

**ANNA UNIVERSITY, CHENNAI**  
**UNIVERSITY DEPARTMENTS**  
**B.E. MINING ENGINEERING**  
**REGULATIONS – 2015**  
**CHOICE BASED CREDIT SYSTEM**

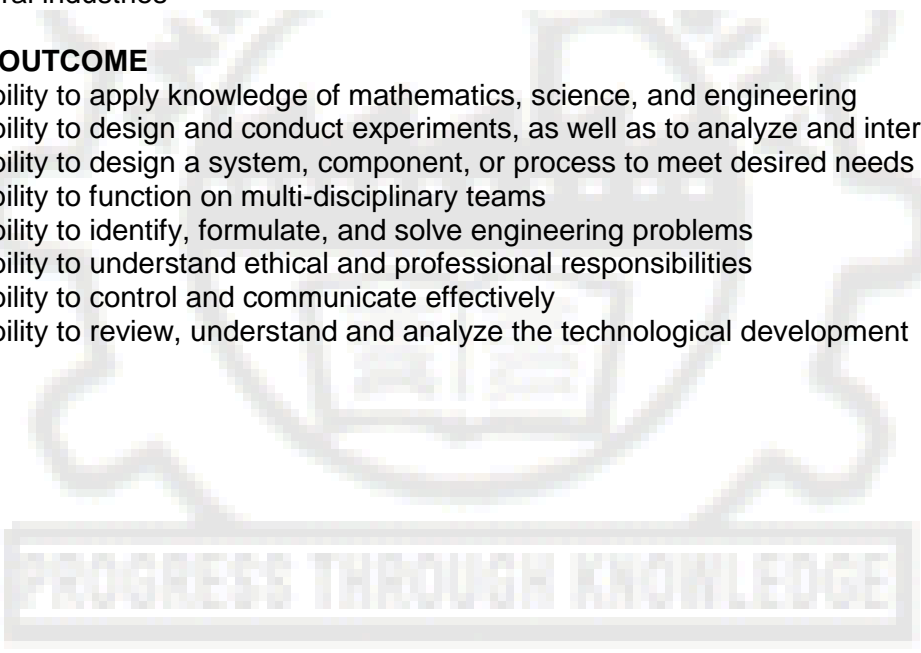
**PROGRAM EDUCATIONAL OBJECTIVES**

Bachelor of Mining Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

1. Function ethically in a variety of professional roles such as mine planner, designer, production manager, consultant, technical support representative, regulatory specialist academicians and research with emphasis on the mineral industries
2. Advance in their careers in the mineral industry, adapting to new situations and emerging problems.
3. Demonstrate an understanding of the importance of mining to the society and for working in a contemporary society in which safety and health, responsibility to the environment, and ethical behavior are required without exception
4. Possess professional skills such as effective communication, teamwork, and leadership.
5. Pursue advanced degrees in mineral-related fields and also those fields that support the mineral industries

**PROGRAM OUTCOME**

- a) an ability to apply knowledge of mathematics, science, and engineering
- b) an ability to design and conduct experiments, as well as to analyze and interpret data
- c) an ability to design a system, component, or process to meet desired needs
- d) an ability to function on multi-disciplinary teams
- e) an ability to identify, formulate, and solve engineering problems
- f) an ability to understand ethical and professional responsibilities
- g) an ability to control and communicate effectively
- h) an ability to review, understand and analyze the technological development



Mapping PEO with POs:

PEO/ PO	a	b	c	d	e	f	g	h
1.	√	√	√	√	√		√	
2.			√	√	√			
3.						√	√	√
4.					√	√	√	√
5.	√	√	√	√	√			



Sem	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Semester I	Mathematics - I	√	√			√			
	Engineering Chemistry	√	√			√			
	Engineering Physics	√	√			√			
	Engineering Mechanics	√	√	√		√		√	
	Engineering Graphics	√	√	√		√		√	
	Foundational English						√	√	
	Basic Sciences Laboratory	√	√	√		√			
	Engineering Practices Laboratory	√	√	√	√	√			
Semester II	Mathematics-II	√	√			√			
	Chemistry for Mining Engineering	√	√	√		√			
	Basic of Electronics Engineering	√	√	√		√		√	√
	Computing Techniques	√	√	√		√		√	
	Basics of Electrical Engineering	√	√	√		√		√	√
	Technical English			√			√		
	Computer Practices Laboratory	√	√	√		√			
	Electrical and Electronics Engineering Laboratory	√	√	√		√		√	
Semester III	Geology	√			√	√			√
	Strength of Materials	√	√	√		√			√
	Materials Science	√	√			√			
	Electrical Drives and Control	√	√	√		√			√
	Drilling and Blasting	√	√	√	√	√	√	√	√
	Mine Development	√	√		√	√	√	√	√
	Practical Training – I	√			√	√	√	√	√

Attested

  
 DIRECTOR

	Strength of Materials Laboratory	√	√			√			
	Technical Seminar				√	√	√	√	√
Semester IV	Fluid Mechanics and Machinery	√	√	√		√			√
	Basic Mechanical Engineering for Mining	√	√	√		√			√
	Plane and Geodetic Surveying	√	√			√	√	√	√
	Mineral Processing	√	√		√	√			
	Mining Geology	√			√				
	Mining Machinery-I	√	√	√	√	√		√	√
	Fluid Mechanics and Machinery Laboratory.	√	√	√		√		√	
	Geological Field Work	√	√			√		√	
	Geology Laboratory.	√	√	√		√			
	Mineral Processing Laboratory.	√	√	√		√		√	
<b>Sem</b>	<b>Subject</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
Semester V	Mining Machinery-II	√	√	√	√	√		√	√
	Mine Surveying	√	√			√	√	√	√
	Rock Mechanics and Ground Control – I	√	√	√	√	√	√	√	√
	Mine Environmental Engineering –I	√	√	√		√	√		√
	Surface Mining		√	√	√	√	√		√
	Basic Mechanical Engineering for Mining Laboratory.	√	√	√		√		√	
	Plane and Geodetic Surveying Laboratory	√	√					√	
	Practical Training – II	√			√	√	√	√	√
Semester VI	Environmental Science and Engineering	√	√		√			√	√
	Underground Mining Methods (Coal)		√	√	√		√	√	√

	Rock Mechanics and Ground Control - II	√	√	√	√	√	√	√	√
	Industrial Management		√		√	√	√	√	√
	Communication Skills and Soft Skills			√		√		√	√
	Mining Machinery Laboratory.	√	√	√		√		√	
	Rock Mechanics and Ground Control Laboratory.-I	√	√	√		√		√	
	Survey Camp	√	√	√	√			√	
Semester VII	Underground Mining Methods - Metal		√	√	√		√		√
	Mine Legislation and Safety				√	√	√	√	√
	Mining Environmental Engineering – II	√	√	√			√	√	
	Computer Applications in Mining Laboratory.	√	√	√	√	√		√	√
	Mine Environmental Engineering Laboratory	√	√	√		√		√	
	Mini Project	√	√	√	√	√	√	√	√
	Practical Training - III	√			√	√	√	√	√
	Rock Mechanics and Ground Control Laboratory.-II	√	√	√		√		√	√
Semester VIII	Project Work	√	√	√	√	√	√	√	√

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**CURRICULA AND SYLLABI FOR I - VIII SEMESTERS**

**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MA7151	Mathematics – I	BS	4	4	0	0	4
2.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
6.	HS7151	Foundational English	HS	4	4	0	0	4
<b>PRACTICAL</b>								
7.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
8.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>31</b>	<b>21</b>	<b>2</b>	<b>8</b>	<b>26</b>

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MA7251	Mathematics – II	BS	4	4	0	0	4
2.	CY7254	Chemistry for Mining Engineering	BS	3	3	0	0	3
3.	EE7152	Basic of Electronics Engineering	ES	3	3	0	0	3
4.	GE7151	Computing Techniques	ES	3	3	0	0	3
5.	EE7252	Basics of Electrical Engineering	ES	3	3	0	0	3
6.	HS7251	Technical English	HS	4	4	0	0	4
<b>PRACTICAL</b>								
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
8.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>28</b>	<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>

### SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	AG7307	Geology	BS	3	3	0	0	3
2.	CE7251	Strength of Materials	ES	3	3	0	0	3
3.	EE7304	Electrical Drives and Control	ES	3	3	0	0	3
4.	MI7301	Drilling and Blasting	PC	3	3	0	0	3
5.	MI7302	Mine Development	PC	3	3	0	0	3
6.	PH7251	Materials Science	BS	3	3	0	0	3
<b>PRACTICAL</b>								
7.	CE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
8.	MI7311	Practical Training - I <sup>#</sup>	EEC	0	0	0	0	1
9.	MI7312	Technical Seminar <sup>#</sup>	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>24</b>	<b>18</b>	<b>0</b>	<b>6</b>	<b>22</b>

### SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	AG7402	Mining Geology	PC	4	2	2	0	3
2.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
3.	CE7353	Plane and Geodetic Surveying	ES	4	4	0	0	4
4.	ME7403	Basic Mechanical Engineering for Mining	PC	3	3	0	0	3
5.	MI7401	Mineral Processing	PC	3	3	0	0	3
6.	MI7402	Mining Machinery-I	PC	3	3	0	0	3
<b>PRACTICAL</b>								
7.	AG7413	Geology Laboratory.	BS	2	0	0	2	1
8.	AG7412	Geological Field Work <sup>#</sup>	EEC	0	0	0	0	1
9.	CE7361	Fluid Mechanics and Machinery Laboratory.	ES	4	0	0	4	2
10.	MI7411	Mineral Processing Laboratory.	ES	2	0	0	2	1
<b>TOTAL</b>				<b>28</b>	<b>18</b>	<b>2</b>	<b>8</b>	<b>24</b>

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**DIRECTOR**

### SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MI7501	Mine Environmental Engineering - I	PC	3	3	0	0	3
2.	MI7502	Mine Surveying	PC	3	3	0	0	3
3.	MI7503	Mining Machinery-II	PC	3	3	0	0	3
4.	MI7504	Rock Mechanics and Ground Control-I	PC	3	3	0	0	3
5.	MI7505	Surface Mining	PC	3	3	0	0	3
6.		Professional Elective - I	PE	3	3	0	0	3
<b>PRACTICAL</b>								
7.	CE7362	Plane and Geodetic Surveying Laboratory	ES	4	0	0	4	2
8.	ME7512	Basic Mechanical Engineering for Mining Laboratory.	PC	4	0	0	4	2
9.	MI7511	Practical Training - II <sup>#</sup>	EEC	0	0	0	0	2
<b>TOTAL</b>				<b>26</b>	<b>18</b>	<b>0</b>	<b>8</b>	<b>24</b>

### SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	ME7554	Industrial Management	HS	3	3	0	0	3
2.	MI7601	Environmental Science for Mining Engineering	BS	3	3	0	0	3
3.	MI7602	Rock Mechanics and Ground Control-II	PC	3	3	0	0	3
4.	MI7603	Underground Mining Methods - Coal	PC	3	3	0	0	3
5.		Professional Elective - II	PE	3	3	0	0	3
6.		Professional Elective - III	PE	3	3	0	0	3
<b>PRACTICAL</b>								
7.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2
8.	MI7611	Mining Machinery Laboratory.	PC	2	0	0	2	1
9.	MI7612	Rock Mechanics and Ground Control Laboratory.-I	PC	2	0	0	2	1
10.	MI7613	Survey Camp <sup>#</sup>	EEC	0	0	0	0	1
<b>TOTAL</b>				<b>25</b>	<b>19</b>	<b>0</b>	<b>6</b>	<b>23</b>



### SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MI7701	Mine Environmental Engineering -II	PC	3	3	0	0	3
2.	MI7702	Mine Legislation and Safety	PC	4	4	0	0	4
3.	MI7703	Underground Mining Methods - Metal	PC	3	3	0	0	3
4.		Professional Elective - IV	PE	3	3	0	0	3
5.		Professional Elective - V	PE	3	3	0	0	3
6.		Open Elective – I*	OE	3	3	0	0	3
<b>PRACTICAL</b>								
7.	MI7711	Computer Applications in Mining Laboratory.	PC	4	0	0	4	2
8.	MI7712	Mine Environmental Engineering Laboratory	PC	2	0	0	2	1
9.	MI7713	Rock Mechanics and Ground Control Laboratory.-II	PC	2	0	0	2	1
10.	MI7714	Practical Training - III #	EEC	0	0	0	0	2
11.	MI7715	Mini Project#	EEC	0	0	0	0	2
<b>TOTAL</b>				<b>27</b>	<b>19</b>	<b>0</b>	<b>8</b>	<b>27</b>

### SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.		Professional Elective – VI	PE	3	3	0	0	3
2.		Open Elective – II*	OE	3	3	0	0	3
<b>PRACTICAL</b>								
3.	MI7811	Project Work	EEC	20	0	0	20	10
<b>TOTAL</b>				<b>26</b>	<b>6</b>	<b>0</b>	<b>20</b>	<b>16</b>

**TOTAL NO. OF CREDITS: 186**

\*Course from the curriculum of other UG Programmes

# The contact periods will not appear in the slot time table

### HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	ME7554	Industrial Management	HS	3	3	0	0	3
4.	HS7561	Communication Skills and Soft Skills	HS	3	1	0	2	2

### BASIC SCIENCES (BS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics – I	BS	4	4	0	0	4
2.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics – II	BS	4	4	0	0	4
6.	CY7254	Chemistry for Mining Engineering	BS	3	3	0	0	3
7.	PH7251	Materials Science	BS	3	3	0	0	3
8.	AG7307	Geology	BS	3	3	0	0	3
9.	AG7413	Geology Laboratory	BS	4	0	0	4	2
10.	MI7601	Environmental Science for Mining Engineering	BS	3	3	0	0	3

### ENGINEERING SCIENCES (ES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
2.	GE7152	Engineering Graphics	ES	5	3	2	0	4
3.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
4.	GE7151	Computing Techniques	ES	3	3	0	0	3
5.	EE7252	Basic of Electrical Engineering	ES	3	3	0	0	3
6.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
7.	EE7261	Electrical and Electronics Engineering Laboratory	ES	4	0	0	4	2
8.	CE7251	Strength of Materials	ES	3	3	0	0	3
9.	EE7152	Basic of Electronics Engineering	ES	3	3	0	0	3
10.	EE7304	Electrical Drives and Control	ES	3	3	0	0	3

*Attested*

11.	CE7261	Strength of Materials Laboratory	ES	4	0	0	4	2
12.	MI7411	Mineral Processing Laboratory	PC	2	0	0	2	1
13.	CE7352	Fluid Mechanics and Machinery	ES	3	3	0	0	3
14.	CE7361	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
15.	CE7362	Plane and Geodetic Surveying Laboratory	ES	4	0	0	4	2

### PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MI7301	Drilling and Blasting	PC	3	3	0	0	3
2.	MI7302	Mine Development	PC	3	3	0	0	3
3.	MI7401	Mineral Processing	PC	3	3	0	0	3
4.	ME7403	Basic Mechanical Engineering for Mining	PC	3	3	0	0	3
5.	MI7512	Basic Mechanical Engineering for Mining Laboratory	PC	4	0	0	4	2
6.	AG7402	Mining Geology	PC	4	2	2	0	3
7.	MI7402	Mining Machinery – I	PC	3	3	0	0	3
8.	MI7503	Mining Machinery – II	PC	3	3	0	0	3
9.	MI7502	Mine Surveying	PC	3	3	0	0	3
10.	MI7504	Rock Mechanics and Ground Control – I	PC	3	3	0	0	3
11.	MI7501	Mine Environmental Engineering – I	PC	3	3	0	0	3
12.	MI7603	Underground Mining Methods - Coal	PC	3	3	0	0	3
13.	MI7611	Mining Machinery Laboratory	PC	2	0	0	2	1
14.	MI7612	Rock Mechanics and Ground Control Laboratory – I	PC	2	0	0	2	1
15.	MI7505	Surface Mining	PC	3	3	0	0	3
16.	MI7602	Rock Mechanics and Ground Control – II	PC	3	3	0	0	3
17.	MI7703	Underground Mining Methods - Metal	PC	3	3	0	0	3
18.	MI7713	Rock Mechanics and Ground Control Laboratory – II	PC	2	0	0	2	1
19.	MI7702	Mine Legislation and Safety	PC	4	4	0	0	4
20.	MI7701	Mine Environmental Engineering – II	PC	3	3	0	0	3
21.	MI7711	Computer Application in Mining Laboratory	PC	4	0	0	4	2
22.	MI7712	Mine Environmental Engineering Laboratory	PC	2	0	0	2	1

