2	1	2	2	1	2	2	2	2	2	2	1	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	1.8	2	1.6	2.2	2.4	1.4	1.8	1.6	1.8	1.6	1.8	2.2	2	1.6

GY23C14	ADVANCED MINING GEOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To teach students on surface and underground mining methods
- To teach ore reserve estimation and ore body modeling.
- To teach them mineral prospecting, sampling and drilling techniques.

UNIT I MINERAL MAPPING 9

Advanced surveying and mapping – Triangulation - Establishment of Local Base from National Grid Base-Review of Surface Mapping and Underground Mapping-Different Plans and Sections-Search for ore–Surface and Concealed Guides to ore - Persistence of ore in depth– Preliminary Investigations–Trenching, pitting, crosscutting, tunneling, ADIT; Data Interpretation – Drilling from pits.

UNIT II SAMPLING AND ASSAYING 9

Macro/Micro Economic Considerations - Sampling – Types - Sampling Quantity-Spacing, Sampling error of Mean-Sample Data Processing-Interpretation- Drilling – surface drilling and underground drilling, definition drilling – Core, Diamond Drilling arrangement - Core logging, Preparation of Slice Plan-Maximising Drill Data Vis-à-vis Cost of Drilling-Preparation of Assay Plans/Sections - Cutoff Grade- ROM Grade, Determination of Mineable Limits, Breakeven Stripping Ratio-Ultimate depth- Pit Limit for Different cut-off.

UNIT III ORE RESERVE ESTIMATION 9

Mineral Classification, Mineral Resources and Reserves – Types and Classification - Geological / Techno-economic Considerations in Reserve Classifications – Reserve Estimation Methods – Triple Axial System – UNSC, Simple problems.

UNIT IV OREBODY MODELLING 9

Integrating Surface/ Underground mapping - Drilling Sampling to evolve a 3D Model – Level plan and slice plan, Fold/Fault Interpretation from Maps and Bore hole Data – Software Applications in 3D orebody modelling including GIS.

UNIT V MINERAL PROJECT EVALUATION 9

Time Value of Money; Project Evaluation Technique - Pay Back, Discounted Pay Back, DCF, IRR; Project Ranking; Sensitivity analysis; Feasibility report preparation - Prospect and Operating Mines; Preparation of Mine Plan under Mineral Concession Rules.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students are expected to be able to:

1. Carryout individual mine survey using surveying methods
2. Do sampling and prepare slice plan.
3. Carryout ore reserve estimation for surface and underground deposits.
4. Gain knowledge on surface mining methods
5. Understand underground mining methods

REFERENCES:

1. Beth Thorpe, Mining Geology-Exploration and Management, Syrawood Publishing House, 2016.
2. Robert Stevens, Mineral Exploration and Mining Essentials, Pakawau Geo Management Inc, Reprinted, 2012.
3. R. N. P. Arogyswamy, Courses in mining geology. Oxford-IBH, New Delhi, 1994.
4. McKinstry, H.E. Mining Geology, Newyork: Prentice-Hall, Inc. 1970.
5. Deshmukh, D.J.. Elements of Mining Technology, Dhanbad: Vidyaprakshan, 1998.
6. Hustrulid, H.V and Mark Kuchta, Open Pit Mine Planning and Design Fundamentals, Brookfield USA: A.A Balkema, 1995.
7. Hartman. Howard L, Introduction to Mining Engineering, New York: John Wiley and Sons, 1987.
8. W.C.Peters, Exploration and mining geology. John Wiley & Sons, New York, 1987.
9. Ian Runge, C. 1998 Mining Economics and Strategy, Littleton USA: Society of Mining, Metallurgy and Exploration, Inc.
10. Chatterjee, Kaulir Kishore, 2003, Introduction to Mineral Economics, Chennai, Wiley Eastern Limited and Lakshmi Publications.
11. Bruce, A.K. 1990 Surface Mining, Colorado, Society for Mining, Metallurgy and Exploration, Inc. Published Mines/Minerals Legislations

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	1	1	2	2	2	2
2	2	2	3	2	3	2	1	2	2	2	2	2	3	2	2
3	3	3	2	1	2	3	1	1	2	2	2	1	3	2	2
4	2	2	2	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2.2	2.2	2.2	1.6	2.2	2.4	1.2	1.8	1.6	1.8	1.6	1.8	2.4	2.2	1.8

CY23C05	CHEMISTRY FOR MINING ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with chemical nature of building materials and composites
- To understand different kinds of lubricants adhesives and abrasives
- To know chemistry of different types of fuels and explosives

UNIT I CHEMISTRY OF BUILDING MATERIALS 9

Cement - chemical composition - setting and hardening - concrete - weathering of cement and concrete and its prevention; Special cements - high alumina cement, sorel cement, white Portland cement, water proofing, and quick setting cement; Lime - classification-manufacture, setting and hardening; Refractories - requisites - classification - common refractory bricks -preparation, properties and uses of silica bricks, high alumina bricks, magnesite bricks, carbon bricks, zirconia bricks and carborundum.

UNIT II COMPOSITES 9

Introduction to composites – Characteristics, Matrix materials –Types–Polymer matrix,metal matrix, ceramic matrix,carbon and graphite matrix material.Reinforcement– fiber, particulates,flakes and whiskers, Classification of composites – Particulates,fibrous and laminated composites–Hybrid composites –Application.

UNIT III ALLOYS AND PHYSICAL METALLURGY 9

Alloys: Introduction-definition-properties of alloys-significance of alloying, functions and effect of alloying elements-ferrous alloys-heat treatment of steel- Nonferrous alloys: importance-brass, bronze, aluminum alloys, solders, nickel alloys. Physical metallurgy-powder metallurgy- preparation of metal powders (mechanical pulverization, atomatization, chemical reduction, electrolytic process and decomposition)-mixed and blending, compacting – sintering– uses- advantages and limitations of powder metallurgy.

UNIT IV LUBRICANTS, ADHESIVES AND ABRASIVES 9

Lubricants - functions - classification with examples - lubricating oil; Semi solid lubricants - greases - calcium based, sodium based, lithium based; Solid lubricants - graphite and molybdenum sulphide - properties - viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud and pour point; Selection of lubricants - mechanism of lubrication. Adhesives - adhesive action - development of adhesive strength - physical and chemical factors influencing adhesive action - bonding process of adhesives; Phenol formaldehyde resins, urea formaldehyde resin, polyurethane, epoxy resins. Abrasives - Moh's scale of hardness - natural abrasives - diamond, corundum, emery, garnets and quartz - artificial abrasives - silicon carbide, boron carbide.

UNIT V FUELS AND EXPLOSIVES 9

Classification of fuels - comparison between solid, liquid and gaseous fuels; Calorific value - LCV and HCV; Characteristics of a good fuel, Coal - classification, analysis - proximate analysis and ultimate analysis; Coke - manufacture of metallurgical coke by Otto-Hoffman method; Petroleum - knocking - Octane Number - improvement of antiknock characteristics - diesel -Cetane Number; Gaseous fuels - composition and uses of producer gas, water gas and natural gas; Explosives - characteristics - classification -

chemistry of different types of industrial explosives: gun powder, dynamite, nitroglycerin based explosives, Ammonium nitrate based explosives, ammonium nitrate fuel oil, PETN, RDX and TNT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of the course the students will be able to

- Choose the correct building material for industrial applications
- Recognize and apply basic knowledge on different types of composite materials, their manufacturing and applications
- Identify and recognize the usage of alloys and powder metallurgy in the field of printing technology
- Recognize and apply basic knowledge on lubricants, adhesives and abrasives in engineering
- Gain knowledge on various fuels and explosives for mining applications

TEXT BOOKS:

1. Dara. S. S., A Textbook of Engineering Chemistry, S. Chand & Company Ltd., New Delhi, 2003.
2. Jain P. C. and Monica Jain, Engineering Chemistry, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2014.
3. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2015.