### PROFESSIONAL ELECTIVES (PE)

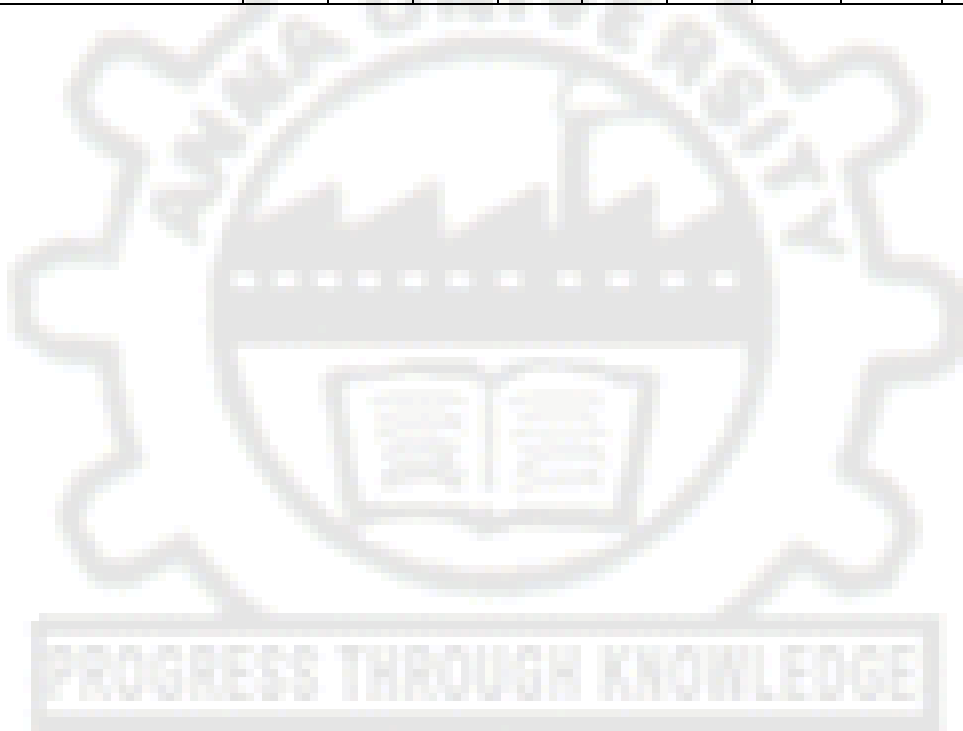
SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7071	Disaster Management	PE	3	3	0	0	3
2.	GE7074	Human Rights	PE	3	3	0	0	3
3.	GE7351	Engineering Ethics and Human Values	PE	3	3	0	0	3
4.	MI7001	Advanced Coal Mining and Mechanization	PE	3	3	0	0	3
5.	MI7002	Advanced Metal Mining and Mechanization	PE	3	3	0	0	3
6.	MI7003	Advanced Rock Blasting Technology	PE	3	3	0	0	3
7.	MI7004	Advanced Surface Mining	PE	3	3	0	0	3
8.	MI7005	Computer Application in Mining	PE	3	3	0	0	3
9.	MI7006	Longwall Mining	PE	3	3	0	0	3
10.	MI7007	Material Handling	PE	3	3	0	0	3
11.	MI7008	Mine Economics and Investment	PE	3	3	0	0	3
12.	MI7009	Mine Planning and Design	PE	3	3	0	0	3
13.	MI7010	Mine Safety Engineering	PE	3	3	0	0	3
14.	MI7011	Mineral Exploration	PE	3	3	0	0	3
15.	MI7012	Numerical Methods in Mining Engineering	PE	3	3	0	0	3
16.	MI7013	Petroleum Engineering	PE	3	3	0	0	3
17.	MI7014	Rock Excavation Engineering	PE	3	3	0	0	3
18.	MI7015	Rock Reinforcement	PE	3	3	0	0	3
19.	MI7016	Rock Slope Engineering	PE	3	3	0	0	3
20.	MI7017	Small Scale Mining and Marine Mining	PE	3	3	0	0	3
21.	MI7018	Subsidence Engineering	PE	3	3	0	0	3
22.	MI7019	Systems Engineering in Mining	PE	3	3	0	0	3
23.	MI7020	Underground Space Technology	PE	3	3	0	0	3
24.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MI7311	Practical Training - I	EEC	0	0	0	0	1
2.	MI7312	Technical Seminar	EEC	0	0	0	2	1
3.	AG7412	Geological Field Work	EEC	0	0	0	0	1
4.	MI7511	Practical Training - II	EEC	0	0	0	0	2
5.	MI7613	Survey Camp	EEC	0	0	0	0	1
6.	MI7714	Practical Training - III	EEC	0	0	0	0	2
7.	MI7715	Mini Project	EEC	0	0	0	0	2
8.	MI7811	Project Work	EEC	20	0	0	20	10

## SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	4	0	0	0	3	0	0	11
2.	BS	12	7	6	1	0	3	0	0	29
3.	ES	10	13	8	10	2	0	0	0	43
4.	PC	0	0	6	12	17	8	14	0	57
5.	PE	0	0	0	0	3	6	6	3	18
6.	OE	0	0	0	0	0	0	3	3	6
7.	EEC	0	0	2	1	2	3	4	10	22
	<b>Total</b>	<b>26</b>	<b>24</b>	<b>22</b>	<b>24</b>	<b>24</b>	<b>23</b>	<b>27</b>	<b>16</b>	<b>186</b>
8.	Non Credit / Mandatory									



MA7151

MATHEMATICS – I

L T P C

(Common to all branches of B.E. / B.Tech. Programmes in I Semester) 4 0 0 4

**OBJECTIVES:**

- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I DIFFERENTIAL CALCULUS 12**

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

**UNIT II FUNCTIONS OF SEVERAL VARIABLES 12**

Partial derivatives – Homogeneous functions and Euler’s theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

**UNIT III INTEGRAL CALCULUS 12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

**UNIT IV MULTIPLE INTEGRALS 12**

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.

**UNIT V DIFFERENTIAL EQUATIONS 12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

Attested

Sobhan  
DIRECTOR

**TEXT BOOKS:**

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

**REFERENCES:**

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

**CY7151****ENGINEERING CHEMISTRY**

L	T	P	C
3	0	0	3

**OBJECTIVES**

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

**UNIT I POLYMER CHEMISTRY****9**

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS****9**

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms-Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY****9**

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

**UNIT IV CHEMICAL THERMODYNAMICS 9**

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

**UNIT V NANOCHEMISTRY 9**

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Preparation of nanoparticles – sol-gel and solvothermal. Preparation of carbon nanotube by chemical vapour deposition and laser ablation. Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning. Properties and uses of nanoparticles, nanoclusters, Nano rods, nanotubes and nanowires.

**TOTAL: 45 PERIODS**

**OUTCOMES**

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

**TEXT BOOKS**

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

**REFERENCES**

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi. 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi. 2011.

**PH7151 ENGINEERING PHYSICS L T P C**  
(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

**OBJECTIVE:**

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

**UNIT I PROPERTIES OF MATTER 9**

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

*Attested*

*Sobhan*  
**DIRECTOR**  
Centre For Academic Courses  
Anna University, Chennai-600 025.





**OBJECTIVE :**

- The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

**UNIT I STATICS OF PARTICLES 12**

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 12**

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.

**UNIT III DISTRIBUTED FORCES 16**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center 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 8**

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

**UNIT V DYNAMICS OF PARTICLES 12**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

Kinetics- Newton's Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - 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.

**L – 45 + T – 15 TOTAL: 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

**TEXT BOOK**

- Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

**REFERENCES**

- Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
- J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**GE7152**

**ENGINEERING GRAPHICS**

**L T P C**  
**3 2 0 4**

**OBJECTIVE**

• To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)**

**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREE HANDSKETCHING**

**14**

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES**

**14**

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS**

**14**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

**14**

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

**15**

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

**COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)**

**3**

Introduction to drafting packages and demonstration of their use.

**L=45+T=30, TOTAL: 75 PERIODS**

## OUTCOMES:

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

## TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50<sup>th</sup> Edition, 2010.

## REFERENCES:

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,," Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28<sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

## Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

## Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

HS7151

FOUNDATIONAL ENGLISH

L T P C  
4 0 0 4

## COURSE DESCRIPTION:

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

## OBJECTIVES:

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

## CONTENTS

### UNIT I GREETING AND INTRODUCING ONESELF 12

**Listening-** Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing-** Guided writing - Free writing on any given topic ( My favorite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

### UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12

**Listening** – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing** –Process description( non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

### UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12

**Listening-** Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing-** Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

### UNIT IV CRITICAL READING AND WRITING 12

**Listening-** Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference);**Writing**–Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

### UNIT V LETTER WRITING AND SENDING E-MAILS 12

**Listening-** Listening to programmers/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading** –Extensive reading; **Writing-** Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

### TEACHING METHODS:

Interactive sessions for the speaking module.  
Use of audio – visual aids for the various listening activities.  
Contextual Grammar Teaching.

### EVALUATION PATTERN:

Internals – 50%  
End Semester – 50%

**TOTAL: 60 PERIODS**

### OUTCOMES:

- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

### TEXT BOOK:

1. Richards, Jack. C with Jonathan Hull and Susan Proctor **New Interchange: English for International Communication. (level2, Student's Book)** Cambridge University Press, New Delhi: 2010.

## REFERENCES:

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively: Developing Speaking Skills for Business English**. Cambridge University Press, Cambridge: Reprint 2011.

BS7161

**BASIC SCIENCES LABORATORY**  
(Common to all branches of B.E. / B.Tech Programmes)

**L T P C**  
**0 0 4 2**

## PHYSICS LABORATORY: (Any Seven Experiments)

### OBJECTIVE:

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle  
b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using grating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

### OUTCOME:

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

## CHEMISTRY LABORATORY:

### (Minimum of 8 experiments to be conducted)

1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.

4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

**TOTAL: 60 PERIODS**

#### TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

<b>GE7162</b>	<b>ENGINEERING PRACTICES LABORATORY</b> (Common to all Branches of B.E. / B.Tech. Programmes)	<b>L T P C</b> <b>0 0 4 2</b>
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#### OBJECTIVES

To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

#### GROUP – A (CIVIL & ELECTRICAL)

#### 1. CIVIL ENGINEERING PRACTICES 15

##### PLUMBING

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

##### WOOD WORK

Sawing, planning and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

##### STUDY

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

#### 2. ELECTRICAL ENGINEERING PRACTICES 15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator and Emergency Lamp

**3. MECHANICAL ENGINEERING PRACTICES**

**WELDING**

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations...
- Study and assembling of the following:
  - a. Centrifugal pump
  - b. Mixie
  - c. Air Conditioner.

**DEMONSTRATION ON FOUNDRY OPERATIONS.**

**4. ELECTRONIC ENGINEERING PRACTICES**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio and Low Voltage Power supplies.

**TOTAL: 60 PERIODS**

**OUTCOMES**

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

**MA7251**

**MATHEMATICS - II**

**L T P C**

**(Common to all branches of B.E. / B.Tech. Programmes in II Semester)**

**4 0 0 4**

**OBJECTIVES:**

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

**UNIT I MATRICES**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II VECTOR CALCULUS**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

*Attested*

*Sobhan*  
**DIRECTOR**



**UNIT III ANALYTIC FUNCTION 12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions  $w = z+c$ ,  $az$ ,  $\frac{1}{z}$ ,  $z^2$  - Bilinear transformation.

**UNIT IV COMPLEX INTEGRATION 12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

**UNIT V LAPLACE TRANSFORMS 12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Upon successful completion of the course, students should be able to:
- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

**REFERENCES:**

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

**OBJECTIVES**

- To make the students conversant with
- Treatment of water for domestic and industrial purpose
- Applications of different kinds of polymers, lubricants and adhesives.
- Types and mechanism of corrosion and control measures
- Application of different types of abrasives and chemical nature of building materials and composites
- Chemistry of different types of fuels and explosives

**UNIT I WATER TREATMENT 9**

Different types of impurities in water-disadvantages of hard water in industries-conditioning methods-external treatment methods-zeolite and ion exchange methods-internal treatment (colloidal, phosphate, calgon, carbonate methods)-desalination (reverse osmosis and electro-dialysis)-requisites of drinking water-treatment of domestic water (screening, sedimentation, coagulation, filtration, disinfection-by chlorination, UV treatment and ozonization).

**UNIT II POLYMERS, LUBRICANTS AND ADHESIVES 9**

Thermosetting and thermoplastics resins-properties and applications of polythene, polypropylene, TEFLON, polystyrene, polyvinyl chloride, PMMA, polyamides, polyesters, bakelite, vulcanization of rubber- rubber blended plastics-laminated glass-thermocole. Lubricants and lubrication-functions-classification with examples properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud and pour point)-greases (calcium based, sodium based, lithium based only)-solid lubricants graphite and molybdenum sulphide. Adhesives-adhesive action-development of adhesive strength-physical and chemical factors influencing adhesive action-bonding process of adhesives-phenol formaldehyde resins, polyurethane, epoxy resins, urea formaldehyde.

**UNIT III CORROSION AND CORROSION INHIBITION 9**

Corrosion-causes of corrosion-principles of chemical corrosion-Pilling-Bed worth rule- principles of electrochemical corrosion-difference between chemical and electrochemical corrosion- factors influencing corrosion-types of corrosion-galvanic corrosion-differential aeration corrosion-stress corrosion-soil corrosion-pitting corrosion, water line corrosion- corrosion control-cathodic protection-sacrificial anode-selection of materials and proper designing-corrosion inhibitors, protective coatings-paints, varnishes and lacquers electroplating- hot dip process.

**UNIT IV ABRASIVES AND 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, soral 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-composites-definition of composites-characteristics-constituents of composites-types-fibre reinforced plastic (FRP)-metal matrix composites (MMC)-ceramic matrix composites (CMC)-properties and applications. Mohs 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 (solid, liquid and gases) comparison-coal varieties-analysis of coal, proximate analysis and ultimate analysis-significance-coke manufacture (Beehive coke oven and Otto-Hoffman by product coke oven method)-characteristics of metallurgical coke. Petrol-knocking-Octane Number-improvement of antiknock characteristics-diesel engine fuel-Cetane Number-gaseous fuels-composition and uses of producer gas, water gas and natural gas-combustion-gross and net calorific values-theoretical calculation of calorific value (Dulong's formula)-calculation of minimum requirement of air (simple calculations)-explosive range, spontaneous ignition temperature-flue gas analysis-Orsat apparatus. Chemistry of different types of industrial explosives like-gun powder, dynamite, nitroglycerin based explosives, Ammonium

nitrate based explosives, ammonium nitrate fuel oil, PETN, TNT, liquid oxygen, slurry explosives and emulsion explosives.

**TOTAL: 45 PERIODS**

### OUTOMES

- Will be familiar with corrosion and its control.
- Will know the characterization techniques.
- Will know the water quality analysis for industrial applications.

### TEXT BOOKS

1. Jain P. C. and Monica Jain, Engineering Chemistry, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2014.
2. Kannan P., Ravi Krishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014.

### REFERENCES

1. Dara. S. S., A Textbook of Engineering Chemistry, S. Chand & Company Ltd., New Delhi, 2003
2. Philip A. Schweitzer P.E, "Corrosion of Polymers and Elastomers", (Corrosion Engineering Handbook, Second Edition), CRC Press, 2006.

**EE7152**

**BASIC OF ELECTRONICS ENGINEERING**

**L T P C**  
**3 0 0 3**

#### OBJECTIVES:

- To provide knowledge in the basic concepts of Electronics Engineering including semiconductors, transistors, electronic devices, signal generators and digital electronics.

#### **UNIT I SEMICONDUCTORS AND RECTIFIERS 9**

Classification of solids based on energy band theory, Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Half and Full wave rectifiers, Zener effect, Zener diode, Zener diode Characteristics, Zener diode as a regulator.

#### **UNIT II TRANSISTOR AND AMPLIFIERS 9**

Bipolar junction transistors – CB, CE, CC configurations and characteristics, Biasing circuits – Fixed bias, Voltage divider bias, CE amplifier, Concept of feedback, Negative feedback, voltage series feedback amplifier, Current series feedback amplifier.

#### **UNIT III FET AND POWER ELECTRONIC DEVICES 9**

FET – Configuration and characteristics, FET amplifier, Characteristics and simple applications of SCR, Diac, Triac and UJT.

#### **UNIT IV SIGNAL GENERATORS AND LINEAR ICS 9**

Positive feedback, Sinusoidal oscillators – RC phase shift, Hartley, Colpitts, Wein bridge oscillators, Operational amplifier – Adder, Inverting and Non-inverting amplifiers, integrator and differentiator, IC 555 based Astable and Monostable Multivibrators.

#### **UNIT V DIGITAL ELECTRONICS 9**

Boolean algebra, Logic Gates, , Half and Full adders, Decoder, Encoder, Multiplexer, Demultiplexer, Flip flops, Digital to Analog converters - R-2R and weighted resistor types, Analog to Digital converters - Successive approximation and Flash types.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to identify electronics components and use them to design circuits.

**TEXT BOOK:**

1. Malvino, 'Electronic Principles', McGraw Book Co., 1993.

**REFERENCES:**

1. Grob. B and Schultz. M.E. 'Basic Electronics', Tata Mcgraw Hill, 2003.
2. Thomas L. Floyd, 'Electronics Devices', Pearson Education, 2002.
3. Thomas L. Floyd, 'Digital Fundamentals', Pearson Education, 2003.
4. Millman, Halkias Jacob, Jit Christos and Satyabrata, 'Electronic devices and Circuits', Tata McGraw Hill, 2<sup>nd</sup> Edition.

<b>GE7151</b>	<b>COMPUTING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Common to all branches of Engineering and Technology)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES**

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

**UNIT I INTRODUCTION 9**

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

**UNIT II C PROGRAMMING BASICS 9**

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

**UNIT III ARRAYS AND STRINGS 9**

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings-String operations – String Arrays - simple programs- sorting- searching – matrix operations.

**UNIT IV POINTERS 9**

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

**UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

**TOTAL : 45 PERIODS****OUTCOMES**

**At the end of the course, the student should be able to:**

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort.
- Use programming language to solve problems.

**TEXT BOOKS:**

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

**REFERENCES:**

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

**EE7252****BASICS OF ELECTRICAL ENGINEERING****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision
- To introduce Magnetic circuits, principle and application of transformers
- To teach principle of operation of DC motors and AC machines
- To teach principle of special electrical machines

**UNIT I                    MAGNETIC CIRCUITS AND ENERGY CONSERVATION                    9**

Magnetic effects of electric current- Magnetic circuits- Magnetic materials and B-H relationship  
Energy and co-energy- Electromagnetic induction and force- Hysteresis and eddy current losses.

**UNIT II                    TRANSFORMER                    9**

Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no-load phasor diagram — Transformer on-load phasor diagram — Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency- All day efficiency –auto transformers.

**UNIT III                    DC MACHINES                    9**

Construction of DC machines – Theory of operation of DC generators – EMF and torque equations-Characteristics of DC generators- Applications, Operating principle of DC motors – Types of DC motors and their characteristics – Speed control of DC motors- Applications

**UNIT IV                    INDUCTION MACHINES AND SYNCHRONOUS MACHINES                    9**

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Double -revolving field theory – starting methods - Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

**UNIT V                    SPECIAL ELECTRICAL MACHINES                    9**

Switched reluctance motor, stepper motor, servo motor, BL DC motor- working principles, speed-torque characteristics and applications.

**TOTAL: 45 PERIODS**

## OUTCOMES:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world  
At the end of the course the students will be able to
- Describe magnetic circuits, principles of operation of transformers, DC machines.
- Explain the working of AC machines and special electrical machines

## TEXT BOOKS:

1. I.J Nagarath and Kothari DP “Electrical Machines “Tata McGraw Hill ,2010.
2. P.C. Sen, “Principles of Electric machines and Power electronics”, John- Wiley& sons 2<sup>nd</sup> edition ,2007.

## REFERENCES:

1. A. E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machinery” 6<sup>th</sup> Edition, Mc Graw Hill, 2013.
2. Stephen J. Chapman, “Electrical Machinery Fundamentals”, 4<sup>th</sup> Edition, Mc Graw Hill, 2003.
3. Edward Hughes, Revised by John Keith Brown and Ian McKenzie Smith, “Hughes Electrical and Electronic Technology”, Pearson Education Limited, 10<sup>th</sup> Edition, 2016.

HS7251

TECHNICAL ENGLISH

L T P C  
4 0 0 4

## OBJECTIVES

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in a professional environment.

## CONTENTS

### UNIT I ANALYTICAL READING

12

**Listening-** Listening to informal and formal conversations; **Speaking** – Conversation Skills (opening, turn taking, closing)-explaining how something works-describing technical functions and applications; **Reading** –Analytical reading, Deductive and inductive reasoning; **Writing-** vision statement–structuring paragraphs.

### UNIT II SUMMARISING

12

**Listening-** Listening to lectures/ talks on Science & Technology; **Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing-** Extended definition –Lab Reports – Summary writing.

### UNIT III DESCRIBING VISUAL MATERIAL

12

**Listening-** Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** – Reading journal articles - Speed reading; **Writing-**data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

### UNIT IV WRITING/ E-MAILING THE JOB APPLICATION

12

**Listening-** Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice ( mock interview); **Reading** – Reading job advertisements and profile of the company concerned; **Writing-** job application – cover letter –Résumé preparation.

### UNIT V REPORT WRITING

12

**Listening-** Viewing a model group discussion; **Speaking** –Participating in a discussion - Presentation; **Reading** – Case study - analyses -evaluate – arrive at a solution; **Writing-** Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

**TEACHING METHODS:**

Practice writing

Conduct model and mock interview and group discussion.

Use of audio – visual aids to facilitate understanding of various forms of technical communication.

Interactive sessions.

**EVALUATION PATTERN:**

Internals – 50%

End Semester – 50%

**TOTAL: 60 PERIODS**

**OUTCOMES**

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

**TEXT BOOK:**

1. Craig, Thaine. **Cambridge Academic English: An integrated skills course for EAP (Student's Book) Level: Intermediate** Cambridge University Press, New Delhi: 2012

**REFERENCES:**

1. Laws, Anne. **Presentations**. Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engineering**. Cambridge University Press, Cambridge, New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic writing A practical Guide for Students**. Routledge, London: 2004
6. Hewings, Martin. **Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.



GE7161

**COMPUTER PRACTICES LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES**

- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

**LIST OF EXPERIMENTS**

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions

5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

**TOTAL: 60 PERIODS**

**OUTCOMES**

**At the end of the course, the student should be able to:**

- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

**LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS**

30 Systems with C compiler

**EE7261**

**ELECTRICAL AND ELECTRONICS ENGINEERING  
LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVE:**

- To train the students in performing various tests on electrical drives, sensors and circuits.

**LIST OF EXPERIMENTS:**

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt motor
3. Load test on S Transformer
4. Load test on Induction motor
5. Regulation of 3 Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and Thermistor
13. Flapper Nozzle system

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Ability to perform speed characteristic of different electrical machine
- Ability to use of diodes, transistors for rectifiers
- Ability to use of operational amplifier



**OBJECTIVES:**

- To lay emphasis on the study of minerals, rocks and structures.
- Understanding the sciences of ores and minerals.

**UNIT I      PHYSICAL GEOLOGY      9**

Geology in mining engineering: scope and applications – earth structure and composition – weathering processes and grades – groundwater: origin, occurrence and exploration techniques.

**UNIT II      STRATIGRAPHY      9**

Geological time scale – mineral resource distributions and economic importance of Archean, Paleozoic, Mesozoic and Cenozoic rocks of India.

**UNIT III      MINERALOGY      9**

Classification of minerals – Physical properties of minerals – Properties of quartz, feldspar, pyroxene, amphibole, mica, olivine and garnet group of minerals and calcite.

**UNIT IV      PETROLOGY      9**

Classification of rocks – Description of igneous, sedimentary and metamorphic rocks – forms and mode of occurrence of rocks – Engineering properties of rocks: field and laboratory tests.

**UNIT V      STRUCTURAL GEOLOGY      9**

Introduction to geological structures – folds, faults, joints and unconformities – classification, criteria for recognition in the field and significance in mineral exploration. Determination of strata thickness. Dip and strike calculations.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The students will know about minerals, rocks and geological structures. They will also learn about stratigraphy and groundwater exploration.

**TEXT BOOKS:**

1. Parbin Singh. Geology for Engineers, IBH Publications, N. Delhi. 1991.
2. Arthur Holmes, Principles of Physical Geology, Thomas Nelson and Sons, USA, 1964.

**REFERENCES:**

1. Blyth F.G.H. and de Freitas M.H. Geology for Engineers, 7th edition, Elsevier Publications, 2006.
2. Bell F.G. Engineering Geology, Elsevier Publications, 2007.
3. Ford, W.E. Dana's Textbook of Mineralogy (4th edition), Wiley Eastern Ltd., N. Delhi, 1989.
4. Winter, J.D. An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, N. Delhi, 2001.
5. Billings, M.P. Structural Geology, Prentice Hall Inc., N. Jersey, USA, 1972.
6. Krishnan M.S. Geology of India and Burma, 3rd Edition, IBH Publishers, N. Delhi, 1984.

**OBJECTIVE:**

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9**

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

**UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

**UNIT III TORSION 9**

Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

**UNIT IV DEFLECTION OF BEAMS 9**

Double Integration method – Macaulay's method – Area moment Theorems for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theory – Application of theories of failure.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.
- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

**TEXT BOOKS:**

- Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2007
- Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007

**REFERENCES:**

- Egor. P.Popov “ Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2001
- Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education Series, 2007.
- Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 2007
- Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole Mechanics of Materials, Tata Mcgraw Hill publishing 'co. Ltd., New Delhi.

**OBJECTIVES:**

To impart knowledge on

- Basics of electric drives
- Different speed control methods
- Various motor starters and controllers
- Applications

**UNIT I INTRODUCTION****9**

Basic elements of electric drives – classification of electric drives- different types of mechanical loads – choice of electric drive – status of AC and DC drives - control circuit components: Fuses, switches, circuit breakers, contactors. Relay – control transformers.

**UNIT II SPEED CONTROL OF DC MACHINES****9**

Thyristor based bridge rectifier circuits – chopper circuits - DC shunt motors and series motor : typical and modified speed torque characteristics - Ward Leonard method – applications of modified characteristics - solid state DC drives – electrical braking.

**UNIT III SPEED CONTROL OF AC MACHINES****9**

Induction motor – speed torque characteristics – pole changing, stator frequency variation – stator voltage variations - slip-ring induction motor : rotor resistance variation, slip power recovery scheme – basic inverter circuits- variable voltage frequency control - constant torque and constant power 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, service condition of electric drive – classes of duty – industrial application.

**TOTAL : 45 PERIODS****OUTCOME:**

- Upon completion of this subject, the student can able to explain different types of electrical machines and their performance in various applications.

**TEXT BOOKS:**

1. S. K. Pillai, 'A first Course on Electrical Drives', New Age International Publishers, New Delhi, Second Edition, Reprint, 2004
2. Vedam Subramaniam, 'Electric Drives: Concepts and Applications' Tata McGraw Hil, New Delhi, Second Edition, Reprint, 2011.
3. Gopal K.Dubey. 'Fundamentals of Electrical Drives' Alpha Science International Ltd., Second Edition, 2001.

**REFERENCES:**

1. S.K Bhattacharya, Brinjinder Singh 'Control of Electrical Machines' New Age International Publishers, Reprint, 2003.
2. John Bird 'Electrical Circuit theory and technology' Elsevier, Fifth Edition, 2014.
3. N.K De and P.K Sen 'Electric Drives' Prentice Hall of India Private Ltd, Ninth printing, 2006.

**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 blasting
- To learn the different methods of blasting adopted in surface and underground coal / non-coal mines including adverse effects of blasting & their control
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to 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. Estimation of cost of drilling, economics of drilling.

**UNIT II EXPLOSIVES, ACCESSORIES AND TOOLS****9**

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

**UNIT III BLAST DESIGN IN SURFACE MINES****10**

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

**UNIT IV 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; controlled blasting techniques. Blasting in underground coal mining – Present status & future trends.

**UNIT V ADVERSE EFFECTS OF BLASTING AND INSTRUMENTATION****8**

Dangers associated with blasting in opencast mines and underground mines – misfires, blown out shots, incomplete detonation, 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; Alternatives to blasting.

**TOTAL : 45 PERIODS****OUTCOME:**

- The students will have knowledge on drilling and blasting operations in surface and underground mines. They will also learn to understand and design blasting pattern for surface mines, dimensional stones, road constructions, oil and ground water.

**TEXT BOOKS:**

1. Rao, K.U.M, and Misra, B., (1998), Principles of Rock Drilling, Oxford & IBH Publications, New Delhi, p.265.
2. Jimeno, C.L., Jimeno, E.L, Carcedo, E.J. Drilling and Blasting of Rocks, A.A.Balkema, Rotterdam,

## REFERENCES:

1. Clark, G.B., Principles of Rock fragmentation, Wiley Interscience Publication, 1987.
2. Konya, C.J. and Walter, E.J. Surface Blast Design, New Jersey, 1990.
3. Bhandari, Sushil, Engineering Rock Blasting Operations, A.A.Balkema, Rotterdam, 1997.
4. Per-Anders Persson, Roger Holmberg, and Jaimin Lee. Rock Blasting and Explosives Engineering, CRC Press, 1994.
5. Hustrulid, W. A. Blasting Principles of Open Pit Mining, Vol. 1- General Design Concept, A.A. Balkema, Rotterdam, 1999.
6. Singh, B and Pal Roy, P., (1993), Blasting in Ground Excavations and Mines, Oxford & IBH Publications, New Delhi, p.177.
7. Chugh, C.P., (1999), Diamond Drilling, Oxford & IBH Publications New Delhi.
8. Pradhan, G.K., and Sandhu, G.S., Manual of Rock Blasting, IME Publications, 1996.
9. Janusz Reś, Krzysztof Wladzielczyk and Ajoy K. Ghose., Environment-friendly Techniques of rock breaking, CRC Press, 2003.
10. Langefors, U., and Kihlstrom, (1973), B., The Modern Techniques of Rock Blasting, URMO Publications.

MI7302

MINE DEVELOPMENT

L T P C  
3 0 0 3

## OBJECTIVES:

- To demonstrate the importance of mining in national economy, understand the terminology associated with the discipline and be familiar with the available regulatory mechanism to enable safe & sustainable mining operations.
- To know the history of mining and describe the correlation between the development of mining and cultural progress.
- To introduce the field of mining and provide basic input about mining unit operations.
- To learn the various modes of access and study the methods of designing the access.

## UNIT I INTRODUCTION TO MINING

9

Historical overview of mining, role of the mining industry in the modern world and contribution to national economy; Positive and negative aspects of Mining Industry / Economical, Social, Environmental and Health impacts of Mining; Role of mining engineers in industry. Statute related to Mining Industry; Evaluation of Mining and Mining machinery; Present and future trends of mining industry. Mineral deposit – different types and their classification; Indian mineral resources and world status, Stages in the life of a mine.

## 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 DRIFTING AND TUNNELING

8

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 IV INTRODUCTION TO MINING METHODS

10

Introduction to mining methods – selection criteria & comparison. Overview of surface mining: Types of surface mines, unit operations, basic bench geometry, applicability & limitations and advantages & disadvantages. Overview of underground mining: Different coal mining methods and their applicability & limitations; Different metal mining methods and their

applicability & limitations; Introduction to various aspects of mining – ventilation, illumination, rock mechanics, mine management and mine economics.

## **UNIT V      ADVANCES IN MINING TECHNOLOGY**

**8**

Sustainability Practices in Mining. Computer applications in mining; Impacts of globalization on mining. Status with respect to sea bed mining. Introduction to novel mining methods. Challenges being faced by mining industry; Role of statutory bodies like DGMS, IBM, PESO, MoEF, etc in mining industry.

**TOTAL: 45 PERIODS**

### **OUTCOME:**

- The students will have introductory knowledge on role of mining industry on national economics and 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.

### **REFERENCES:**

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Universal Mining School - Lecture notes, cardiff, U.K
3. Tatiya, R.R., Surface and Underground Excavations. A.A. Balkema, Rotterdam, 2005.

**PH7251**

## **MATERIALS SCIENCE**

(Common to Manufacturing, Industrial, Mining, Aeronautical,  
Automobile and Production Engineering)

**L T P C**  
**3 0 0 3**

### **OBJECTIVE:**

- To impart knowledge on the basics of binary phase diagrams and their applications
- To learn the phase diagram, effect of alloying elements and various transformations in the Fe-C system, and also the heat treatment of steels.
- To introduce various strengthening methods of materials, and also various mechanical properties and their measurement
- To instill the types, properties and applications of magnetic, dielectric and superconducting materials.
- To introduce the preparation, properties and applications of various new materials.

## **UNIT I      PHASE DIAGRAMS**

**9**

Solid solutions - Hume Rothery's rules - The phase rule - single component system – onecomponent system of iron - binary phase diagrams - isomorphous systems - the tie-line rule – the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems – microstructural change during cooling.

## **UNIT II      FERROUS ALLOYS AND HEAT TREATMENT**

**9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's law - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, bainitic and martensitic transformations - tempering of martensite - heat treatment of steels - annealing - normalizing - quenching and tempering - case hardening - induction, flame and laser hardening - carburizing, cyaniding, carbonitriding and nitriding.

**UNIT III MECHANICAL PROPERTIES****9**

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

**UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS****9**

Ferromagnetism – Domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials, properties, types and applications.

**UNIT V NEW MATERIALS****9**

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fiber reinforced plastics – Metallic glasses – types, glass forming ability of alloys – Inoue criteria – melt spinning process – applications - Shape memory alloys – phases, shape memory effect, pseudoelastic effect – NiTi alloy – applications- Nanomaterials – preparation: ball milling and chemical vapour deposition - properties and applications – carbon nanotubes – Biomaterials.

**TOTAL: 45 PERIODS****OUTCOME:**

Upon completion of this course, the students will

- gain knowledge on the basics of binary phase diagrams and the use of lever rule
- learn about the Fe-C phase diagram, effect of alloying elements, TTT in the Fe-C system, and also the heat treatment of steels.
- understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
- acquire knowledge on the types, properties and applications of magnetic, dielectric and superconducting materials.
- get adequate understanding on the preparation, properties and applications of ceramics, composites, metallic glasses, shape-memory alloys and nanomaterials.