REFERENCE BOOKS:

1. Sharma B.K, Industrial Chemistry, Krishan Prakashan; 17/e edition, 2014.
2. Nathaniel Gordon,Alloys: Metallurgy and Engineering Hardcover, Willford Press, 2020
3. Sharma S.C., Composite Materials, Narosa Publishing House, New Delhi,2000

EE23050 ELECTRICAL DRIVES AND CONTROL L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Basic elements of electric drives - classification of electric drives- different types of mechanical loads-choice of electric drive - Four quadrant operation of drives-control circuit components: Fuses, switches, circuit breakers, contactors. Relay - control transformers.

UNIT II SPEED CONTROL OF DC MACHINES 9

Fully controlled and half controlled rectifier fed separately excited DC motor and DC series motor, Rectifier fed DC series motor - Chopper fed DC motor - Speed torque characteristics - Braking types dynamic and regenerative braking.

UNIT III SPEED CONTROL OF INDUCTION MACHINES 9

Induction motor - Stator voltage control - Rotor resistance control - slip power recovery scheme - Basic Inverter operation - V/f control - Constant torque and Constant hp mode of operation.

UNIT IV MOTOR STARTERS AND CONTROLLERS 9

DC motor starters using voltage sensing relays, current sensing relays and time delay relays - wound rotor induction motor starters – starters using frequency sensing relays -DOL -starter

UNIT V HEATING AND POWER RATING OF DRIVE MOTORS 9

Load diagram, over load capacity, insulating materials, heating and cooling of motors – classes of duty - Determination of Power rating – industrial application of DC and AC drives in mining.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- To understand the requirements of motor selection for different load profiles.
- To analyse the speed torque characteristics of converter/chopper fed DC motor.
- To analyse the speed torque characteristics of adjustable speed induction motor drives.
- To understand the control circuits for starting of DC and AC drives
- To determine the power rating of an electric drive system for various classes of duty.

TEXT BOOKS:

1. Gopal K.Dubey. 'Fundamentals of Electrical Drives' Alpha Science International Ltd., SecondEdition, 2010.
2. Vedam Subramanian, 'Electric Drives: Concepts and Applications' Tata McGraw Hil, New Delhi,Second Edition, Reprint, 2017.
3. S. K. Pillai, 'A first Course on Electrical Drives', New Age International Publishers, New Delhi,Second Edition, Reprint, 2004.

REFERENCES:

1. S.K Bhattacharya, Brinjinder Singh 'Control of Electrical Machines' New Age InternationalPublishers, Reprint, 2018.
2. John Bird 'Electrical Circuit theory and technology' Elsevier, Fifth Edition, 2014.
3. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2015.

MI23024	TUNNELLING ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic concept of tunnelling & ground improvement techniques.
- To understand the fundamentals design of tunnels.

UNIT I INTRODUCTION 8

Terminology & general aspects, historical developments of tunnelling, classification of tunnelling methods, merits and demerits, conditions favourable for tunnel construction - parameters influencing location, shape and size; surface and subsurface conditions; planning and site investigations like geology, hydrogeology, geological disturbances etc.,

UNIT II GEOMECHANICS 8

Classification and characterisation of rock mass and soil, in-situ determination of engineering properties of rock mass, geotechnical exploration for soil profile, effect of geological structures on tunnel excavation, stress analysis using numerical methods; instrumentation and measurements in tunnelling.

UNIT III CONVENTIONAL TUNNELLING METHODS 10

Factors affecting choice of excavation technique; various tunnelling methods - soft ground and hard rock, shallow tunnelling, deep tunnelling; Scaling factor using their properties in tunnel design; Operation cycles in conventional tunnelling; selection of drilling equipment, drilling tools, drillability factors; types of drilling patterns and vertical drilling; selection of blasting techniques - explosives, initiators,; blast design, tunnel blast performance - powder factor, equipment selection for mucking and transportation.

UNIT IV MODERN TUNNELLING METHODS 10

Tunnelling by roadheaders and impact hammers - cutting principles, method of excavation, selection, limitations and technical problems, tunnel boring machines - boring principles, method of excavation, selection, performance, limitations and technical challenges, scope of application, special methods - New Austrian tunnelling; Immersed tunnelling, micro tunnelling, tunnel jacking, technical considerations and limitations.

UNIT V SUPPORTS, VENTILATION AND SAFETY 9

Ground squeeze, rock burst, types of supports, design and selection of support - lining, rock bolt, grouting, ground treatment in tunnelling, tunnel ventilation systems during and after completion - methods of ventilation, air conditioning, tunnelling utilities - lighting and drainage of tunnels, risk management of tunnelling; Safety aspects in road, rail tunnels and metro tunnels.

OUTCOMES

1. The students will able to design the tunnel for the given geo-technical conditions and choose the type of the equipment and operations.
2. The Students will be able to recognize the different types of tunnelling methods, operations and equipment.
3. The students will have knowledge about tunnelling construction concepts.
4. The students will learn about tools and technology used for tunnelling construction.
5. The students will get adequate knowledge about various laws applicable to tunneling construction.

TEXT BOOKS:

1. Bernhard M. Markus T. Ulrich M., “Handbook Of Tunnel Engineering I & II: Basics And Additional Services For Design And Construction”, John Wile Publications, 2014.
2. Brady B H G, Brown E T, “Rock Mechanics: for Underground Mining”, Springer’s Publishers, 3rd Edition, 2004.

REFERENCES:

1. Champan D, “Introduction to Tunnel Construction”, CRC Press, 1st Editions, 2010.
2. Kuesel, T. R., King, E. H., Bickel, J. O. , “Tunnel Engineering Handbook”, Springer US, 2nd edition, 2011.
3. Ramamurthy T N, “Engineering in Rocks for Slopes Foundations and Tunnels”, PHI Learning Pvt Ltd, 2nd Edition, 2010.
4. Subhash C Saxena, “Tunnel Engineering”, Dhanpat Rai &Sons , New Delhi, 1998.
5. Srinivasan R, Bhaskar R C,“Harbour, Dock and Tunnel Engineering”, Charotar Publishers, 2003.

MI23025 UNDERGROUND SPACE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

The course enables the students to be familiar with the recent developments in various technologies used in underground spaces includes tunnelling and cavern projects across the world.

UNIT-I INTRODUCTION 7

Scope and application, historical developments, art of tunnelling, tunnel engineering, future tunnelling requirements. Types of Underground Excavations: Tunnel, adit, decline, shaft; parameters influencing location, shape and size, supports/lining; geological aspects; planning and site investigations.