**TEXT BOOKS:**

1. Raghavan, V. "Physical Metallurgy: Principles and Practice", Phi Learning (2009).
2. Balasubramaniam, R. "Callister's Materials Science and Engineering", Wiley India Pvt. Ltd. (2014).
3. Palanisamy P.K., "Materials Science", Scitech (2013).

**REFERENCES:**

1. Raghavan, V. "Materials Science and Engineering", Printice Hall of India (2007).
2. Shackelford, J.F. "Introduction to Materials Science for Engineers". Pearson India (2006).
3. Donald Askeland. "Materials Science and Engineering", Brooks/Cole (2010).
4. Smith, W.F., Hashemi, J. and R.Prakash. "Materials Science and Engineering", Tata Mcgraw Hill Education Private Limited (2014).

**OBJECTIVES:**

- To study the mechanical properties of materials subjected to different types of loading.

**LIST OF EXPERIMENTS**

1. Tension test on mild steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

**TOTAL: 60 PERIODS****OUTCOMES:**

- The students will have the knowledge in the area of testing of materials

**REFERENCES:**

1. Strength of Materials Laboratory Manual, Anna University, Chennai-600 025.
2. IS 432(Part I) -1992 – Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement

**OBJECTIVE:**

To impart practical experience to the student for gaining deeper understanding of the various activities and principles of mining.

Gaining practical experience is an important aspect of the mining engineering programme. It has many characteristic features of its own. The students have to undergo training in mining / allied industry / research institute during the summer vacation at the end of the II Semester for a period of 2-3 weeks and obtain a valid certificate from the competent authority of the organization providing training. The students have to submit a report on the training which would be evaluated during the ensuing III Semester. This carries a total of one credit during the III Semester. Evaluation would be done by a faculty or a group of faculty 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 - I in subsequent years before undergoing practical training - II. The decision of the competent authority is final in this regards.

**OUTCOME:**

The students will understand various activities and principles of surface mining and its importance.



MI7312

TECHNICAL SEMINAR

L T P C  
0 0 2 1

**OBJECTIVE:**

To overcome the stage fear and face questions.

The technical seminar topic(s) must be selected either from published lists or the students themselves may propose suitable topics in consultation with their faculty in charge. The aim of the technical seminar is to deliver the topic in a structured way with effective communication manner.

The progress of the mini project is evaluated by the faculty in charge who is assigned by the Head of the Department to assess the students' presentation skills.

**TOTAL: 30 PERIODS**

**OUTCOME:**

The students will be able to exhibit the skills of presentations such structure, uses of visual aid, content preparation, delivery and facing the critical questions.

AG7402

MINING GEOLOGY

L T P C  
2 2 0 3

**OBJECTIVE:**

To familiarize the students with the economic mineral deposits and the techniques used to explore mineral and fossil fuel deposits.

**UNIT I ECONOMIC GEOLOGY**

**6+6**

Ore forming process, mineral deposits formed from magmatic, hydrothermal and volcanic process: mechanical concentration, oxidation and supergene enrichment.

**UNIT II ECONOMIC INDIAN MINERAL DEPOSITS**

**6+6**

Metallic, non-metallic deposits, study of graphite, copper, zinc, lead, gold, iron, manganese, radioactive minerals, asbestos, mica, gemstone-origin, mode of occurrence and distribution in India. Origin and occurrence of industrial minerals-ceramic, refractory, abrasive, glass and paint industry.

**UNIT III COAL AND PETROLEUM GEOLOGY**

**6+6**

Origin, physical properties, processes, occurrence of coal and its types, petroleum deposits. Fossil fuel distribution in sedimentary basins of India.

**UNIT IV GEOPHYSICS**

**6+6**

Geophysical prospecting methods – seismic, electrical, magnetic and gravity methods of mineral prospecting, Location of ore body, coal and petroleum reserves, subsurface litho-log and 3-D models.

**UNIT V REMOTE SENSING AND GIS**

**6+6**

Introduction to aerial and satellite remote sensing, identification of photo recognition elements; applications of remote sensing and GIS in geological mapping and mineral exploration.

**TOTAL: 60 PERIODS**

**OUTCOME:**

- The students will be familiar in economic geology and Indian mineral deposits. They will have exposure on geophysics, remote sensing and GIS.

**TEXT BOOKS:**

1. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, 1956
2. Krishnaswamy, S. Indian Mineral Resources, Oxford and IBH Publication Company, New Delhi, 1984.

**REFERENCES:**

1. Bales, R.L., Geology of the Industrial Rocks and Minerals, Harper press (India) Ltd., Faridabad, 1988.
2. Arogyaswamy, R.N.P., courses in Mining Geology, Oxford and IBH Co., New Delhi, 1988.
3. Umapathy, R.M., Text book of Mining Geology, Daltsons, 2002.

**CE7352****FLUID MECHANICS AND MACHINERY****L T P C  
3 0 0 3****OBJECTIVE:**

- The applications of the conservation laws to flow through pipes and hydraulic machines are studied .To understand the importance of dimensional analysis. To understand the importance of various types of flow in pumps and turbines.

**UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension. Flow characteristics – concept of control volume - application of control volume to continuity equation, energy equation and momentum equation.

**UNIT II FLOW THROUGH CIRCULAR CONDUITS 9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

**UNIT III DIMENSIONAL ANALYSIS 9**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

**UNIT IV PUMPS 9**

Impact of jets - Euler's equation - Theory of rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps – working principle - work done by the impeller - performance curves - Reciprocating pump - working principle – indicator diagram – work saved by fitting air vessels – Rotary pumps – classification – comparison of working principle with other pumps – advantages.

**UNIT V TURBINES 9**

Classification of turbines – heads and efficiencies – velocity triangles – axial, radial and mixed flow turbines – Pelton wheel and Francis turbine - working principles - work done by water on the runner – draft tube - specific speed - unit quantities – performance curves for turbines – governing of turbines.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Critically analyse the performance of pumps and turbines.

**TEXT BOOKS:**

1. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co.(2010)
2. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi(2004)
3. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House (2002), New Delhi

**REFERENCES:**

1. Robert .Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", ISBN 978-0-470-54755-7, 2011.

**CE7353****PLANE AND GEODETIC SURVEYING****L T P C  
4 0 0 4****OBJECTIVES:**

- To introduce the rudiments of plane surveying and geodetic principles to Geoinformatics Engineers.
- To learn the various methods of plane and geodetic surveying to solve the real world problems.
- To introduce the concepts of Control Surveying
- To introduce the basics of Astronomical Surveying

**UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING 12**

Classifications and basic principles of surveying – Equipment and accessories for ranging and chaining – Methods of ranging – Chain traversing – Basic principles and applications of Plane Table and Compass - Levels and staves - Methods of levelling - Booking -Reduction - Curvature and refraction - Contouring.

**UNIT II THEODOLITE SURVEYING 12**

Horizontal and vertical angle measurements - Temporary and permanent adjustments – Heights and distances–Tacheometric surveying – Trigonometric levelling – Horizontal curves in route surveying – classification, functions and requirements - methods of setting out simple curves - setting out transition curves by offsets and angles

**UNIT III CONTROL SURVEYING AND ADJUSTMENT 12**

Horizontal and vertical control- Methods - Triangulation- Base line - Instruments and accessories – Corrections - Satellite station - Traversing - Gale's table. Concepts of measurements and errors – error propagation and linearization – adjustment methods – least square methods – angles, lengths and levelling network – simple problems.

**UNIT IV ASTRONOMICAL SURVEYING 12**

Astronomical terms and definitions - Motion of sun and stars - Celestial coordinate systems – different time systems - Nautical Almanac - Apparent altitude and corrections - Field observations and determination of time, longitude, latitude and azimuth by altitude and hour angle method

**UNIT V MODERN SURVEYING 12**

Total Station : Advantages - Fundamental quantities measured – Parts and accessories – working principle – On board calculations –Field procedure - Errors and Good practices in using Total Station

GPS: System components – Signal structure – Selective availability and antispoofing – receiver components – Planning and data acquisition – Data processing - Errors in GPS - Applications

**TOTAL : 60 PERIODS**

## OUTCOMES:

At the end of the course the student will be able to understand

- The use of various surveying instruments in mapping
- The error and adjustments procedures associated with surveying and mapping
- The methods used for establishment of horizontal and vertical control
- Concepts of astronomical surveying and methods to determine time, longitude, latitude and azimuth

## TEXT BOOKS :

1. T.P. Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. S.S.Bhavikatti, Surveying Theory and Practice, I.K.International Publishing House Pvt. Ltd, New Delhi, 2010

## REFERENCES:

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M.Anderson and Edward M. Mikhail, Surveying Theory and Practice, Tata McGraw Hill Education Private Limited, New Delhi, 2012
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004
4. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice' Hall of India 2004
5. K.R. Arora, Surveying Vol I & II, Standard Book house , Twelfth Edition. 2013

ME7403

**BASIC MECHANICAL ENGINEERING FOR MINING**

**L T P C**  
**3 0 0 3**

## OBJECTIVE:

- To give an overall understanding on prime areas of mechanical engineering like Thermodynamics, Heat transfer, IC engines, Power Transmission and Machine elements for Mining Engineering students.

### **UNIT I BASIC CONCEPTS OF THERMODYNAMICS AND HEAT TRANSFER 9**

Basic concept – properties – point and path functions – systems – processes – thermodynamic equilibrium - laws of thermodynamics – Steady Flow Energy Equation (SFEE) - first law applied to open and closed systems – Second law of thermodynamics – heat engines and heat pumps Heat transfer – conduction – general conduction equation in Cartesian coordinates – conduction in composite walls. Convection – free and forced convection – simple empirical correlations. Radiation – laws – black body and grey body radiation.

### **UNIT II IC ENGINES AND AIR CONDITIONING 9**

I C engines – classification - construction and working principles of two and four stroke engines – S I and C.I. engines. Air conditioning – air standard cycles, Otto and Diesel cycle. Introduction to Air conditioning, vapour compression cycle – vapour absorption cycle – psychrometric processes..

### **UNIT III POWER TRANSMISSION 9**

Friction in screw threads, bearings, mechanical and hydraulic clutches. Rope, belt and chain. Gears – nomenclature, laws of gearing, types of gears including rack and pinion, interference, gear trains, power calculation in couplings, clutches and brakes.

**UNIT IV KINEMATICS OF MACHINES****9**

Mechanisms – basics – kinematic concepts and definitions – degree of freedom, mechanical advantage – transmission angle – description of common mechanisms – quick return mechanisms, straight line generators, dwell mechanisms, ratchets and escapements – universal joints. Cams and followers – terminology and definitions, displacement diagrams – uniform velocity, parabolic and simple harmonic motions.

**UNIT V ROTODYNAMIC AND VIBRATORY MACHINES****9**

Fans and compressors – types, construction, working principle, characteristics and applications. Single stage and multistage air compressors – intercooling. Simple calculations for output and efficiency. Vibration – free and forced vibration. Vibrators and shakers – construction, working principle, applications and limitations.

\* **Approved HEAT and Mass Transfer and PSG Design Data Book is permitted to use in the examinations.**

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Nag, P.K. Basic and Applied Thermodynamics, 8<sup>th</sup> Edition, Tata Mc Graw Hill, 2008.
2. Rajput, R.K. Thermal Engineering, 6<sup>th</sup> Edition, Laxmi Publications, 2007
3. Ballaney, P.L. Thermal Engineering, Khanna Publishers, 24<sup>th</sup> Edition, 2003.
4. Shigley J.E., Pennock G.R. and Uicker J.J. Theory of Machines and Mechanisms, Oxford University Press, 2003.

**REFERENCES:**

1. Bhandari V.B. Design of Machine Elements, 7<sup>th</sup> Edition, tata McGraw- Hill, 2009
2. Sundraraja Moorthy T. V and Shanmugam N. Machine Design, 9<sup>th</sup> Edition, Anuradha Publishers, 2003.
3. Khurmi R. S. and Gupta J. K. Theory of Machines, Eurasia Publishing House, 2005.
4. Rattan S. S. Theory of Machines, tata McGraw- Hill Education, 2009.

**MI7401****MINERAL PROCESSING****L T P C  
3 0 0 3****OBJECTIVE:**

This course enables the students to choose suitable parameters and appropriate methodology & machinery for processing various types of minerals.

**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 COMMINATION****8**

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**

Collecting sample on site (mine face); Purpose, factors governing particle behaviour, laboratory and industrial screens, trommels, vibrating screens, etc. wet and dry screening, classification, classifiers. Metallurgical accounting and control - Sampling and weighing the ore, moisture and assay sampling, on stream analysis, automatic control in mineral processing

**UNIT IV SEPARATION/CONCENTRATION****12**

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

**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; generalised plant practice/flow sheets for coal and other important ores – copper, aluminum, lead, zinc, gold, uranium, iron, limestone, magnesite and beach sand minerals.

**TOTAL:45 PERIODS****OUTCOME:**

- The students will have knowledge on processing of minerals / ores / coal, comminution, sampling, industrial sizing, different techniques for separation/concentration and special methods to process the minerals.

**TEXT BOOKS**

1. Wills, B.A, Mineral Processing Technology, Pergamon Press, Oxford, 2006.
2. Jain, S.K, Ore Dressing, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1986.

**REFERENCES**

1. Gaudin, A.M, Principles of Mineral Dressing, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 2003.
2. Maurice C. Fuerstenau (Editor), Kenneth N. Han (Editor), Principles of Mineral Processing, Society for Mining, Metallurgy, and Exploration, 573p, 2003.
3. Prayor, E.J, (1974), Mineral Processing, 3<sup>rd</sup> Edition, Applied Science Publishers, London, p.844.
4. Richards, R.H, Charles E. Locke, S.B and Schuhmann, R, (1953), Textbook of Ore Dressing, McGraw-Hill Book Company Inc, Newyork, p.608.
5. Taggart, A.F, Handbook of Mineral Dressing, Chapman and Hall, New York, 1945.
6. Vijayendra, H.G, Handbook on Mineral Dressing, Vikas Publishing House Pvt. Ltd., New Delhi, 2001.
7. Weiss, N.L. (Ed.), S.M.E. Mineral Processing Handbook, Volume – I &II, 1986.

**MI7402****MINING MACHINERY – I****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the electrical layouts and power distribution in mine.
- To study the rope haulage layouts, technical details and applications.
- To study the various modes of transport means and electrical circuits.
- To study the types of pumps, installations and design calculations.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

**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. 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.

**UNIT II ROPE HAULAGE 9**

Rail Track and tubs– gauge; layout, curves, turnouts and cross-over, track maintenance, main features of rolling stock like tubs, mine cars man riding cars and tippers;Types of rope haulages – merits, demerits and fields of application, constructional features, safety appliances and rope haulage calculations.

**UNIT III OTHER TRANSPORT SYSTEMS 10**

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 rope ways, gravity transport, principles of hydraulic& pneumatic transportation and their fields of application, electric layouts, man-riding systems.

**UNIT IV PUMPING & CONVEYING 10**

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 – Various types of conveyors, Scraper chain conveyors, AFCs, belt conveyors, cable belt conveyor, shaking and vibrating conveyors, armoured flexible conveyors, high angle conveying, electrical layouts. Numerical problems in conveyors

**UNIT V MINE ELECTRICAL ENGINEERING 7**

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**

**OUTCOME:**

- The students will have basic knowledge on motive power used in mines, pumping, rope haulage and face haulage & conveying transport systems. They also will know about mine electrical engineering in all statutory aspects.

**TEXT BOOKS**

1. Cherkassky, B.M., Pumps, Fans, Compressors, MIR Publishers, 1980.
2. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.

**REFERENCES:**

1. Karelin N.T., Mine Transport, Orient Longmans, N. Delhi.
2. Mason, E., Coal Mining Series, Mining Machinery, Virtue and Company Ltd., London.
3. Statham, I.C.F., Coal Mining, Vol. I, II, III and IV, Caxton Eastern Agencies, Calcutta.
4. Deshmukh D.J., Elements of Mining Technology, Vol. III EMDEE Publishers, Nagpur,1989.
5. Universal Mining School - Lecture notes, cardiff, U.K

**AG7413**

**GEOLOGY LABORATORY**

**L T P C  
0 0 2 1**

**OBJECTIVES:**

- To identify minerals, rocks, ores and geological structures
- To learn geological mapping, remote sensing techniques and geophysical methods

**UNIT I MINEROLOGY 6**

Identification of physical properties of quartz and feldspar varieties, hypersthene hornblende, augite, mica, asbestos, barite, calcite, fluorite, tourmaline, beryl, corundum, kyanite, garnet, sillimanite. Study of Moh's scale of hardness.

**UNIT II PETROLOGY****4**

Identification and description of igneous rocks – important plutonic, hypabyssal and volcanic type of rocks: Sedimentary rocks – rudites, arenites, argillites and carbonates, metamorphic rocks – gneiss, marble, slate, schist, quartzite.

**UNIT III STRUCTURAL GEOLOGY****4**

Exercises on structural maps of geological site and interpretation of geological conditions; 3 point and 4 point bore hole problems to decipher the subsurface geological conditions for mining of resources.

**UNIT IV ORE GEOLOGY****6**

Identification of ores of iron, manganese, lead, zinc, copper, chromium, aluminum, graphite and Ore reserve estimation.

**UNIT V REMOTE SENSING & GEOPHYSICS****6**

Study of aerial photographs and satellite imageries. Preparation of geological and structural maps. Electrical resistivity survey, seismic survey – 2 and 3 layer problems.

**UNIT VI GEOLOGICAL MAPPING METHODS****4**

Topo sheets, Map scale – types, preparation and interpretation of contour maps, drainage maps, symbols, rock and geological structures, use of clinometers, Brunton compass and knowledge on GPS.

**TOTAL: 30 PERIODS****OUTCOME**

- The students will have knowledge on ore reserve estimation, ore assaying, remote sensing, geological mapping and identification of geological structures.

**TEXT BOOKS:**

1. Bateman, A.M., Economic Mineral Deposits, John Wiley and Sons, 1956.
2. Krishnaswamy, S. Indian Mineral Resources, Oxford and IBH Publication Company, New Delhi, 1984.
3. Bell F.G., Engineering Geology, Elsevier Publications, 2007.

**AG7412****GEOLOGICAL FIELD WORK****L T P C**

Five days field visit to different quarries, mines and important geological formations during IV Semester.

**0 0 0 1****OBJECTIVE:**

To impart practical experience to the student for gaining deeper understanding of the geological principles.

Field work is compulsory for ALL the students.

- Identification of minerals, rocks and ores in the field
- Recognition of geological structures like faults, folds, joints etc. in the field
- Measurement of strike and dip using Brunton compass and Clinometer
- Learning geological mapping techniques

The students have to submit a report on the training which would be evaluated during the ensuing IV Semester. This carries a total of one credit during the IV 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 geological field work. 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 geological field work with the subsequent batch of students. The decision of the competent authority is final in this regard.

**OUTCOME:**

The students will be able to identify mineral, rock and various geological features and knowledge of geological mapping.

**CE7361                      FLUID MECHANICS AND MACHINERY LABORATORY                      L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

**LIST OF EXPERIMENTS**

<b>1. Flow Measurement</b>	<b>32</b>
1. a. Calibration of Rotometer	
b. Flow through Venturimeter	
2. Flow through a circular Orifice	
3. Determination of mean velocity by Pitot tube	
4. Verification of Bernoulli's Theorem	
5. a. Flow through a Triangular Notch	
b. Flow through a Rectangular Notch	
<b>2. Losses in Pipes</b>	<b>8</b>
6. Determination of friction coefficient in pipes	
7. Determination of losses due to bends, fittings and elbows	
<b>3. Pumps</b>	<b>16</b>
8. Characteristics of Centrifugal pumps	
9. Characteristics of Submersible pump	
10. Characteristics of Reciprocating pump	
<b>4. Determination of Metacentric height</b>	<b>4</b>
Demonstration Only	

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines

**REFERENCES:**

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, Chennai. 2004.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House, New Delhi, 2000.
3. Subramanya, K. Flow in open channels, Tata McGraw - Hill pub. Co.1992.
4. Subramanya, K. Fluid mechanics, Tata McGraw- Hill Pub. Co., New Delhi, 1992.

**MI7411                      MINERAL PROCESSING LABORATORY                      L T P C**  
**0 0 2 1**

**OBJECTIVE:**

To study various mineral processing technique to enrich minerals.

- 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 sedimentation characteristics of a given sample
- 11 Study of flowsheets for various mineral concentration techniques.
- 12 Study of various pollution control measures adopted in the beneficiation plants.
- 13 Study of coal preparation flow sheets.

**TOTAL: 30 PERIODS**

**OUTCOME:**

The student will be able to understand the various techniques of mineral processing.

**REFERENCES:**

1. Wills, B.A, Mineral Processing Technology, Pergamon Press, Oxford, 2006.
2. Jain, S.K, Ore Dressing, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1986.
3. Gaudin, A.M, Principles of Mineral Dressing, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 2003.

**MI7501**

**MINE ENVIRONMENTAL ENGINEERING – I**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the behavior of mine gases and their movement in underground mine
- To understand the functions of various devices and fans used
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

**UNIT I MINE GASES & CLIMATE**

**11**

Occurrence, properties, physiological effects, permissible limits, detection – types of instruments, construction, principle and limitations, measurement and analysis, methane formation & storage in coal, Ventilation Air Methane (VAM), methane layering, Coward's diagram, methane drainage  
Psychrometric properties of air, Sources of heat and humidity in mines and their effects, heat stress estimation, cooling power of mine air and methods of improving cooling power.  
Psychrometric surveys, Flame safety lamps

**UNIT II PRINCIPAL LAWS OF AIR MOVEMENT IN UNDERGROUND**

**8**

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-Prandtl equation for rough flows, resistance of mine roadways, friction and shock resistance, etc.

**UNIT III NATURAL VENTILATION AND AIR CURRENT DISTRIBUTION IN MINES**

**9**

Natural ventilation, effect of depth, temperature, pressure, etc. thermodynamic treatment, distribution of air current in mines – splitting, stoppings, regulators, ventilation doors, air crossings, controlled recirculation, etc. Retrograde and boundary, ascensional, decensional, homotropical and antitropical ventilation systems, Ventilation in deep and hot mines, remedial measures including air cooling and air conditioning. Numerical problems.

**UNIT IV MECHANICAL VENTILATION****9**

Main mechanical ventilators, booster fans and auxiliary fans, and their selection, installation, various ventilation layouts, fan performance, characteristics and testing, fans in series and parallel, fan drifts and evasees, reversal of air current, forcing versus exhaust ventilation, ventilation of long headings including overlap systems, coursing of air.

**UNIT V VENTILATION PLANNING****8**

Calculation of pressure and quantity requirements, permissible minimum and maximum air velocities in different parts of underground mines, economic analysis, ventilation standards, network analysis, monitoring of mine environment. principles and computer applications. Method of ventilation surveys and surveying instrument.

**TOTAL : 45 PERIODS****OUTCOME:**

The students will be able to understand the various properties of mine gases, control measures using different ventilation methods and control devices.

**TEXT BOOKS:**

1. Mishra, G.B. Mine Environment and Ventilation, Oxford University Press, 1992.
2. Hartman, H.L. Mine Ventilation and Air Conditioning, Wiley Interscience publication, 1993.

**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.

**MI7502****MINE SURVEYING****L T P C  
3 0 0 3****OBJECTIVES:**

- To study methods of underground traversing and surveys.
- To study the various modern surveying techniques and instrumentation.
- To study 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****10**

Special features of Underground Mining surveying, Mine correlation of mine surveys to national grid, Underground traversing and its constraints, Correlation of underground and surface surveys by different methods, by traversing through shafts, assumed bearing, Weiss quadrilateral, Weiss triangle methods, estimation of errors,; Illustrative examples: Measurement of shaft depth..

**UNIT II ALIGNMENT SURVEY AND TACHOMETRY****12**

Alignment / Gradient control of vertical and inclined shafts sinking and raising shafts; gradient control in development openings; Holing surveys; 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.

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

**UNIT III STOPE & SUBSIDENCE SURVEYS AND MINE PLANS 8**

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 CONTOURING AND CURVE SETTING 8**

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 SURVEYING METHODS 7**

Application of Remote sensing and photogrammetry in exploration and mining; EDM; Electronic theodolite, Electronic Tachometer (Total station); Laser Theodolite; GPS; GIS; DTM Applicability and limitations, GPR application in surveying, Laser Scanning, introduction to surveying softwares and use.

**TOTAL: 45 PERIODS**

**OUTCOME:**

The students will have knowledge on methods of underground traversing, alignment of survey, methods of stope and subsidence surveys. They will have a confident about preparation of mine plans and section and also contouring and curve setting.

**TEXT BOOKS:**

1. Punmia, B.C., Surveying Vol I and II, Laxmi Publication, New Delhi, 1991
2. Kenetkar, T.P., Surveying and Levelling, Vol I and Vol II, United Book Corporation, Poona, 1991.

**REFERENCES**

1. Winniberg, F., Metalliferous Mine Surveying
2. Mason, E., Coal Mining Series, Surveying, Vol I And Vol II, Virtue And Company Limited, London.
3. Clark, D., Plane And Geodetic Surveying, Vol I And Vol II, CBS Publishing Co., 1986.
4. Assur, V.L. And Pilatov, A.M., Practical Guide To Surveying MIR Publishers, Moscow 1988.
5. Borshch, V., Komponiets, A., Navitny, G. And Knysh., Mine Surveying MIR Publishers Moscow, 1989.
6. Sahni, Advanced Surveying, Lovely Prakashan, Dhanbad, 1992.
7. Alam Chand., Modern Concept Of Mine Survey, Lovely Prakashan, Dhanbad, 1992.
8. Ghatak., Mining Surveying, Lovely Prakashan, Dhanbad, 1990

**MI7503**

**MINING MACHINERY – II**

**L T P C  
3 0 0 3**

**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 related to this course.

**UNIT I WINDING ENGINES****9**

Winding systems, drum winders, drives, mechanical braking of winders, safety devices in winding, overwind and overspeed protection, Koepe and multi-rope friction winding, electrical layouts. Duty cycles of drum winders of different drum cross-sections. Special problems of deep shaft winding.

**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, etc., signalling systems, winding calculations relating to rope size & numbers, capacity & power requirement for cages, skips, drum and Koepe winding systems. Surface and Pit-bottom layouts - Mine car circuits at the surface and pit bottom, creepers, skip winding – loading and discharge arrangements. Case studies, railway sidings and layouts.

**UNIT III COAL FACE MACHINERY****9**

Construction, salient mechanical and electrical features and operations of coal drills and their control panels, coal cutters, different types of mechanical loaders coal ploughs, cutter loaders and continuous miners; development road headers in face mechanisation, longwall mining equipment, electrical and hydraulic layouts; condition monitoring of mining machinery for underground and opencast mines and ore handling plants, modern concepts in underground mine mechanisation.

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

Classification. Hydraulic system diagram. Under carriage. Design and Constructional details of Front end loaders, Hydraulic excavators and Electric Rope shovel, Backhoe, Dragline, Bucket Wheel Excavator. Bucket Chain Excavator and Surface Miners.

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

Classification of transport equipments; Understanding of construction and technical specifications of Dumpers of different types including multi-axial dumpers, Tractors, trailers, dump trucks, Rippers (types), Motor Graders, Bull Dozers, Rock breakers, Road Compactors, Water Tankers.

**TOTAL : 45 PERIODS****OUTCOME:**

- The students will have the knowledge on functions of winding engines, winding accessories, pit-top and bottom mine circuits. They will also know about working of various coal face machinery, and design & constructional details of excavating and other prominent machinery used in surface mines.

**TEXT BOOKS:**

1. Amitosh Dey, Heavy Earth Moving Machinery, Lovely Prakashan Publications, Dhanbad, 2000.
2. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.
3. Ramlu, M.A. Mine Hoisting, CRC Press, 1996

**REFERENCES:**

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Cherkassky, B.M., Pumps, Fans, Compressors, MIR Publishers, 1980.
3. Deshmukh, D.J., Elements of Mining Technology, Vol. I, II and III, EMDEEE Publishers, Nagpur, 1979.
4. Alemgren G., Kumar U., and Vagenas N., Mine Mechanisation and Automation, A.A., Balkema Publication, 1993.
5. Mason, E., Coal Mining Series, Surveying, Vol I and II Virtue and Company Limited, London, 1985.

**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****12**

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 PROPERTIES OF ROCKS AND ROCK INDICES****6**

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, rock mass classification.

**UNIT III MECHANICAL PROPERTIES OF ROCKS****12**

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 IV NON-DESTRUCTIVE TESTING METHODS AND TIME DEPENDENT PROPERTIES OF ROCKS****6**

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 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 PERIODS****OUTCOME:**

- The students will have fundamental knowledge on application of rock mechanics, physico-mechanical properties of rocks and different types of underground supports.

**TEXT BOOKS:**

1. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78.
2. Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.

**REFERENCES:**

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley and Sons Inc., New York, 1967.
2. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
3. Hoek, E., and Brown, S.T., Underground Excavations in Rocks, Institute of Mining
4. Metallurgy, London, 1980.

**OBJECTIVES:**

- The objective of this course is to provide students in mining engineering with the necessary knowledge to design safe, efficient and environmentally responsible surface mining operations.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

**UNIT I INTRODUCTION****8**

Status of surface mining, types of surface mines, applicability and limitations, concept of stripping ratio, stripping economics, concept of ultimate pit limits, design of haul roads, elements of surface mine planning - selection of site for box cut, selection of operating parameters like bench height, width, slope, etc.

**UNIT II LAYOUT AND DESIGN OF SURFACE MINES****8**

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, Development of opencast mine layouts for various shapes of deposits. Conversion of Underground mine to opencast mine vis-a vis open cast mine to underground mine related problems and probable solutions.

**UNIT III GROUND PREPARATION METHODS****8**

Preparation of the site – Ripping, Drilling and Blasting; Types, operation, selection, applications and limitations of ground preparation equipments – Rippers, Dozers, Blasthole drills and rock breakers, Determining number of drill machines, dozers and rippers for planned production. Concept of rippability, Blasting in Opencast Mines over Developed Galleries.

**UNIT IV EXCAVATION SYSTEM IN SURFACE MINES****11**

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

**UNIT V TRANSPORT AND WASTE DUMPS****10**

Scope and application of different modes of transport system in surface mines – Trucks, Synchronization of shovel and dumper capacity for required production; Locomotives; Conveyors (shiftable and high-angle) – mode of operation, applicability and limitations, Scope and application of in-pit crushers in surface mines. Illumination in surface mines.

Types of waste dump – internal and external; dump formation methods and corresponding equipment; Dump stability and stabilisation measures.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have ability to classify and select the suitable surface mining methods and equipment based on site conditions. They will also have a concept of waste dump formations and slope failures in surface mines

**TEXT BOOKS:**

1. Kennedy, B.A., Surface Mining – 2<sup>nd</sup> Edition, SME, New York, 1990.
2. Hartman H.L., Introductory Mining Engineering, John Wiley and Sons, 2002.

**REFERENCES:**

1. Hartman, H.L. (Ed.), SME Mining Engg. Handbook Vol. I and II, Society for Mining, Metallurgy, and Exploration, Inc., 3<sup>rd</sup> edition, 2011.
2. Mishra G.B., Surface Mining, Dhanbad Publishers, Dhanbad, 1990.
3. Pfeleider, E. P, Surface Mining, 1st Edition, New York, 1968.

4. Rzhovsky V., Open pit Mining Operations, Mir Publications, 1971.
5. Amitosh De, Heavy Earth Moving Machinery, Lovely Prakashan, Dhanbad, 2000.
6. Hustrulid, W. and Kuchta, M, Open Pit Mine Planning & Design, Vol. 1, Fundamentals, Balkema, Rotterdam, 1998.
7. Hustrulid, W. A., Mccarter, M. K., And Van Zyl, D. J. A., Ed., Slope Stability in Surface Mining, Littleton, 2000.
8. Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994.

**CE7362**

**PLANE AND GEODETIC SURVEYING LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- To familiarize with the various surveying instruments and methods.

**EXERCISES :**

1. Determination of area of polygon by base line method using chain
2. Chain traversing
3. Fly levelling
4. Check levelling
5. Study of theodolite and its accessories
6. Measurement of horizontal and vertical angles using theodolite
7. Determination of tacheometric constants
8. Determination of elevation of an object using single plane method when base is accessible/ inaccessible
9. Determination of distance and difference in elevation between two inaccessible points using double plane method.
10. Heights and distances by stadia tacheometry
11. Heights and distances by tangential tacheometry
12. Study of Total station and GPS(demonstration only)

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- At the end of the course the student will be able to use various surveying instruments like chain, level and theodolite for mapping.