UNIT-II DRILLING AND BLASTING 9

Drilling - drilling principles, drilling equipment, drill selection, specific drilling, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, types of cuts- fan, wedge, burn cut and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

UNIT-III MECHANISED EXCAVATIONS 10

Tunnelling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

UNIT-IV TUNNEL BORING MACHINES 11

Tunnelling by Roadheaders and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems. Tunnelling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

UNIT –V UNDERGROUND SPACE SERVICES 8

Supports in Tunnels: Principal types of supports and applicability. Ground Treatment like strata grouting or stabilization, pre-grouting & post-grouting in Tunnelling; Different strata grouting materials, techniques and operating parameters; Adverse ground conditions and its effect on tunnelling; Excavation of large and deep tunnels, caverns. Tunnel Services: Ventilation, drainage and pumping; Hazards in Tunnelling.

TOTAL: 45 PERIODS

OUTCOMES:

1. To acquire practical knowledge on design, construction and monitoring, maintenance and rehabilitation of tunnels and large underground earth-sheltered structures.
2. To determine the appropriate size, dimension and design of opening of underground space in different strata conditions.
3. The students will have knowledge about underground space construction concepts.
4. The students will learn about tools and technology used for underground construction.
5. The students will get adequate knowledge about various laws applicable to underground space construction.

TEXT BOOKS

1. Clark, G.B., (1987), Principles of Rock Fragmentation, John Wiley and Sons, New York.
2. Johansen, John and Mathiesen, C.F., Modern Trends in Tunnelling and Blast Design, AA Balkema, 154p, 2000.

REFERENCE BOOKS

1. Per-Anders Persson, Roger Holmberg, Jaimin Lee, (1993), Rock blasting and explosives Engineering, CRC Press, p.560.
2. Bickel, J.O., Kuesel, T.R. and King, E.H., Tunnel Engineering Handbook, Chapman & Hall Inc., New York and CBS Publishers, New Delhi, 2nd edition, Chapter 6, 544p, 1997.
3. Legget, R.F., Cities and Geology, McGraw-Hill, NewYork, 624 p., 1973.
3. Hudson, J.A., Rock Engineering Systems – Theory and practice, Ellis Horwood, England, 185 p.
4. Surface and underground excavations – methods, techniques and equipment – 2nd edition, by Ratan Raj Tatiya, Leiden, CRC Press/Balkema, 2013, 866 pp.
5. Mechanical excavation in mining and civil industries, by Nuh Bilgin, Hanifi Copur and Cemal Balci, Boca Raton, FL, CRC Press, Taylor & Francis Group, 2014, 366 pp
6. Raid Excavation and Tunneling Conference (2011). Edited by Steve Redmond and Victor Romero, Society for Mining, Metallurgy and Exploration Inc. (SME), 12999 E. Adams Aircraft Circle Englewood, Colorado, USA 80112 (www.smenet.org) ISBN 978-0-87335-343-4, pp. 1592

MI23026 NUMERICAL METHODS IN MINING ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To study the finite element methods, finite difference methods and boundary element methods
- To understand the practical applications of numerical methods in mining field

UNIT I INTRODUCTION TO ELASTIC AND PLASTIC MODELS 9

Fundamentals, elastic, plastic, homogeneous and isotropic, non-linear elastic and belastoplastic models.

UNIT II FINITE DIFFERENCE METHODS 9

Concept, formation of mesh element, finite difference patterns, solutions, application to mining.

UNIT III FINITE ELEMENT METHODS 9

Concept, discretisation, element configuration, element stiffness, assemblage and solutions, two and three dimensional solutions, linear and non-linear analysis, applications in geomechanics; simulation of joints in strata.

UNIT IV BOUNDARY ELEMENT METHOD 9

Concept, discretisation, different methods of solution for isotropic and infinite media.

UNIT V PRACTICAL APPLICATIONS IN MINING AND ROCK MECHANICS 9

Practical Applications in stress analysis, slope stability, subsidence prediction, pillar design, rock burst, etc.

TOTAL: 45PERIODS

OUTCOME:

- The students will get the concept about finite element models, methods and boundaryelements method and its practical applications in mining and rock mechanics

TEXT BOOKS:

1. Desai, C.S. and Abel, J.F., Introduction to the finite Element Method, Van Nostrand Riehokl Co., New York, 1983.
2. Zienkiewicz, O.C., The Finite Element Method in Engineering Science, Tata McGraw Hill 1972.

REFERENCES:

1. Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 1987.
2. Mukhopadyay, M., Matrix Finite Element – Computer and Structural Analysis, Oxford and IBH Publishing co., 1984
3. Brown, E.T., (Ed) Analytical and Computational Methods in Engineering and Rock Mechanics, Allen and Unwin, London, 1987.

MI23027 **NON-DESTRUCTIVE TESTING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

On completion of this course, the students are expected to be conversant with

1. Principles of various NDT techniques
2. The equipment required for the NDT
3. The mechanism involved in there NDT techniques
4. Applications of NDT and recent trends in NDT

UNIT I LIQUID PENETRANT AND MAGNETIC PARTICLE INSPECTION 9

Liquid penetrant systems – processing cycles – inspection of surface defects – Generation of Magnetic fields – Magnetic particle inspection equipments – Demagnetization – Applications and limitations.

UNIT II RADIOGRAPHY 11

Production of x-rays – Characteristic rays and white ray – Tube current and Voltage – Sources of 8 rays – Half life period – Penetrating power – Absorption of x and y rays – Radiation contrast and film contrast – exposure charts – pentameters and sensitivity – Safety.

UNIT III EDDY CURRENT INSPECTION 7

Eddy current production – Impedance concepts – Inspection of magnetic materials – Inspection of non magnetic materials – influences of various parameters – Advantages and limitations.

UNIT IV ULTRASONIC TESTING 10

Production of ultrasonic waves – Different types of waves – normal beam inspection – Angle beam inspection – thickness measurements – Applications.

UNIT V RECENT TECHNIQUES 8

Non destructive inspection– Instrumentation for non destructive testing – Principles of holography Principle of acoustic emission – Applications of holographic techniques– advantages and limitations – Other techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have knowledge about liquid penetrant systems, magnetic fields, etc.
2. The students will have basic understanding of characteristics of rays, half life period, etc.
3. The students will have knowledge about eddy current, their advantages and limitations, etc.
4. The students will have adequate knowledge about ultrasonic waves their types and applications.
5. They will also learn about recent techniques of non-destructive testing.

TEXT BOOK:

1. Barry Hull and Vernon John, “Non Destructive Testing”, MacMillan, 1988.

REFERENCES:

1. Americal Society of Metals, Metals Hand Book, 9th Edition, Volume 11 (1980)
2. Birchan, D, “Non Destructive Testing”, Oxford University Press, 1977.
3. Proceedings of the 10th International Acoustic Emission Symposium, Japanese Society for Non Destructive Inspection, Sendai, 1990.
4. Holler, P., “New Procedures in Non Destructive Testing” Springer Verlag, 1983

LIST OF HONOR SUBJECTS

MI23028	MINE CLOSURE PLANNING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the principles, processes and methodologies associated with mine closure planning
- To work out and develop mine closure plan in accordance with the mining and environmental laws.

UNIT I INTRODUCTION 9

Mine Closure concepts and concerns; Mine Closure Planning and its components, need of Closure Planning in mining ventures; technical information for Closure Planning.