**REFERENCES:**

1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. James M.Anderson and Edward M. Mikhail, Surveying Theory and Practice, Tata McGraw Hill Education Private Limited, New Delhi, 2012
4. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004
5. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice' Hall of India 2004
6. K.R. Arora, Surveying Vol I & II, Standard Book house , Tenth Edition, 2008



**OBJECTIVE:**

Students should be able to verify the principles studied in thermal and engineering design course by performing experiments in the laboratory

**THERMAL EXPERIMENTS**

1. Study of I.C. engines and components
2. Performance test on 4 S diesel engine
3. Performance test on reciprocating air-compressor
4. Study of refrigeration system
5. Natural and forced convection studies

**ENGINEERING DESIGN**

1. Cam displacement and velocity analysis
2. Whirling of shaft-determination of critical speed of shaft with concentrated loads
3. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
4. Vibrating system – spring mass system – determination of damping co-efficient of single degree of freedom system.
5. Transverse vibration – free – beam, determination of natural frequency and deflection of beam.
6. Study of Gears and linkage mechanisms

**TOTAL : 60 PERIODS****OUTCOMES:**

- ability to use of thermal experiments related to IC and refrigeration and air conditioning
- ability to use of various engineering design experiments

**REFERENCES:**

1. Nag, P.K. Basic and Applied Thermodynamics, 8<sup>th</sup> Edition, Tata Mc Graw Hill, 2008.
2. Rajput, R.K. Thermal Engineering, 6th Edition, Laxmi Publications, 2007
3. Ballaney, P.L. Thermal Engineering, Khanna Publishers, 24th Edition, 2003.
4. Shigley J.E., Pennock G.R. and Uicker J.J. Theory of Machines and Mechanisms, Oxford University Press, 2003

**OBJECTIVE:**

To impart practical exposure to the students for gaining deeper understanding of 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 mining / allied industry / research institute during the summer vacation at the end of the IV Semester for a period of 4 weeks and obtain a valid certificate from the competent authority of the organisation providing training. The students have to submit a report on the 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 one or more faculty on different marking heads such as training, viva voce report etc., or other approved evaluation system.

Normally a student is not permitted to withdraw from the practical training. In case of any unforeseen circumstances / valid reasons if he/she 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 before undergoing practical training - III. The decision of the competent authority is final in this regards.

**OUTCOME:**

The students will understand various activities and principles of mining / allied engineering /research method and its importance

**ME7554****INDUSTRIAL MANAGEMENT**

L	T	P	C
3	0	0	3

**OBJECTIVE**

- To develop modern concepts of Industrial Management

**UNIT I INTRODUCTION****9**

Technology Management - Definition – Functions – Evolution of Modern Management – Scientific management Development of management Thought. Approaches to the study of management, Forms of organization – Individual Ownership- partnership – Joint Stock companies – co-operative Enterprises- Public sector Undertakings, Corporate frame Work – Share Holders- Board of Directors- Committees – Chief Executive – Line and functional Managers, Constraints – Environmental – Financial – Legal- Trade Union

**UNIT II FUNCTIONS OF MANAGEMENT****9**

Planning – nature and purpose – objectives – strategies – policies and planning premises – Decision making – Organizing – Nature and process – premises – Departmentalization – line and staff – Decentralization – organizational culture, Staffing – selection and training – placement – performance appraisal – career strategy – organizational development. Leading managing human factor – Leadership – communication, Controlling – process of Controlling – Controlling Techniques – productivity and inventory management systems-Tools of Techniques– Prevention control, industrial safety

**UNIT III ORGANIZATIONAL BEHAVIOUR****9**

Definition – Organization – Managerial Role and functions – organizational approaches, individual behavior – causes – Environmental Effect – Behavior and performance, perception – organizational Implications. Personality – Contributing factors – Dimension – Need Theories – process Theories – Job satisfaction, Learning and Behavior- Learning Curves, work design and approaches

**UNIT IV GROUP DYNAMICS****9**

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective Communication, leadership- Formal and informal characteristics- Managerial Grid – Leadership Styles – Group Decision making – Leadership Role in Group Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organizational centralization and decentralization – Formal and informal – organizational structures – organizational change and development – Change process – Resistance to change – culture and ethics

**UNIT V MODERN CONCEPTS****9**

Management by objectives (MBO) – Strategic Management – SWOT analysis –Evolving development strategies, information technology in management – Decision support system – Management Games – Business Process Re-engineering (BPR) – supply chain management (SCM) –Global Perspective – Principles and Steps – Advantages and Disadvantages

**TOTAL: 45 PERIODS****OUTCOME**

- The course will enable student preparedness to technology management and the forms of organisation in an industry. This course also enables the student to understand the functions of Management and also the organisational behaviour. It also gives some knowledge on the modern concepts such as Strategic management, SWOT analysis, Business Process Re-engineering (BPR) and supply chain management (SCM).

## TEXTBOOKS

1. Herald Koontz and Heinz Wehrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.
2. M.Govindarajan and S.Natarajan, Principles of Management, Prentice Hall of India Pvt.Ltd. New Delhi 2007

## REFERENCES

1. S.Chandran, Organizational Behaviors, Vikas Publishing House Pvt., Ltd, 1994
2. Ties, AF,Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110011, 1992
3. Joseph J,Massie, 'Essentials of Management' Prentice Hall of India. Ltd. 1985

MI7601

**ENVIRONMENTAL SCIENCE FOR MINING ENGINEERING**

**L T P C**  
**3 0 0 3**

### 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, Objectives of Sustainable Development.

### UNIT II ENVIRONMENTAL 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 including dust, Control and preventive measures for air pollution 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 ENVIRONMENTAL 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, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to equipment vibrations & their monitoring, prevention and control, Land pollution, land for alternation dealing with mind out land , re-vegetation, land use plan, Textural classification and properties of soil. Impact of pollution on human health,

### UNIT IV ENVIRONMENTAL MANAGEMENT

9

Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 – EIA Notification – 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,

Attested

Sobhan  
DIRECTOR

**UNIT V ENVIRONMENTAL LEGISLATIONS****9**

Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regulatory agencies and occupation consent to establish and operate wild life protection act and rules , Environmental clearance procedure for a mining Project.

**TOTAL: 45 PERIODS****OUTCOME:**

- 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 and Technology.
- 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, Addison Wesley Longman Ltd, Singapore, 1997.
- 10 Christopher Sheldon and Mark Yoxon, Installing Environmental Management System –a step by step guide, Earthscan Publications Ltd, London, 1999.
- 11 Lee Kuhre, ISO 14001 Certification –Environmental Management Systems, Prentice

**MI7602****ROCK MECHANICS AND GROUND CONTROL – II****L T P C  
3 0 0 3****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 stabilisation 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 OF UNDERGROUND 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****OUTCOME:**

- The students will have knowledge on rock mechanics instrumentation, approach to pit slope stability, theories of subsidence and failure of rocks. They will also know about design of underground openings and methods of stowing.

**TEXT BOOKS:**

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley 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. and Page, C.H., Practical Handbook for Underground Rock Mechanics, Transtech Publications, Berlin, 1986.
6. Whittaker, B.N. and Reddish, D.J., Subsidence – Occurrence, Prediction and Control – Elsevier Science Publishers, the Netherlands, 1989

**OBJECTIVES:**

- To study the development of panels and extraction of coal in Bord and Pillar method
- To study the Longwall advancing and retreating methods
- To study the various special methods of winning coal
- 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**

Status of coal industry and deposit, factors affecting choice of mining methods, classification of mining methods, grading and analysis of coal.

**UNIT II BORD AND PILLAR METHOD-DEVELOPMENT****9**

Design and development of a district / 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**

Pillar extraction by caving and stowing methods; mechanised extraction of pillars, shaft pillar extraction, 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, multi slices, sublevel caving, horizon mining, gallery blasting method, contiguous seam working, working steeply inclined seams, working under surface structures and seams liable to spontaneous heating, outburst and bumps, etc. hydraulic mining, Wongawalli, shortwall, highwall mining, underground coal gasification, coal bed methane, shield mining.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will gain knowledge on development and depillaring of coal by Bord and Pillar and advancing and retreating in Longwall methods. They will also know about methods of winning of coal seams which have special features.

**TEXT BOOKS:**

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

**REFERENCES**

1. Singh, T.N. Singh, Underground Winning of Coal – Oxford & IBH Publishing Co. 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 and Technology, 1987.
7. Internet: www.miningindia.com

**COURSE DESCRIPTION**

This course aims to help engineering students acquire the employability skills necessary for the workplace. It also attempts to meet the expectations of the employers by giving special attention to presentation skills, group discussion skills and soft skills. This aim will be achieved through expert guidance and teaching activities focusing on the above listed skills and language skills in the Language Laboratory.

**OBJECTIVES**

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills and soft skills.
- To help them improve their writing skills necessary for the workplace situation.

**CONTENTS****UNIT I WRITING SKILLS**

Preparing job applications – writing the cover letter and resume – applying for jobs online – e-mail etiquette – writing reports – collecting, analyzing and interpreting data.

**UNIT II SOFT SKILLS**

Hard skills & soft skills – soft skills: self-management skills & people skills – training in soft skills – persuasive skills – sociability skills – interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability – stress management – motivation techniques – life skills.

**UNIT III PRESENTATION SKILLS**

Preparing slides using the computer– structuring the content (parts of a presentation)- body language – answering questions – individual presentation practice — mini presentation (practice sessions)

**UNIT IV GROUP DISCUSSION SKILLS**

Participating in group discussions – understanding group dynamics – brainstorming – questioning and clarifying – GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD – mock GD.

**UNIT V INTERVIEW SKILLS**

Interview etiquette–technical Interview/HR Interview/body language – mock interview – attending job interviews – Types of interviews- telephone/skype interview – stress interview, one to one/panel interview – FAQs related to job interview.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Students will be able to make presentations and participate in group discussions with confidence.
- Students will be able to perform well in interviews.
- They will have adequate writing skills.

**REFERENCES:**

1. Downes, Colm. Cambridge English for Job Hunting. CUP, 2008
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of soft skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft skills. New Delhi: Rupa and Co. 2006.

6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.
7. Sarawati, V. and Revathi Vishwanathan, Soft Skills for Career Communication Preetat Publications, Chennai: 2011

### EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989
2. Bagchi, Cubroto. The Professional. New Delhi: Penguin Books India, 2009.

### WEB RESOURCES

1. [www.humanresources.about.com](http://www.humanresources.about.com)
2. [www.careerride.com](http://www.careerride.com)
3. <https://bemycareercoach.com/softskills>

MI7611

MINING MACHINERY LABORATORY

L T P C  
0 0 2 1

### OBJECTIVE:

- To study the various mining machineries, ropes, conveyors and different types of machines used in underground mines
1. Study and construction of different types of wire ropes and types of rope cappels used for rope haulages & winding, safety hooks used in winding.
  2. Construction of compressed air operated drill
  3. 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. 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
  8. Study of various types of head gear, fleet angle, study of shaft fittings, suspension gear, safety dogs and protective roofing, study of guides– methods of support and tensioning arrangements.
  9. Construction of cages, skips & their fittings and brakes of winders & haulers
  10. Study of different types of conveyors (components & safety devices) like armoured face conveyors, belt conveyors, gate belt conveyors, shaker & vibrating conveyors, high angle conveyors
  11. Study of coal drill and its electrical panel/gate end box
  12. Study of pit top & pit bottom layouts in shaft and inclines.
  13. Study of different types of loading machines
  14. Study of cool plough and shearer.
  15. Study of continuous miner and road headers.

**TOTAL: 30 PERIODS**

### OUTCOME:

The students will be able to understand the underground machineries, ropes, pit-top and pit-bottom layouts.

### REFERENCES:

1. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.
2. Statham, I.C.F., Coal Mining, Vol. I, II, III and IV, Caxton Eastern Agencies, Calcutta.
3. Deshmukh, D.J., Elements of Mining Technology, Vol. I, II and III, EMDEEE Publishers, Nagpur, 1979.



**OBJECTIVES:**

- To study the various of methods to determine the properties of rocks
- To study the operation of various instruments and equipment.

**DETERMINATION OF**

- 1 RQD of rocks.
- 2 Protodyaknov index of rocks.
- 3 Point load index strength of rocks
- 4 Porosity of rocks.
- 5 Water absorption of rocks.
- 6 Impact strength index.
- 7 Hardness of rocks by different methods.
- 8 Uni-axial compressive strength of dry and water saturated rock samples.
- 9 Tensile strength of rock using Brazilian test method.
- 10 Flexural Strength of rocks.
- 11 Shear strength of rocks.
- 12 Tri-axial strength of rock and drawing of Mohr's envelope.
- 13 Slake durability index of rocks.
14. Determination of longitudinal wave velocities of rocks using NDT.

**TOTAL: 30 PERIODS****OUTCOME:**

The students will have knowledge on strength and deformation characteristics of rock using different methods.

**REFERENCES:**

1. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78.
- 2 Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.
- 3 Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.

**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 organised in a 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 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.

Attested


  
 DIRECTOR

**OUTCOME:**

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

**MI7701****MINE ENVIRONMENTAL ENGINEERING – II****L T P C**  
**3 0 0 3****OBJECTIVES:**

- To study about spontaneous heating, mine fires, inundation and explosions
- To study about mine rescue, first aid and illumination.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

**UNIT I SPONTANEOUS HEATING AND FIRES 12**

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

**UNIT II EXPLOSIONS 8**

Causes, prevention and control of underground fire-damp and coal dust explosions including 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, safety boring apparatus, design and construction of water dams and barriers, recovery of flooded mines, dewatering of old workings, layout of drainage systems and sumps.

**UNIT IV MINE RESCUE AND FIRST AID SAFETY 9**

Classification of mine rescue apparatus including self-rescuer, various types of rescue and escape apparatus, rescue organisation of a mining company, layout of a modern rescue station including personnel, first aid to the persons injured in mine-accidents, electric shock, asphyxiation, different methods of artificial respiration, rescue and recovery work in mines including through boreholes.

**UNIT V MINE ILLUMINATION 7**

Electric safety lamps, their maintenance and examination, lamp room design and organisation, lighting from mains, lighting on mechanised longwall faces and gassy mines, photometry and illumination survey, legislations related to illumination survey.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have knowledge on spontaneous heating, mine fires, inundation and explosions. They will also know about mine rescue and first aid.

**TEXT BOOKS:**

- 1 Kaku L.C., Fires in Coal Mines, Oriental Publishers, II Edition, 1985.
- 2 Ramlu, M.A., Mine Disasters and Mine Rescue, Oxford and IBH Publishers, 1991.

**REFERENCES:**

- 1 Ramlu, M.A., Mines Fires, Explosion, Rescue, Recovery and Inundations, Mukhertu Publishers, Kharagpur, 1989
- 2 Misra, G.B., Mine Environment and Ventilation, Oxford University Press, 1993.
- 3 McPherson, M.J., Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993.

- 4 Sarkar, S.K. and Sarkar, S., State of Environment and Development in Indian Coalfields, Oxford and IBH, 1996.
- 5 Classified Circulars by D.G.M.S., Dhanbad.
- 6 Ghatak, S., Mine Management, Legislation & General Safety.

**MI7702**

**MINE LEGISLATION AND SAFETY**

**L T P C**  
**4 0 0 4**

**OBJECTIVES:**

- To study various acts, rules and regulations relating to the mineral industry
- To study accidents, diseases and mine safety

**UNIT I INTRODUCTION TO MINING LAWS AND LEGISLATION 10**

General principles of mining laws, development of mining legislation of India. Enactment of various statutes and by-laws.

**UNIT II ACTS, RULES APPLICABLE TO MINING - I 15**

Mines Act, Mines Rules, Bye-laws, and standing orders (Except the ones which are related to in courses Drilling & Blasting, Surface Mining, Mining Machinery I & II, Mine Environmental Engineering I & II, Underground Mining methods (Coal & Metal) and Rock Mechanics and Ground Control I & II, Mine surveying.

**UNIT III ACTS, RULES APPLICABLE TO MINING - II 15**

Indian electricity rules, coalmines conservation and development act, Workman's compensation act., General provisions of Mines and Minerals Regulation and Development Act, Mineral Concession Rules, Vocational Training .Rules, Crèche rules, Maternity benefit act, Payment of Wages Act, Gratuity and P.F. Rules, Explosives act, Rescue Rules, Factories Act.

**UNIT IV ACCIDENTS AND DISEASES 10**

Classification of accidents, causes and prevention of accidents, accident enquiry reports, cost of accidents, occupational and miner's diseases and their social effects.

**UNIT V MINE SAFETY 10**

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

**TOTAL : 60 PERIODS**

**OUTCOME:**

- The students will have knowledge on various acts, rules and regulations relating to the mineral industry. They will also know about accidents, diseases and mine safety.

**TEXT BOOKS:**

- 1 Coal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.
- 2 Metal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.

**REFERENCES**

- 1 Mines Act 1952, Lovely Prakashan, Dhanbad, 1995.
- 2 DGMS Circulars, By National Council of Safety in Mines, Dhanbad, 1995.
- 3 Mines rules, 1955, Lovely Prakashan, Dhanbad, 1995.
- 4 The Mines Rescue Rules, 1986, Lovely Prakashan, Dhanbad, 1995.
- 5 The Indian Electricity Rules, 1995, Lovely Prakashan, Dhanbad, 1995.
- 6 The Payment of Wages Act, 1936, Ram Narain Lal Beni Prasad, 1995.
- 7 Vocational Training Rules, Lovely Prakashan, Dhanbad, 1995.
- 8 The Workmen's compensation Act, 1923, Ram Narainlal Beni Prasad, Allahabad, 1995.
- 9 Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994



**OBJECTIVE:**

To study the computer programming for mining problems, mine ventilation network analysis, modeling of surface and underground workings using various software.