UNIT II MINE CLOSURE STAGES 9

Issues in mine closure planning. Different mine closure operations. Role of regulatory authorities and mine operator in mine closure. Tools and Techniques for Mine Closure; Post-mining site rehabilitation programme.

UNIT III FINANCIAL PROVISIONS 9

Mine Closure Finance; Principles, planning, financial provisions, implementation, standards for closure criteria, systems approach for mine closure and development of closure plan.

UNIT IV ENVIRONMENTAL CRITERIA 9

Factors to be considered, Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) preparation, Mine Closure Planning. Sustainable Development and Mine Closure. Sustainable Post mining Environmental Care.

UNIT V LEGAL PROVISIONS 9

Legal provisions for environmental protection – various acts, rules and regulations and various legal aspects of mine closure planning. Its advantages and amendments. Guidelines from Ministry of Environment, Forest and Climate change. Preparation of a Mine Closure Plan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have basic knowledge about factors related to mine closure planning.
2. The students will have knowledge about various mine closure concepts.
3. The students will learn about mine closure tools and technology.
4. The students will get adequate knowledge about various laws applicable to mine closure.
5. They will also learn about the different types of financial provisions applicable for mine closure activities.

TEXT BOOKS:

1. Hartman,H.L.,IntroductoryMiningEngineering,JohnWileyandSons,NewYork,1987
2. Mineral Deposit Evaluation: A practical approach by Alwyn E. Annels 1991.
3. SME Mining Engineering Handbook 2nd Edition, Howard L. Hartman, 1992.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23029 **MINE ECONOMICS AND VALUATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To conversant with importance of mineral economics
- To aware about the various financial aspects of mineral industry.

UNIT I INTRODUCTION 9

Introduction: Importance of Mineral resource in Economy; Mineral Resources & Reserves - concept, Economic importance of the mineral industry; mining economy, risky nature of the mining industry, Demand and Supply, Elasticity of Demand, national mineral policy.

UNIT II MINING COST 9

Elements of Economics, Factors of Production, Functions and Forms of Capital, Market Systems, Trade Cycle.
Mineral price and pricing, Capital and operating costs; factors affecting operating cost; methods of estimating future costs; standard cost and forecast; budget and budgetary control.

UNIT III MINE VALUATION 9

Basic concept, Earlier approaches to mine valuation, recent approaches to valuation; Time value of money Price information – revenue estimates, taxes, Accounting profits and cash flows.

Financial Management - Methods of financing industrial enterprises, Sources of funding Enterprises, shares, debentures, dividends and interest. Break even chart and inventory control computations.

UNIT IV INVESTMENT APPRAISAL 9

Elements of investment appraisal, Static methods of investment appraisal; Investment Decisions - discounted cash flow methods, non-discounted cash flow methods, advantages and disadvantages of them, Internal Rate of Return & Return on Investment, Net Present Value. Book keeping, balance sheet, profit and loss statement.

UNIT V TAXATION SYSTEMS AND PROJECT REPORTS 9

Mineral Taxation System, Internal and External Trade, Mineral information system; Pre-feasibility, feasibility, and detailed project reports.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will have basic knowledge about economic importance of the mineral industry.
2. The students will have knowledge about mine economics concepts.
3. The Students will learn about markets, pricing and profit
4. To gain a practical understanding of economic evaluation and financial analysis methods and their application to mineral projects
5. To understand various evaluation techniques for investment decision making, taxation system basics in India and other countries.

TEXT BOOKS:

1. Applied Geostatistics by Edward H. Isaaks
2. Geostatistics: Modeling Spatial Uncertainty Novel by Jean-Paul Chilès and Pierre Delfiner
3. An Introduction to Mineral Economics by K. K. Chatterjee.

REFERENCES:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO 1992.
5. Indian MiningYear Book 1994 – MMRDAct and Mineral Concession Rules.
6. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8th edition, 2017
7. T.S. Reddy & A. Murthy, Financial Accounting, Margham Publications, 2014.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
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3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23030	MINE MANAGEMENT	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To conversant with significance & role of mine management
- To make conversant with management, organization, structures, personnel management and managerial behaviors.

UNIT I EVOLUTION OF MANAGEMENT THEORY 9

Principle of Scientific & Administrative management, Behavioral Management, Management functions, Planning, Organizing and Control, Levels of Management. Structure of organization for Enterprises, Roles & Skills of Managers.

UNIT II PERSONNEL MANAGEMENT 9

Selection, training and executive development program of human resources, Essence of Manpower planning, Job evaluation, Performance Appraisal, Job analysis, Incentive, human needs and various need hierarchy theories, X theory & Y theory and Huzbergs motivational theories; Leadership – role of leader & types of leadership. Effective Communication and Counseling skills in mining industry. Absenteeism – causes and remedy - in mining industry.

UNIT III PRODUCTION MANAGEMENT 9

Determination of norms and standards of operations by work study, work measurements, Production planning, Scheduling and control, Queuing theory, short and long term planning, Productivity - its concept and measurement, Quality control. Introduction to ISO 9001-2 & 14001, Quality Circle, TQM& TPM. Industry 4.0, Material Management – Models, Stores, Warehouse & Logistic management.
Introduction, components and nature of inventory problems, Classical EOQ model; EOQ model with quantity discount; Static and dynamic inventory problems.

UNIT IV INDUSTRIAL PSYCHOLOGY 9

Definition & Applications, Personality Traits & Theories, Studies of physical factors and their effect on man, Psychological tests and Uses. Industrial relations, Human relations, Industrial Disputes – Causes, Analysis of industrial disputes, Prevention and settlement of industrial disputes, Trade union movements in India.

UNIT V INDUSTRIAL ACT AND LAWS 9

Industrial Dispute Act, Industrial Trade Union Act, Payment of wages Act, Workmen's Compensation Act, Contract Labor Laws.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To know managerial aspects of mines and its organization and structures,
2. To understand the fundamentals of principles of management
3. To learn the application of management principles in mining industries.
4. To understand the overview of various management laws applicable to the mining industry.
5. To study the behaviour science, industrial psychology and motivations etc human aspects

TEXT BOOKS:

1. Mine Management, V.N. Singh, Lovely Prakashan, 2003.
2. Industrial Engineering and Management (17th Edition) by O.P. Khanna
3. Personnel Management and Industrial Relations by Dr. Satish Mamoria & Dr. Mohan Lal Dashora Dr.Chaturbhuj Mamoria
4. Industrial-Engineering-Production-Management M. Mahajan, Dhanpat Rai & Co. (P) Limited.

REFERENCES:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. DGMS Circulars pertaining to Labour Welfare & Rehabilitation, 2023.
3. Khanna, O.P., Rai, D. Industrial Engineering and Management, 2005.
4. Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2005.
5. Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2004.
6. Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23031	MINE ACQUISITION AND OPERATIONALIZATION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the different statutory provisions of ownerships, auction, mineral acquisition.
- To make conversant with operationalization of the mines.

UNIT I AUCTION LAWS 9

Procedure for obtaining non-exclusive reconnaissance permits (NREP), mining lease or composite license (prospecting licence-cum-mining lease) of coal and non-coal mineral, Salient provisions of Mineral Auction Rules, 2015.

UNIT II FEASIBILITY REPORT 9

Introduction of UNFC classification, Mineral (Evidence of Mineral Content) Rules 2015, Preparation of geological study report, prefeasibility report, and feasibility report.

UNIT III MINE PLANNING 9

Mining plan, Mining scheme, progressive mine closure plan and final mine closure plan for coal/non-coal mine as per the guidelines issued by Ministry of Coal/IBM. Case studies.

UNIT IV ENVIRONMENTAL CLEARANCE 9

Provisions for obtaining prior Environment clearances under EIA Notification 2006, Forest clearance under Forest Conservation Act, Recommendations of the Standing Committee of National Board for Wild Life under the Wild Life (Protection) Act 1972, Consent to establish under Water and Air Act, Consent to operate under Water and Air Act, etc . Study of EIA report and EMP of mining projects. Case Studies.

UNIT V LAND ACQUISITION LAWS 9

Salient provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013 (LARR Act), The Coal Bearing Areas (Acquisition and Development) Act, 1957.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To know legal aspects of acquisition of mineral deposits and mines.
2. To understand the fundamentals of project report preparation.
3. To learn the application of mine planning principles in acquisition of mining projects.
4. To understand the overview of environment laws applicable to the mining industry.
5. To study the land acquisition laws.

TEXT BOOKS:

1. Mines And Minerals (Development and Regulation) Act, 1957
2. Mineral Conservation and Development Rules, 2017
3. The Coal Bearing Areas (Acquisition and Development) Act, 1957
4. The Mineral Concession Rules, 2016
5. Coal Mines Special Provisions Act, 2015
6. Mineral Auction Rules, 2015
7. Minerals (Evidence of Mineral Contents) Rules, 2015

8. Land Acquisition Act, 1894
9. Land Acquisition, Rehabilitation & Resettlement Act 2013
10. National resettlement and Rehabilitation Policy (NRRP) 2007

REFERENCES:

1. Guidelines issued by IBM for preparation of Mine plan and mine closure plan
2. Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Order, 2015
3. The Environment (Protection) Act, 1986
4. Forest Conservation Act, 1980
5. The Wild Life Protection Act, 1972
6. Water (Prevention and Control of Pollution) Act, 1974
7. Air (Prevention and Control of Pollution) Act, 1981

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23032 **PLANNING AND DESIGN FOR TUNNELS** **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To expose the students with concepts of planning and design for tunnel and underground space.
- To understand the principles, processes and methodologies associated with tunnel and underground space planning.

UNIT I NEED FOR UNDERGROUND SPACE 9

Engineering and Strategic Utilities, Planning and design process for excavation of roadways, tunnels and caverns, Tunnel Layout.

UNIT II GENERAL CONCEPTS 9

Benefits and drawbacks, classification and configurations, psychological and physiological effects, Legal and administrative issues, exterior and entrance design, layout and spatial contributions

UNIT III GEO-ENGINEERING INVESTIGATIONS 9

Topographical and geological survey, augering, drilling, soil and rock sampling and testing, preparing sub-surface geological cross section, georadar use and data analysis for shallow tunnels, geophysical investigations to prove deeper sub-surface features, Geotechnical investigation, Physico-mechanical properties and collection of rock mechanical data, stability analysis and identification of failure.

UNIT IV PLANNING AND DESIGN 9

Determination of appropriate location, size, shape and alignment, Assessment of behavior of tunneling media - deformation modulus and support pressure measurement, instrumentation and monitoring of rockmass performance, application of numerical modelling in space design, earthquake effects on tunnels, design of underground space in rocks with the help of field data. MEP: Mechanical, Electrical and Plumbing Services for Tunnels and Caverns.

UNIT V TUNNELING TECHNOLOGY 9

Trenchless Technologies: Horizontal directional drilling, Micro Tunneling, Boring equipment; Feasibility assessment and Report preparation for tunnels; Case studies of planning and design: Metro, highway tunnel, underground station, storage of oil & gas, food, Water/sewage treatment plants, immersed tunnels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To learn the entire aspects of planning and design of tunnels from exploration through to design and engineering.
2. To understand the basic principles of tunnel planning, the processes and the methodologies keeping in mind the global best practices.
3. To understand the overview of environment laws applicable to the tunnelling industry.
4. To study the case studies of planning and design of tunnels.
5. To prepare the feasibility assessment report for the tunnels.

TEXT BOOKS:

1. Goel, R. K., et. Al (2012), Underground Infrastructures, Planning, Design and construction, Elsevie.

REFERENCES:

1. Admiraal, H. et al (2018), Underground Spaces Unveiled, ICE
2. Barry N. Whittaker, Russell C. Frith (1990), Tunnelling: Design, Stability and Construction Books, IMM publication

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23033	NOVEL METHODS OF MINING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To expose the students with concepts of planning and design for novel methods of mining.
- To understand the application of different novel mining methods.

UNIT I NEED FOR NOVEL METHODS 9

Borehole Mining: Borehole mining of coal, uranium, Sulphur. Drilling, maintenance services, Jet Cavitation and fracturing, Solution mining of important minerals, leaching.

Coal Bed Methane: Coal Fundamentals and Geology, Key Coal Properties, Coal Permeability, Measurement of Coal bed Gas Content, Elements of a CBM, Isotherms, and Recovery Factor, Development Considerations, Well Design and Drilling, Gas Recovery & Well Performance

UNIT II NOVEL CONCEPTS 9

Coal Gasification: Introduction to gasification: Chemical reactions, Process technologies: Coal Liquefaction, Underground gasification – principles and potential, Conversion of coal to syngas, Impact of coal properties on gasification. Case studies in India and abroad.

UNIT III GEO-ENGINEERING INVESTIGATIONS 9

Hydraulic Mining: Introduction, Process of hydraulic mining, hydro monitors, water jets, surface and underground layouts, merits and impacts.

UNIT IV PLANNING AND DESIGN 9

Determination of appropriate location, size, shape and alignment, Assessment of behavior of tunneling media - deformation modulus and support pressure measurement, instrumentation and monitoring of rockmass performance, application of numerical modelling in space design, earthquake effects on tunnels, design of underground space in rocks with the help of field data. MEP: Mechanical, Electrical and Plumbing Services for Tunnels and Caverns.

UNIT V NOVEL TECHNOLOGY 9

Mining of placer deposits, Ocean Floor Mining, Deep Ocean exploration, sea bed mining, ocean floor nodules mining, technology, dredgers and other machines for mining and transport.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To learn the entire aspects of planning and design of novel mining technology.
2. To understand the basic principles of novel mining and the methodologies keeping in mind the global best practices.
3. To understand the overview of environment laws applicable to the novel mining technology.
4. To study the case studies of novel mining technology.
5. To prepare the feasibility assessment report based on the geo-engineering investigations.

TEXT BOOKS:

1. Underground Mining Methods SME Mining Engineering Handbook 2nd Edition Howard L. Hartman
2. Introductory Mining Engineering : Hartman 2nd Edition,
3. Society of Mining Engineering Handbooks –Vol. I and II.

REFERENCES:

1. Techniques in Underground Mining - Selection : Richard E. Gertsch et al, SME 1998
2. Underground Mining Methods: Engineering Fundamentals and International Case Studies: A. Hustrulid, 2001

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

GY23C07	MINERAL EXPLORATION AND GEOSTATISTICS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To expose the students with concepts of Mineral exploration and Geostatistics.
- To understand the application of different Geostatistics tools in the mineral industry.