1. Design of pillars
2. Blast design
3. Subsidence prediction.
4. Mine ventilation network analysis.
5. Modelling of airflow through underground workings using CFD.
6. Ore body modeling.
7. Slope stability analysis in soil and rocks.
8. Fragmentation Analysis
9. Truck dispatch system optimization
10. Digital Terrain and Wire-frame modelling
11. Surface Mine Design using MPD Software
12. Underground Mine Design using MPD Software
13. Pit optimization using MPD Software
14. Production Scheduling for grade control
15. Design of experiments.

**TOTAL: 60 PERIODS****OUTCOME:**

- The students will be able to use the planning software for surface and underground mining methods.

**REFERENCES:**

1. E Balagurusamy , Fundamentals of Computers , Mc Graw Hills Publication, 2009
2. MPD Software Manual.
3. Fragalyst Software Manual

**OBJECTIVES:**

- To determine the psychrometric properties, gas percentage in atmosphere.
- To study the principles and characteristics governing mine fans.
- To understand lamp design and perform underground illumination surveys.

**EXERCISES:**

1. Study of flame safety lamp, gas testing with flame safety lamp.
2. Mine air sampling and detection of various mine gasses, like, methane, carbon monoxide (CO), High volume air samplers etc.
3. Determination of psychrometric properties of air, measurement of cooling power by Kata thermometer.
4. Study of air-reversal arrangement for mine fans.
5. Study of pressure survey and quantity survey in mines using velometer, anemometer and barometer.
6. Determination of air-borne dust by gravimetric dust sampler, personal dust sampler and by high volume sampler.
7. Noise survey.
8. Determination of crossing point temperature of coal
9. Determination of inflammability index of coal
10. Study of self rescuers of different types.
11. Study of self contained breathing apparatus

12. Proximate analysis of coal
13. Illumination survey.
14. Determination of pH, TDS, TSS, dissolved oxygen and chemical oxygen demand of water.
15. Determination of organic carbon of soil sample

**TOTAL: 30 PERIODS**

**OUTCOME:**

- The students will get practical knowledge about underground mine ventilation equipment's functions, usage and interpretation of data.

**REFERENCES:**

1. Misra, G.B., Mine Environment and Ventilation, Oxford University Press, 1993.
2. Ramlu, M.A., Mines Fires, Explosion, Rescue, Recovery and Inundations, Mukhertu Publishers, Kharagpur, 1989
3. McPherson, M.J., Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993.

**MI7713 ROCK MECHANICS AND GROUND CONTROL LABORATORY – II**

**L T P C**  
**0 0 2 1**

**OBJECTIVE:**

To study the physico-mechanical properties of rock, ground vibration monitoring, stowing characteristics, etc.

1. Time dependent properties of rocks
2. Drillability index of rocks.
3. Stress and fracture patterns around underground model openings
4. Young's Modulus of Elasticity and Poisson's ratio.
5. Rock anchorage capacity of a rock bolt
6. Roof convergence and other ground control instruments
7. Post Failure Behaviour of Rocks
8. Angle of Internal Friction
9. Measurement of vibration generated by blasting and operation of machines
10. Stowing/ shrinkage Characteristics
11. Study of flat Jack.
12. Study of creep of rocks.
13. Study of strata monitoring instruments.
14. Determination of shear strength of soil
15. Determination of tri-axial strength of soil.

**TOTAL : 30 PERIODS**

**OUTCOME:**

The students will have knowledge on time dependent properties of rock, subsidence, ground vibration monitoring, stowing characteristics various aspects of strata monitoring and strength of soil.

**REFERENCES:**

1. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78.
2. Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.
3. Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980

MI7714

**PRACTICAL TRAINING - III**

**L T P C**  
**0 0 0 2**

**OBJECTIVE:**

To impart practical exposure to the students for gaining deeper understanding of various activities and principles of underground mining.

Gaining practical experience is an important aspect of the mining engineering programme and its has many characteristic features of its own. The students have to undergo practical training in mines / allied industry / research institute during the summer vacation at the end of the VI Semester for a period of 4 weeks and obtain a valid certificate from the competent authority of the organisation providing 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 two credits during the VII Semester. Evaluation would be done by one or more faculty on different marking heads such as training, viva-voce, report etc., or other approved evaluation system.

Normally a student is not permitted to withdraw from the practical training. In case of any unforeseen circumstances / valid reasons if he/she 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-III subsequently. The decision of the competent authority is final in this regard.

**OUTCOME:**

The students will understand various activities and principles of mining / allied engineering / research and its importance

MI7715

**MINI PROJECT**

**L T P C**  
**0 0 0 2**

**OBJECTIVE:**

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

A project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the mini project work is to comprehend the principles by applying them to a new problem which may be a design and manufacture of a device, a research investigation, a computer or management project or a design problem.

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

**OUTCOME:**

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

MI7811

**PROJECT WORK**

**L T P C**  
**0 0 20 10**

**OBJECTIVE:**

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

A project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be a design and manufacture of a device, a research investigation, a computer or management project or a design problem.

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 external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

**TOTAL: 300 PERIODS**

**OUTCOME:**

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

GE7071

**DISASTER MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS**

**9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)**

**9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.



**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context,
- Disaster damage assessment and management.

**TEXT BOOKS:**

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13:978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt.Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

**REFERENCES**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

**GE7074**

**HUMAN RIGHTS**

**L T P C  
3 0 0 3**

**OBJECTIVES :**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I**

**9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

<b>UNIT II</b>	<b>9</b>
Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.	
<b>UNIT III</b>	<b>9</b>
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.	
<b>UNIT IV</b>	<b>9</b>
Human Rights in India – Constitutional Provisions / Guarantees.	
<b>UNIT V</b>	<b>9</b>
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.	

**TOTAL : 45 PERIODS**

**OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

<b>GE7351</b>	<b>ENGINEERING ETHICS AND HUMAN VALUES</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

<b>UNIT I</b>	<b>HUMAN VALUES</b>	<b>3</b>
Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.		
<b>UNIT II</b>	<b>ENGINEERING ETHICS</b>	<b>9</b>
Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment		
<b>UNIT III</b>	<b>ENGINEERING AS SOCIAL EXPERIMENTATION</b>	<b>9</b>
Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.		
<b>UNIT IV</b>	<b>ENGINEER'S RIGHTS AND RESPONSIBILITIES ON SAFETY</b>	<b>12</b>
Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and Chernobyl as case studies.		

**UNIT V GLOBAL ISSUES****12**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

**TOTAL : 45 PERIODS****OUTCOME**

- Students will have the ability to perform with professionalism , understand their rights , legal ,ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

**TEXT BOOKS**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics –Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES**

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

**MI7001****ADVANCED COAL MINING AND MECHANIZATION****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the recent trends of level of mechanisation for coal face
- To understand the various advanced methods of coal mining

**UNIT I COAL FACE MECHANISATION****8**

Recent Trends, mechanised bord and pillar mining, case studies.

**UNIT II MINING OF THICK SEAMS****8**

Problems, past experiences in India, current methods, mining of thick, contiguous, and steep seams

**UNIT III HYDRAULIC MINING****9**

Applicability, operating parameters, equipment, layouts, Indian experience. Computer applications such as remote control and environmental monitoring in hydraulic mining.

**UNIT IV LONGWALL MINING****10**

Powered supports, development of powered supports, their types and designs, selection for different conditions, last drivages for longwall panelling, remotely operated powered support and longwall faces, Indian experiments, salvaging in longwall.

**UNIT V UNDERGROUND COAL GASSIFICATION****10**

Scope, application, methods of gasification, design of gasification plants, coal bed methane. Environmental monitoring techniques and computer applications in coal gasification techniques.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The students will have good exposure about the various advanced methods of coal mining with the knowledge about advanced coal face mechanization.

**TEXT BOOKS:**

1. Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
2. Singh, T.N., and Dhar, B.B. Thick Seam Mining, Problems and Issues, Oxford & IBH Publishers, 1992

**REFERENCES:**

- 1 Mathur, S.P., Mining Planning for Coal, M G Consultants, Bilaspur, 1993
- 2 Peng S.S. and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992
- 3 T.N. Singh, Underground Winning of Coal, Oxford IBH Publishers, 1999
- 4 R.D. Singh, Principles and Practices of Modern Coal Mining, New Age International, 1997

**MI7002****ADVANCED METAL MINING AND MECHANIZATION****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the recent advancement of metal mine development
- To understand the various advanced methods of metal mining

**UNIT I      ADVANCED MINE DEVELOPMENT      9**

Recent advances in raising, winzing, development of drives, tunnels, cross- cuts, drifts, stope preparations, opening up of mineral deposit, enlargement of drives and raises, recent trends in shaft sinking. Techno economic aspects.

**UNIT II      ADVANCED METAL MINING AND STOPING PRACTICES      9**

Recent advances in stoping practices, VCR mining, deep mining, stoping practices in rockburst prone mines, back-filling, recent developments in metal mining in India.

**UNIT III      MECHANISATION, SUPPORT SYSTEMS IN METAL MINES      9**

Mechanisation in metal mines – LHD declines, hydraulic transport, trackless mining, modern support system used in metal mines, recent developments in winding and transport

**UNIT IV      SPECIAL MINING TECHNIQUES      9**

Marine mining methods – sea water, marine beaches, continental shelves, sea-bed sediments and polymetallic nodules, solution mining, ore leaching, in situ leaching techniques.

**UNIT V      SPECIAL PROBLEMS OF ORE MINING      9**

Special problems of deep mines – rock pressure, heat, humidity, rock burst, noise and dust pollution, deep winding and transport, etc.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have good knowledge about the various advanced methods of metal mining and special mining techniques to overcome the field issues.

**TEXTBOOKS:**

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Hartman, H.L., Mine Ventilation and Air Conditioning, Wiley Inter Science Publication, New York, 1986

**REFERENCES;**

1. Peng, S.S, Ground Control, Wiley Interscience, New York, 1985
2. Underground Mining Methods Handbook, AMIE Publication, 1992
3. Karmakar, H., Mine Working, Vol. I and II, Lovely Prakashan, Dhanbad, 1995
4. Underground Mining Methods and Technology, Elsevier Science Publishers, 1990

**MI7003****ADVANCED ROCK BLASTING TECHNOLOGY****L T P C  
3 0 0 3****OBJECTIVE:**

- The course enables the students to be familiar with the recent developments in various blasting technology used in surface & underground mines and construction projects across the world.

**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, Tunnel breakthrough under water.

**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 Hot 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**

Blasting damages – Micro and macro level damages due to blasting; Ground vibrations, flyrock and air over pressure. Influence of Blasting on surface structures and underground workings; Safety during blasting

**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, blast economics, computer applications in blasting.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will be familiar with the recent developments in various rock blasting technology being adopted in mining and construction areas.

**TEXT BOOKS:**

1. Pal Roy, Piyush,(2015), Rock Blasting: Effects and Operations, CRC Press, 380p, 3<sup>rd</sup> Edition, 2015.
2. Johansen, John and Mathiesen, C.F., (2000), Modern Trends in Tunnelling and Blast Design, AA Balkema, 154p, 2000.

## REFERENCES:

1. William A, Hustrulid, (1999), Blasting Principles for Open pit mining, A.A.Balkema.
2. Bhandari S., (1997), Engineering Rock Blasting Operations, AA Balkema Rotterdam, Netherlands, p.375.
3. Per-Anders Persson, Roger Holmberg, Jaimin Lee, (1993), Rock blasting and explosives Engineering, CRC Press, p.560.
4. Ghose, A.K and Joshi, A (Ed), (2013), Blasting in Mining – New Trends, CRC Press, 2013.
5. Singh, P.K. and Sinha, A (Ed), (2012), Rock fragmentation by blasting (FRAGBLAST 10), CRC Press, 872p.

MI7004

ADVANCED SURFACE MINING

L T P C  
3 0 0 3

## 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 GEOTECHNICAL PARAMETERS

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 slope and other design 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. In pit 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

**OUTCOME:**

- The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends in opencast mines, safety and environment.

**TEXT BOOKS**

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open Pit Mine Planning & Design, Elsevier, 1995

**REFERENCES**

- 1 Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995
- 2 Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994
- 3 Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
- 4 Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990

**MI7005**

**COMPUTER APPLICATION 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 INTRODUCTION 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 10**

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 8**

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**

**OUTCOME:**

- The students will have basic programming knowledge and its applications on various mining related problems and familiarity with hardware and software issues during development of programs. They will also have a perspective on high-end simulation methodologies and modern techniques to solve mining problems.

**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 , Mc Graw Hills Publication, 2009
4. Basandra S K, Computers Today Fourth Edition, Galgotia Publications Pvt. Ltd, 2004

**MI7006****LONGWALL MINING****L T P C  
3 0 0 3****OBJECTIVES:**

- To pioneer the history of longwall mining and its development stages
- To understand the extraction, support and transport on a longwall face
- To learn ventilation methods and strata monitoring instruments

**UNIT I PLANNING****10**

History of longwall mining and its development, techno-economic consideration of the modified longwall retreat panels, longwall advance panels with caving method and stowing method, design of gate roadways and their size disposition, layout of panels, production and manpower planning, sublevel caving systems for thick seams, caving system in thin seams, multi-slice longwall mining, application of longwall mining for steep seams, longwall caving in metal mines.

**UNIT II SUPPORTS****10**

Types of supports used in longwall mining in the past and present, design of powered supports for different situations, longwall face end problems, supports in longwall gate roadways during drivage and extraction, pressure distribution around a moving longwall face, caving of thick seams and thin seams. Main roof fall, local fall and induced roof wall, floor heaving, precautions during main fall and surface subsidence.

**UNIT III EXTRACTION AND TRANSPORT ON A LONGWALL FACE****10**

Methods of mining coal on longwall faces, machines – shearers, ploughs etc., methods of cutting and face advancement, stables and sumping, gate road pillar extension. Mode of transporting coal or ore in longwall face and machinery used. Shortwall Mining – a modified longwall mining. Remotely operated longwall faces. Shifting of longwall equipment.

**UNIT IV DEVELOPMENT AND WORKING OF LONGWALL FACES****8**

Methods of driving gate roadways, choice of selection of machinery, road headers and dinters, special problems associated with working of longwall faces - faults, roof caving, face spalling, overburden movement, subsidence control, hydraulic stowing, dealing with spontaneous heating while working thick seams in coal.



**UNIT V ENVIRONMENT AND ANCILLARY****7**

Methods of ventilating longwall faces and gate roadways. Methane control, dust control and noise control, monitoring at longwall faces. Assessment of cost of ventilation. Electric and hydraulic circuits. Surface and ground water effects. Strata monitoring with instruments.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have better understanding about mine planning, methods of working, development of longwall face, support systems, methods of ventilating longwall faces and transport system on a longwall face

**TEXT BOOKS:**

- 1 Peng , S.S., Longwall Mining, 2nd Edition, John Willey and Sons, New York, 2006
- 2 Singh, R.D., Principles and Practices of Modern Coal Mining, New Age International, 1997.

**REFERENCES:**

- 1 Mathur, S.P., Mining Planning for Coal, M.G. Consultants, Bilaspur, 1999
- 2 Singh T.N., Dhar, B.B. Thick Seam Mining, problems and Issues, Oxford & IBH Publishers, 1992.
- 3 Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994.
- 4 Longwall Mining in Company Seminar – Proceedings – The Singareni Collieries Co. Ltd., 1990.

**MI7007****MATERIAL HANDLING****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the basic principles in material handling and its equipment
- To study the conveyor system and its advancement

**UNIT I BULK HANDLING SYSTEMS****9**

Basic principles in material handling exclusive to mining industry and its benefits. Classification of material handling equipments. Current state of art of bulk handling materials in mining in the world and Indian scenario; Selection of suitable types of systems for application. 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, stackers and reclaimers, 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**

**OUTCOME:**

- The students will get exposure towards the 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. Hustrulid, W., and Kuchta, M. Open Pit Mine Planning & Design, Vol. 1, Fundamentals, Balkema, Rotterdam, 1998.

**REFERENCES:**

- 1 Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
2. Deshmukh, D.J., Elements of Mining Technology, Vol.I, II and III, EMDEE Publishers, Nagpur, 1979.
- 3 Peng, S.S., and Chiang, H.S., Longwall Mining, John Wiley and Sons, New York, 1984.
4. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol.I and II, Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992.
- 5 Vorobjev, B.M., and Deshmukh, R.T. Advanced coal Mining, Vol.I and II, Mrs Kusum Deshmukh, P.O. Indian School of Mines, 1966.
6. Woodruff, S.D., Methods of Mining, Working, Coal and Metal Mines, Vol.II and III, Pergamon Press, 1968.
- 7 Sinclair, J., Winding and Transport in Mines, Sir Isaac Pitman and Sons, Ltd., London, 1959.

**MI7008**

**MINE ECONOMICS AND INVESTMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

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

**UNIT I INTRODUCTION 4**

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-statistica I methods, classification of reserves.

**UNIT III MINE VALUATION 12**

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; profitability index – their implications in mine economic evaluation.

*Attested*

**UNIT IV PROJECT APPRAISAL****12**

Methods of project evaluation – pay back, annual value, benefit/cost ratio, ERR and IRR, etc., 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****8**

Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P & L account, balance sheet, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have knowledge on estimation and valuation of mineral deposits. They will possess about project appraisal, finance and accounting.