UNIT I INTRODUCTION 9

Introduction to mineral exploration; Significance and necessity; Prospecting and exploration criteria; Exploration strategy and design - stages of mineral exploration; theory and methods of sampling; resources and reserves - terminology and classification schemes; conventional methods of ore estimation.

UNIT II GEOSTATISTICS 9

Introduction to geo-statistics and statistical estimates using population and samples; Concept of Random variables; Probability and Lognormal distribution. Basics of Geo-statistics: Regionalized variable and data analyses.

UNIT III SEMI-VARIOGRAM AND CO-VARIOGRAM 9

Definitions, characteristics, and computations in one, two and three dimensions; mathematical models; associated difficulties viz. anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend.

UNIT IV KRIGING 9

Introduction to Kriging: Linear, Ordinary and Simple kriging; Solving kriging system of equations for Point and Block Kriged Estimates and Kriging Variance with some examples number of samples. nugget effect. Influence of Nugget effect on kriging weights; Properties of kriging.

UNIT V GEOSTATISTICAL APPLICATIONS 9

Geo-statistical evaluation of mineral deposits, ore body modelling, calculation of mineral resource inventory, grade-tonnage relationships, role of kriging variance in optimization of exploration drilling and misclassified tonnages.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Understand the basic concepts of geo-statistics and statistical estimates.
2. Gain knowledge on semi-variogram and its application in mineral exploration.
3. Solve the different kriging system of equations and understand nugget effect.
4. Understand the concepts of mineral resource inventory and geostatistical simulation.
5. To study the Geostatistical applications in the mineral industry.

TEXT BOOKS:

1. Mineral Exploration: Principles and Applications, Swapan Kumar Haldar, Elsevier Science Publishing Co Inc; 2nd edition, 2018.
2. Novel Methods and Applications for Mineral Exploration, Paul Alexandre, MDPI, Switzerland, 2020.

REFERENCES:

1. Mining geostatistics, Andre G. Journel, 1998
2. Economic Evaluations in Exploration, Friedrich-Wilhelm Wellmer, Manfred Dalheimer, Markus Wagner, 2nd Edition 2008.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23034	DIMENSIONAL STONE TECHNOLOGY	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To expose the students with concepts of Dimensional Stone Technology.
- To understand the application of different tools & techniques in the dimensional stone industry.

UNIT I INTRODUCTION 9

Resources of Marble, Granite, Slate, Sandstone and Limestone as Dimensional stones in India vis a vis world, uses, marketing, export. Geological, mineralogical and physico-mechanical properties of dimensional stones; Criteria for selection of dimensional stone deposit. Procedure for obtaining mining lease and preparation of project proposal.

UNIT II MINING TECHNOLOGY 9

Conventional mining of Sandstone, Limestone, Marble and Granite; Recent developments- wire saw including blind cut technique, chainsaw, belt saw, hydraulic splitting, flame jet cutting, water channeling etc; Blasting techniques in dimensional stone mines: various types of explosives used, controlled blasting for providing horizontal & vertical cut; Splitting by swelling material.

UNIT III DIMENSIONAL MINING TECHNIQUES 9

Insitu splitting technique used in compact limestone for utilization of waste as dimensional stone. Various types of loaders, cranes and hydraulic excavator used in dimensional stone mines; Quarry layouts. Hole making technique using hole-finder and laser beam. Application and development of diamond tools, formation of stone block and their handling.

UNIT IV PROCESSING 9

Dressing- Mono block dresser; Sawing- gang saws, circular saws; Preparation and mounting of blades/discs and segments; 94 slab repair by resin Polishing - Manual, Mechanical; Various types of polishing machines; Abrasives- type, use and selection, shaping; Tile preparation; Automatic tiling plant, slurry handling and treatment including water supply; Multiwire technology.

UNIT V ENVIRONMENTAL ISSUES IN DIMENSIONAL MINING 9

Environmental impacts of mining and processing of dimensional stones; Secondary use of quarried land and waste of the industry; Land reclamation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To acquire knowledge to excavate blocks of marble, granite, sandstone etc.
2. Gain knowledge on understanding of various techniques of dimensional stone mining including diamond wire saw, blind cut technique.
3. To get the benefit of processing techniques such as gang saws, automatic tiling plant, multiwire machine for slab making etc.
4. To Understand the concepts of processing technology pertaining to dimensional stone mining.
5. To study the environmental impacts due to mining and processing.

TEXT BOOKS:

1. Rathore S. S., Bhardwaj G. S., Jain S. C; “Dimensional Stone Technology” Himanshu Publication New Delhi.

REFERENCES:

1. Rathore S. S., Laxminarayana V.; “Safety and Technology in Marble Mining and Processing in New Millennium” Proc. Of National Workshop held March 10-11 200 Udaipur
2. Rathore S. S., Gupta Y. C., Parmar R. L.; “Recent Development in Machinery and Equipment for Dimensional Stone Mining” held Dec. 13-14, 2003 at Udaipur.
3. India Stones, Business Magazine on Indian Stone Industry, Pub. ICONZ Communications, 203, Mahaveer Residency, 15 Main J. P. Nagar, 5th phase, Bangalore

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
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3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23035	OPEN PIT SLOPE ANALYSIS AND DESIGN	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand revolving the basic mechanics and various types of rock slope failures
- To acquire adequate knowledge on analysis and design of slopes in highwall benches and dumps.

UNIT I INTRODUCTION 9

Types and formation of slopes in surface mines, pit slope vis-à-vis mine economics, mechanism of common modes of slope failure, factors influencing stability of slopes, and planning of slope stability investigations.

UNIT II GEOTECHNICAL INFORMATION 9

Geotechnical data required for highwall slope stability studies. Collection of Geological Data and their interpretation for stability studies of highwall slopes.

UNIT III SHEAR STRENGTH CHARACTERISTICS 9

Shear strength of intact rock, discontinuity surfaces, filled discontinuities and rock-mass - estimation and determination; Surface roughness, joint roughness coefficient –estimation and determination.

UNIT IV WATER FLOW PARAMETERS 9

Concepts of water flow through a material and its permeability; water flow through rock-mass, water flow through soil type material and broken spoil material; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.

UNIT V DESIGN OF PIT SLOPES AND DUMPS 9

Slope stability assessment methods and techniques; Analysis and design criteria and methodology for highwall slopes and backfill and waste dumps; Probabilistic approaches of slope analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters.
2. The students will understand the parameters influencing the slope stability.
3. The students will acquire knowledge different types of failure modes.
4. The students will have enhanced knowledge analysis and design of slopes for both highwall benches and dumps.
5. They will also know about techniques & guidelines for slope monitoring programs

TEXT BOOKS:

1. Duncan C.Wylie and ChristopherW. Mah, Rock Slope Engineering, 4th Edition, CRC Press, 456p, 2004.
2. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.

REFERENCES:

1. John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1st Edition, CRC Press, 510p, 2009.
2. William A. Hustrulid (Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Slope stability in Surface Mining, Society for Mining, Metallurgy, and Exploration, 442p, 2001.
3. John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4th Edition, Wiley-Blackwell; 4 edition, 488p, 2007.
4. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989.
5. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction, A.A. Balkema, Netherlands, 2006.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	3	2	2	2	0	0	2	2	2	2
2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2
3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23036	ROCK BLASTING TECHNOLOGY FOR MINING AND CONSTRUCTION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To make conversant with rock fragmentation by using explosives.
- To learn blast design in mining and construction projects.

UNIT I HISTORY AND USE OF EXPLOSIVES 9

blasting and its applicability to mining and construction industry. Role of blasting in production of minerals and in construction industry. Blasting inputs and outputs, Controllable and non-controllable parameters. Blast Economics, blasting costs and role of fragmentation with blasting costs, cost optimization, Environmental impact of blasting.

UNIT II EXPLOSIVES HANDLING AND MECHANICS OF BLASTING 9

Basics of Explosives and their classifications as low explosives, high explosives and blasting agents; Indian classification of explosives. Properties of explosives for their selection, Testing of explosives for safety. Standards of storage and handling of explosives, Provisions in Explosives Act and legal aspects of explosives

Various Pattern of holes for drives and drift, roadways, underground storage and tunnels, pattern of holes for surface excavation, Blasting accessories and tools. Initiation system and firing sequences. Blasting operation in surface and underground coal mines, metal mines, drifts, shaft, tunnels and caverns. Safety precautions during blasting, blasting fumes.

UNIT III ROCK EXPLOSIVE INTERACTION 9

Various rock fragmentation theories. Role of rock parameters, explosive parameters and blast design parameters on blasting. Evaluation of blasting results, techno economic evaluation of fragmentation, fragmentation Analysis of production blasts, fragmentability and productivity. fragmentation and costs, effect of structural discontinuities on blasting results, Use of various software and Blast Information Management Systems etc.

UNIT IV BLAST DESIGN FOR MINING AND CONSTRUCTION 9

Blast designs for tunnels, caverns, nuclear waste disposal and other domestic purpose. Blast design for surface workings and opencast mines. Blast design for non-coal and coal mines. Ground vibrations, fly rock and noise due to blasting. Minimization of environmental damages due to blasting.

UNIT V CONTROLLED BLASTING TECHNIQUES 9

Controlled blasting techniques for surface blasting and underground blasting, Use of innovative techniques in blasting like, air deck, cushion blasting, underwater blasting, blasting near sensitive structures, cast blasting etc. use of blasting techniques for demolition of structures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. To understand the basic characteristics of explosives
2. To know the mechanism of rock breakage utilization of explosives energy.
3. To conduct the blasting operation in mine and its safer aspects.
4. To design the optimum blast and control measures
5. To design the controlled blast techniques & guidelines for environmental sustainability and safety.

TEXT BOOKS:

1. Gokhale, B.V., Rotary Drilling and Blasting in Large Surface Mines, 2nd Edition, CRC Press, 2011.
2. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A.A.Balkema, Rotterdam, 1995.
3. Rao, K.U.M, and Misra, B., Principles of Rock Drilling, Oxford & IBH Publications, New Delhi, 1998.

REFERENCES:

1. Antipas Massawe, Drilling and Blasting Part I: Blasting Lectures and Tutorials,
2. 1st Edition, LAP Lambert Academic Publishing, 2010.
3. Antipas Massawe, Drilling and Blasting Part II: Drilling Manual, 1st Edition, LAP
4. Lambert Academic Publishing, 2010.
5. Bhandari,Sushil, Engineering Rock Blasting Operations, A.A.Balkema, Rotterdam,
6. 1997.
7. Clark, G.B., Principles of Rock fragmentation, Wiley Interscience Publication,
8. 1987.
9. Chugh, C.P., Diamond Drilling, Oxford & IBH Publications New Delhi, 1999.
10. Hustrulid, W.A. Blasting Principles of Open Pit Mining,Vol.1- General Design
11. Concept, A.A. Balkema, Rotterdam, 1999.
12. Janusz Reś, Krzysztof Wladzielczyk and Ajoy K. Ghose., Environment-friendly
13. Techniques of rock breaking, CRC Press, 2003.
14. Konya, C.J. and Walter, E.J. Surface Blast Design, New Jersey, 1990.
15. Langefors, U., and Kihlstrom, (1973), B., The Modern Techniques of Rock Blasting, URMO Publications.
16. Per-Anders Persson, Roger Holmberg, and Jaimin Lee. Rock Blasting and Explosives Engineering, CRC Press, 1994.
17. Pradhan, G.K., and Sandhu, G.S., Manual of Rock Blasting, IME Publications, 1996

CO-PO & PSO MAPPING

CO	PO												PSO		
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3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
AVG	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23901 MINING FOR NATION BUILDING L T P C
3 0 0 3

OBJECTIVES:

- To understand importance of Mineral & Mining industry and their contribution to economic growth of the nations and to the mankind.
- To understand the methods of exploration of minerals and to establish mineral resources.
- To learn the various surface, underground mining methods, slope stability and mineral processing and its impacts on the society.

UNIT I INTRODUCTION TO MINING INDUSTRY 9

Introduction to mining industry, National Mineral Policy, 2008, Classification of Mineral Deposits, Importance of mineral & mining industry in national growth, Economic Mineral Deposits and Host Rocks. Mineral Sampling Equipment, Sampling Methods, Sample Reduction for Chemical Analysis, Accuracy and Due Diligence in Sampling, Quality Assurance and Quality Control, Optimization of Samples.

UNIT II SURFACE MINING 9

Classification of surface mining methods, applicability and limitations, significances of surface mining, concept of stripping ratio, working pit slope and ultimate pit slope, common modes of slope failures, factors influencing stability of slopes, Types of waste dump – internal and external; dump formation methods and corresponding equipment; Dump stability and stabilization measures.

UNIT III UNDERGROUND MINING & MINERAL PROCESSING 9

Classification of underground mines (coal & metals), comparisons of underground coal mining with metal mining, Rock Mechanics and Support System, Mine Closure Procedures. Ore Handling, Comminution, Screening and Classification, Concentration, Metallurgical Accounting, Ore to Concentrate and Metal.

UNIT IV LEGAL FRAMEWORK OF MINING 9

Allocation of jurisdiction over minerals and mines under the Constitution Minor minerals and other minerals; National Mineral and Exploration Policy, 2016. Overview of laws: Indian Mines Act, 1952; Mines and Minerals (Development and Regulation) Act, 1957; Mineral Conservation and Development Rules, 2017, Minerals (Evidence of Mineral Contents) Rules, 2015; Atomic Energy Act, 1962.

UNIT V ENVIRONMENT PROTECTION 9

Proprietary rights over minerals: Articles 294 and 297 Coal; Mineral Concession Rules, 1960; Powers of Central and State Governments; Reconnaissance permit, Prospecting and Mining licenses/lease, Composite License: Duration, termination etc. Method of grant of license: Auctions Amendments to the MMDR Act Captive mines. Environmental laws and their applicability to the mining sector, Water and Air Pollution, EIA, Forest and Wildlife Clearance. Circular Economy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. The students will be able to choose the proper techniques for extraction of the reserves.
2. They will have knowledge of overall operation of mining industry.

3. They will understand the importance of mining for the national building.
4. They will compliance to various mining legal framework.
5. They will improve upon the mining operation with existing environmental provision.

REFERENCES:

1. Haldar, S. K., Mineral Exploration Principles and Applications, Elsevier, First Edition, 2013.
2. Moon C J., Whateley M K.G. & Evans A M., Introduction to Mineral Exploration, Blackwell Publishing, Second Edition, 2012.
3. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
4. Deshmukh,D.J., Elements of Mining Technology, Vol.I & II , Vidyaseva Prakashan, Nagpur, 1994.
5. Wills, B.A. & Finch, J., Wills' Mineral Processing Technology - An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery, Butterworth-Heinemann, 8th Edition, 2015.