**TEXT BOOKS:**

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Arogyaswamy, R.N.P. Courses in Mining Geology, Oxford and IBH Publishing Co., 1994.

**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 Mining Year Book 1994 – MMRD Act and Mineral Concession Rules.

**MI7009****MINE PLANNING AND DESIGN****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the planning of opencast & underground mines 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; mine plan preparation; Choice between surface and underground mining.

**UNIT II OPENCAST MINING****12**

Development of Ultimate Pit Configuration (open pit limits) 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, mine design, 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; design of shaft pillars and protective pillars, planning of production capacity, optimization of mine size – mine production capacity, layout of development drives / raises / winzes etc, length of faces, etc, planning of support systems,

ventilation, layout 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 EQUIPMENT PLANNING**

**8**

Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment, their capacities and population for different mining conditions. Maintenance planning and scheduling including spare management; Equipment information – performance monitoring and expert systems.

#### **UNIT V PROJECT IMPLEMENTATION AND MONITORING**

**8**

Pre-project activities – feasibility report, environmental clearance, detailed project report, 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. Environmental impact assessment and preparation of environmental management plan.

**TOTAL : 45 PERIODS**

#### **OUTCOME:**

- The students will have knowledge on planning of opencast mining, underground mining and equipment utilization. They will also know about project implementation and monitoring methods.

#### **TEXT BOOKS:**

- 1 Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
- 2 Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995.

#### **REFERENCES**

- 1 Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.
- 2 Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.
- 3 Christoper J. Bise, Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy, and Exploration, 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. and Pal Roy, P., Blasting in Underground excavations and mines, CMRS Dhanbad, 1993.
- 7 Peng, S.S. and Chaing, H.S., Longwall Mining, John Wiley & Sons, New York, 1984.
- 8 Rzhevsky, V.V., Opencast Mining – Technology and Integrated Mechanisation, MIR Publishers, Moscow, 1987.
- 9 Rzhevsky, V.V., Opencast Mining – Unit Operations, MIR Publishers, Moscow, 1987.

**MI7010**

**MINE SAFETY ENGINEERING**

**L T P C**  
**3 0 0 3**

#### **OBJECTIVES:**

- To learn the level of risk associated with mining, risk assessment and management
- To know the occupational diseases, mine disasters and mitigation

#### **UNIT I MINE ACCIDENTS**

**8**

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****8**

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****8**

Introduction – methodology, symbols and Boolean techniques, qualitative analysis, computerized methods, statistical analysis, safety information, systems design.

**UNIT IV RISK ASSESSEMENT AND DISASTER MANAGEMENT****11**

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****10**

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****OUTCOME:**

- The students will have deep knowledge about the mine accidents, disaster, disease and mine safety with risk assessment, mitigation and management.

**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.

**MI7011****MINERAL EXPLORATION****L T P C  
3 0 0 3****OBJECTIVES:**

- To know the mineral resources and prospecting techniques
- To understand exploration techniques and strategy
- To study the prefeasibility and feasibility reports and its evaluation methods

**UNIT I MINERAL RESOURCES AND PROSPECTING****10**

Introduction to important mineral resources in India and world wide, surface and aerial prospecting, reconnaissance, application of geochemical, geophysical and geostatistical methods

<b>UNIT II</b>	<b>EXPLORATION</b>	<b>9</b>
Preliminary and detailed exploration by boring, exploratory mining by shafts, drifts, cross-cuts, collection and compilation of data for computer processing.		
<b>UNIT III</b>	<b>EXPLORATION STRATEGY</b>	<b>8</b>
Exploration investment decision, exploration techniques and strategies, exploration targets.		
<b>UNIT IV</b>	<b>EXPLORATION GROUPS AND THEIR ROLE</b>	<b>8</b>
Strategy and structure of the exploration group, government policies, aspects of exploration, role of exploration in the mining company.		
<b>UNIT V</b>	<b>PREPARATION AND EVALUATION OF PROJECT REPORTS</b>	<b>10</b>
Evaluation of exploration and development projects, study of typical pre-feasibility and feasibility reports.		
		<b>TOTAL : 45 PERIODS</b>

**OUTCOME:**

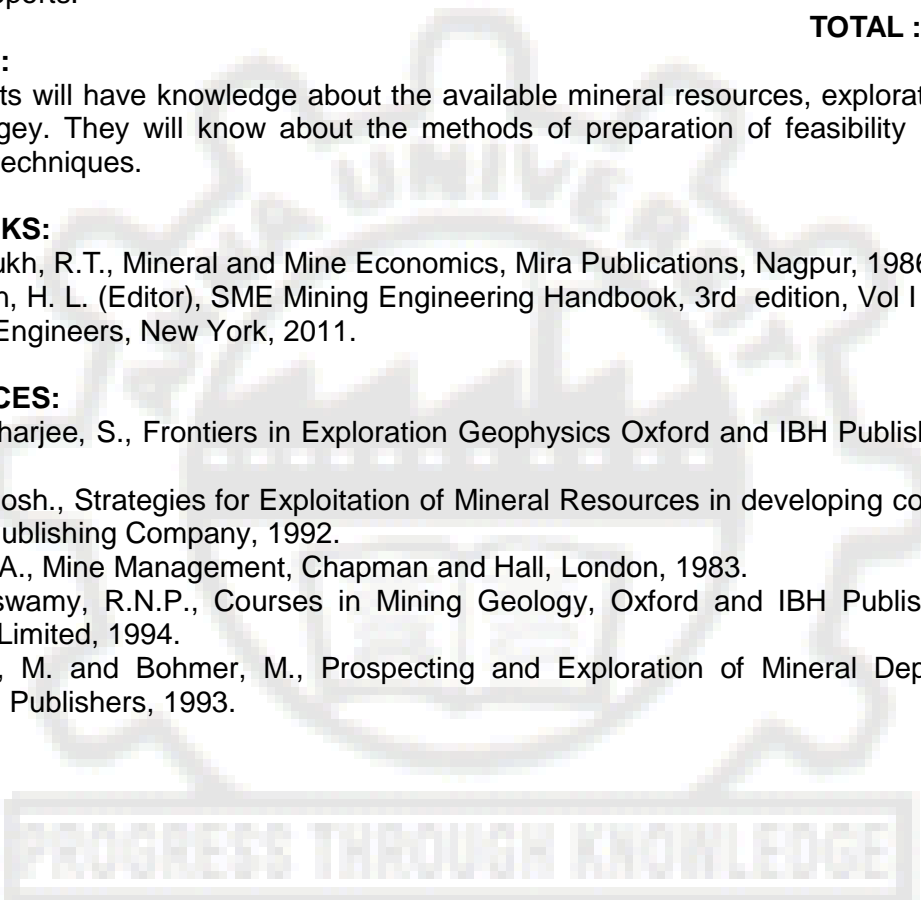
The students will have knowledge about the available mineral resources, exploration techniques and its stage. They will know about the methods of preparation of feasibility reports and its evaluation techniques.

**TEXT BOOKS:**

- 1 Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
- 2 Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.

**REFERENCES:**

- 1 Bhattacharjee, S., Frontiers in Exploration Geophysics Oxford and IBH Publishing Company, 1992.
- 2 A.K. Ghosh., Strategies for Exploitation of Mineral Resources in developing countries, Oxford & IBH Publishing Company, 1992.
- 3 Ioan, D.A., Mine Management, Chapman and Hall, London, 1983.
- 4 Arogyaswamy, R.N.P., Courses in Mining Geology, Oxford and IBH Publishing Company Private Limited, 1994.
- 5 Kuzvart, M. and Bohmer, M., Prospecting and Exploration of Mineral Deposits, Elsevier Science Publishers, 1993.



<b>MI7012</b>	<b>NUMERICAL METHODS IN MINING ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**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 elasto-plastic models.

**UNIT II FINITE DIFFERENCE METHODS 9**  
 Concept, formation of mesh element, finite difference patterns, solutions, application to mining.

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- 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 boundary elements 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 Rieholk 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.

**MI7013**

**PETROLEUM ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To learn the exploration methods and reserve estimation in petroleum industry
- To know the drilling and production methods in petroleum industry

**UNIT I EXPLORATION METHODS AND RESERVE ESTIMATION 9**  
 Concept of Petroleum Engineering; Regional petroleum prospecting – magnetic and gravity methods, procedures for data collection, corrections, Interpretation; Seismic reflection method data acquisition, seismic processing, display of seismic data interpretation, hot spots for oil and gas, 3D surveying Volumetric oil and gas reserve estimation – deterministic methods – Monte Carlo method, parametric methods, Three point estimates – uncertainty of input to estimation.

**UNIT II DRILLING OPERATIONAL PRACTICES 9**  
 Rotary oil well rig, rotary drilling, basic operations for brakes, Betties Protector, drill-pipe wiper, tong pull back, making-up joints, breaking up joints, connecting and disconnecting Kelly & Hook, checking conditions of rotary ships and master Busting – operational practices for spudding-in-drill-color and pipe connection, pulling out, running in stabilization tools and operation, fitting of well head, installation of blow-out preventor (BOP) and testing drill stem assembly, failure of drill pipes, drill stem design, tension loading, external fluid pressure- height on bit, drill collar bending, strength ratio, transition zone, quick guide to solve drill stem failures – directional drilling, inclinometer survey, horizontal drilling

**UNIT III HYDRAULIC (MUD) PROGRAMME****9**

Drilling fluid, function, classification of drilling fluid, drilling complication and mud importance, designing hydraulic programme for drilling operations, equations used in hydraulic programme, pump characteristics, calculation of system processor losses, selection of nozzle size, optimization of hydraulic programme

**UNIT IV CASING AND CEMENTATION****9**

Tensile requirements for casing, API casing list, casing performance properties, types of casings, casing policy, casing and lines, calculation of fracture pressure gradient, casing settings depth selection, casing design, specialization of casing, collapses pressure, tensile load, burst pressure, tension on collapse strength of casing, design factors, casing design, cementation, cement properties, types procedures and purposes.

**UNIT V WELL COMPLETION AND PRODUCTION****9**

Logging operations, logging methods, interpretation calculation of saturation, gas saturation, water saturation, porosity, permeability, oil and gas findings, perforation techniques, well completion, production tubing, well head x'mas tree fittings – transportation - oil to gas and water separator – oil to stockyard Reservoir Engineering – concept and approach, oil recovery – primary, secondary, enhanced oil recovery techniques. Offshore drilling technology, rigs of offshore drilling, general jacking procedures, drilling from a floating vessel. International oil business, management and economics.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will get knowledge about exploration techniques, drilling operations, casing, cementation, well completion and production in petroleum industry.

**TEXT BOOKS:**

- 1 Archer, J.S., and Wall, C.G. Petroleum Engineering, Graham & Trotman, London, 1988.
- 2 Bhagwan Sahay., Petroleum Exploration and Exploration Practices, Allied Publishers Ltd., 2003

**REFERENCES:**

- 1 Whittaker, A., Theory and Application of Drilling Fluid Hydraulics, International Human Resources Development Corporation, Boston, 1985.
2. Rebig, H., Oil Well Drilling Engineering: Principles & Practices, Graham & Trotman, London, 1988.
3. Gatlin, C., Petroleum Engineering: Drilling and Well Completion, Prentice Hall, Inc., USA., 1980.
4. Frank John, Mark Cook and Mark Gratan. Hydro Carbon exploration and Production, Elsevier, 2003.
5. Australian Drilling Industry Training Committee Ltd., Drilling: The Manual of Methods, Application and Management, Lewis Publishers, 1997.

**MI7014****ROCK EXCAVATION ENGINEERING****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the rock mechanics, rock cutting technology, 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****OUTCOME:**

- The students will have knowledge about mechanism of rock excavation process, influences of rock properties in excavation, rock cutting technology and types of excavating machines

**TEXT BOOKS:**

- 1 Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
- 2 Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987.

**REFERENCES**

- 1 Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
- 2 Chugh, C.P., Diamond Drilling, Oxford-IBH, 1984.

**MI7015****ROCK REINFORCEMENT****L T P C****3 0 0 3****OBJECTIVES:**

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

**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 AND ROCK ANCHORS****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****OUTCOME:**

- The students will have the concept about the rockmass classification, mechanism of rock reinforcement, existing and 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.

**MI7016****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****OUTCOME:**

- The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters

**TEXT BOOKS:**

- Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.
- 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.

**REFERENCES**

- Duncan C.Wylie and Chris Mah, Rock Slope Engineering, 4<sup>th</sup> Edition, 4<sup>th</sup> Edition, CRC Press, 456p, 2004.
- John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1<sup>st</sup> Edition, CRC Press, 510p, 2009.
- 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.
- John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4<sup>th</sup> Edition, Wiley-Blackwell; 4 edition, 488p, 2007.

**MI7017****SMALL SCALE MINING AND MARINE MINING****L T P C  
3 0 0 3****OBJECTIVES:**

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

**UNIT I INTRODUCTION TO SMALL SCALE 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 SMALL SCALE 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 stone mining – manual, semi-mechanised and mechanised mining methods, conventional & novel techniques, recent trends, 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 other 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 GEOLOGY AND RESOURCES****9**

Physical and chemical properties of seawater, overview of marine mineral deposits, deep-sea bed mineral resources, polymetallic nodules, sulphate nodules, 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 manganese nodules, 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, underwater photographs, vehicles and transportation, offshore oil platforms.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have insight about small scale mining methods and marine techniques.

**TEXT BOOKS:**

- 1 Chatterjee, S.K., An Introduction to Mineral Resources, Wiley Eastern Ltd., 1983.
- 2 Ghose, A.K., (Ed). Small Scale Mining – A Global Overview, Oxford - IBH Publishers, 1991

**REFERENCES**

1. Shepherd, F.P., Sub-marine Geology, Harper and Row, New York, 1963.
2. Graff, W.J., Introduction to Offshore Structures: Design, Fabrication and Installation, Gulf Publishing Company, London, 1961.
3. Herbich, J.B., Coastal and Deep Ocean Dredging, Gulf Publishing Co. Houston, 1975.
4. Murthy, T.K.S., Mining the Ocean, CSIR Golden Jubilee Series, CSIR Publications, New Delhi, 1995.

**MI7018****SUBSIDENCE ENGINEERING****L T P C  
3 0 0 3****OBJECTIVES:**

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

**UNIT I 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 IMPACT ON 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 LAWS AND STANDARDS 9**

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

**TOTAL : 45 PERIODS**

**OUTCOME:**

- The students will have knowledge about the subsidence mechanism, prediction and influencing parameters. 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, Elsevier 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.

**MI7019**

**SYSTEMS ENGINEERING IN MINING**

**L T P C  
3 0 0 3**

**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 optimisation, introduction to statistical decision theory and its application in mineral industry.

**TOTAL : 45 PERIODS****OUTCOME:**

The students will learn the concept of system engineering and applicability in mining field.

**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.

**MI7020****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 considerations. Types of Underground Excavations: Tunnel, adit, decline, shaft; parameters influencing location, shape and size; geological aspects; planning and site investigations.

**UNIT II UNDERGROUND 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 III DRILLING AND BLASTING IN UNDERGROUND SPACE****9**

Drilling - drilling principles, drilling equipment, drill selection, specific drilling, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

**UNIT IV UNDERGROUND SPACE MECHANISATION****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 in Tunnelling: Adverse ground conditions and its effect on tunnelling; Excavation of large and deep tunnels, caverns. Tunnel Services: Ventilation, drainage and pumping; Tunnelling hazards.

**TOTAL: 45 PERIODS****OUTCOME:**

- The students will have practical knowledge on design, construction and monitoring, maintenance and rehabilitation of tunnels and large underground earth-sheltered structures.

**TEXT BOOKS:**

1. Hudson, J.A., Rock Engineering Systems – Theory and practice, Ellis Horwood, England.
2. Clark, G.B., (1987), Principles of Rock Fragmentation, John Wiley and Sons, New York.

**REFERENCES:**

1. Legget, R.F., Cities and Geology, McGraw-Hill, New York, 624 p., 1973.
2. Johansen, John and Mathiesen, C.F., Modern Trends in Tunnelling and Blast Design, AA Balkema, 154p, 2000.
3. Per-Anders Persson, Roger Holmberg, Jaimin Lee, (1993), Rock blasting and explosives Engineering, CRC Press, p.560.
4. Bickel, J.O., Kuesel, T.R. and King, E.H., Tunnel Engineering Handbook, Chapman & Hall Inc., New York and CBS Publishers, New Delhi, 2<sup>nd</sup> edition, Chapter 6, 544p, 1997.

**GE7072****FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT****9**

**Global Trends Analysis and Product decision** - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN****9**

**Requirement Engineering** - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

### UNIT III DESIGN AND TESTING

9

**Conceptualization** - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

### UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair – Enhancements - **Product EoL** - Obsolescence Management – Configuration Management - EoL Disposal

### UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

**The Industry** - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS**

#### OUTCOMES:

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

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

#### TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

#### REFERENCES:

1. Hiriyyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013