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3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
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Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

MI23902 ROCK BLASTING ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the basic mechanism of rock fragmentation by blasting
- To know the various types of explosives and accessories used in the blasting operation
- To learn the different methods of blasting adopted in surface and underground coal / noncoal mines.

UNIT I PRODUCTION DRILLING 9

Production drilling; Operating variables; Various methods of drilling - percussive, rotary, rotary percussive; mechanics of different methods of drilling; Down-the-hole drilling & Top hammer drilling; Inclined Drilling.

UNIT II EXPLOSIVES, ACCESSORIES AND TOOLS 9

Various type of explosives and Blasting Agents - ANFO, slurry, emulsion, permitted explosives and their development; Bulk explosives; Selection of explosives; Initiation systems, Blasting accessories, Storage, transportation and handling of explosives; Destruction of explosives and accessories.

UNIT III BLASTING IN UNDERGROUND MINES 9

Mechanics of rock fracturing and displacement by explosive action. Blasting techniques for Underground mines. Drilling pattern for tunneling and shaft sinking; smooth wall blasting techniques; Alternatives to blasting.

UNIT IV BLAST DESIGN IN SURFACE MINES 9

Methods of blasting in surface mines - Primary and secondary blasting, Blast design for surface mines; Rock fragmentation studies, Controlled blasting techniques.

UNIT V DANGERS DUE TO BLASTING AND INSTRUMENTATION 9

Dangers associated with blasting in opencast mines and underground mines; Environmental impacts due to blasting - fly rock, ground vibrations, air blast and its controlling measures; Introduction to instrumentation in blasting –V.O.D probe, vibration monitoring, high speed video camera, etc; Introduction to blasting concepts related to trench cutting, demolition of buildings, underwater blasting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Understand the principles and basic mechanism of production drilling methods for the blasting operation.
2. Select the suitable explosives and accessories in mining and construction projects.
3. Understand design of the blasting pattern for surface mines and underground mines.
4. Use modern tools for providing alternative solutions for blasting.
5. Understand the environmental effects due to blasting and to adopt the required controlling measures.

TEXT BOOKS:

1. Gokhale, B.V., Rotary Drilling and Blasting in Large Surface Mines, 2nd Edition, CRC Press, 2011.
2. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A.A.Balkema, Rotterdam, 1995.
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2. Antipas Massawe, Drilling and Blasting Part II: Drilling Manual, 1st Edition, LAP Lambert Academic Publishing, 2010.
3. Bhandari,Sushil, Engineering Rock Blasting Operations, A.A.Balkema, Rotterdam, 1997.
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5. Chugh, C.P., Diamond Drilling, Oxford & IBH Publications New Delhi, 1999.
6. Hustrulid, W.A. Blasting Principles of Open Pit Mining,Vol.1- General Design Concept, A.A. Balkema, Rotterdam, 1999.
7. Janusz Reś, Krzysztof Wladzielczyk and Ajoy K. Ghose., Environment-friendly Techniques of rock breaking, CRC Press, 2003.
8. Konya, C.J. and Walter, E.J. Surface Blast Design, New Jersey, 1990.
9. Langefors, U., and Kihlstrom, (1973), B., The Modern Techniques of Rock Blasting, URMO Publications.
10. Per-Anders Persson, Roger Holmberg, and Jaimin Lee. Rock Blasting and Explosives Engineering, CRC Press, 1994. 11. Pradhan, G.K., and Sandhu, G.S., Manual of Rock Blasting, IME Publications, 1996.

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Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6

GY23901 OIL EXPLORATION AND PRODUCTION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To teach prospecting methods for oil exploration.
- To teach reserve estimation for oil production.
- To provide knowledge on logging and reservoir properties.

UNIT I SEISMIC PROSPECTING 9

Seismic reflection prospecting – data acquisition – receiver design and characteristics – Energy source – seismic instrumentation - survey positioning – establishment of field parameters; Seismic processing – processing steps and associated pitfalls – signal migration – improving the signal – to noise ratio – velocity stacking and verification – displaying seismic data - Interpretation – structural – stratigraphy – facies, sequence and depositional environment – hot spots for oil and gas; 3 D surveying.

UNIT II RESERVE ESTIMATION AND DRILLING OPERATION 9

Volumetric oil and gas reserve estimation – proved, probable and possible reserves – Deterministic methods, Three point estimates - Expressing uncertain in the input to volumetric estimation - Rotary Drilling rig components – Basic operations – operational practices and procedures – Drill stem and assembly – descriptions, care, maintenance and handling practices -Drill stem Design – installation of blowout prevention.

UNIT III DRILLING MUD 9

Drilling mud – function, composition, properties, classification of drilling mud – Foam drilling – Packer fluids – solid removal – drilling complications and importance of mud - heaving shale , plastic flow shale – lost circulation, blowouts, Procedure for designing hydraulic program – Minimum annular velocity , circulation rate, pump characteristics calculation of system pressure losses –Equations used in hydraulic calculation – Hydraulics worksheet.

UNIT IV CASING AND CEMENTATION 9

Casing – types, policy, specifications , forces acting – Casing design – preparation of casing to be lowered. Cementation – composition, properties, types, cementation - procedures applications.

UNIT V WELL LOGGING RESERVOIR ENGINEERING AND PRODUCTION 9

Well logging – basic concepts – well bore environments – Logging Methods - Interpretation - calculation of saturation, gas saturation, water saturation porosity, permeability - finding oil, gas and water. Perforation techniques - well completion – fittings of well head, casing head housings, casing test, - transportation of oil, Reservoir engineering - principles- Oil recovery – primary, secondary enhanced oil recovery techniques – chemical methods – miscible methods - thermal method – Petroleum management and economics.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students are expected to be able to:

1. Understand the seismic method of prospecting for Oil.
2. Carryout reserve estimation and understand drilling operations.
3. Gain knowledge on drilling mud and its properties.
4. Understand procedure involved in casing and cementation.
5. Comprehend well logging methods and reservoir engineering.

REFERENCES:

1. Brian J. Evans A Hand book for seismic data acquisition in exploration. Geophysical Monograph Series Publisher:Society of Exploration Geophysics, Tulsa, U.S.A., 1997.
2. Robert E. Sheriff. Seismic stratigraphy, Publisher: International Human Resources Development Corporation, Boston 1980.
3. Bhagwan Shtay, Petroleum Exploration and Exploration practices, Allied Publishers Ltd., 2001.
4. Frank John, Mark Cook &Mark Gratan. Hydrocarbon exploration and production, Elsevier 2003.
5. Drilling: The manual of methods, application & management. Australian Drilling Industry Training Committee Ltd., Publisher : Lewis publishes, 1997.

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3	2	3	2	2	2	3	1	0	2	2	2	1	3	1	1
4	2	2	1	1	2	2	0	2	2	2	2	2	2	2	1
5	2	2	2	2	2	2	2	2	0	2	1	2	2	3	2
Avg	2	2.2	2	1.8	2.2	2.4	1.4	1.6	1.6	1.6	1.4	1.8	2.4	2	1.6