

**CURRICULUM**  
**OF**  
**MINING ENGINEERING**  
**BS/BE**  
**MS/ME**

(Revised 2012)



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

# **CURRICULUM DIVISION, HEC**

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# PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop, review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

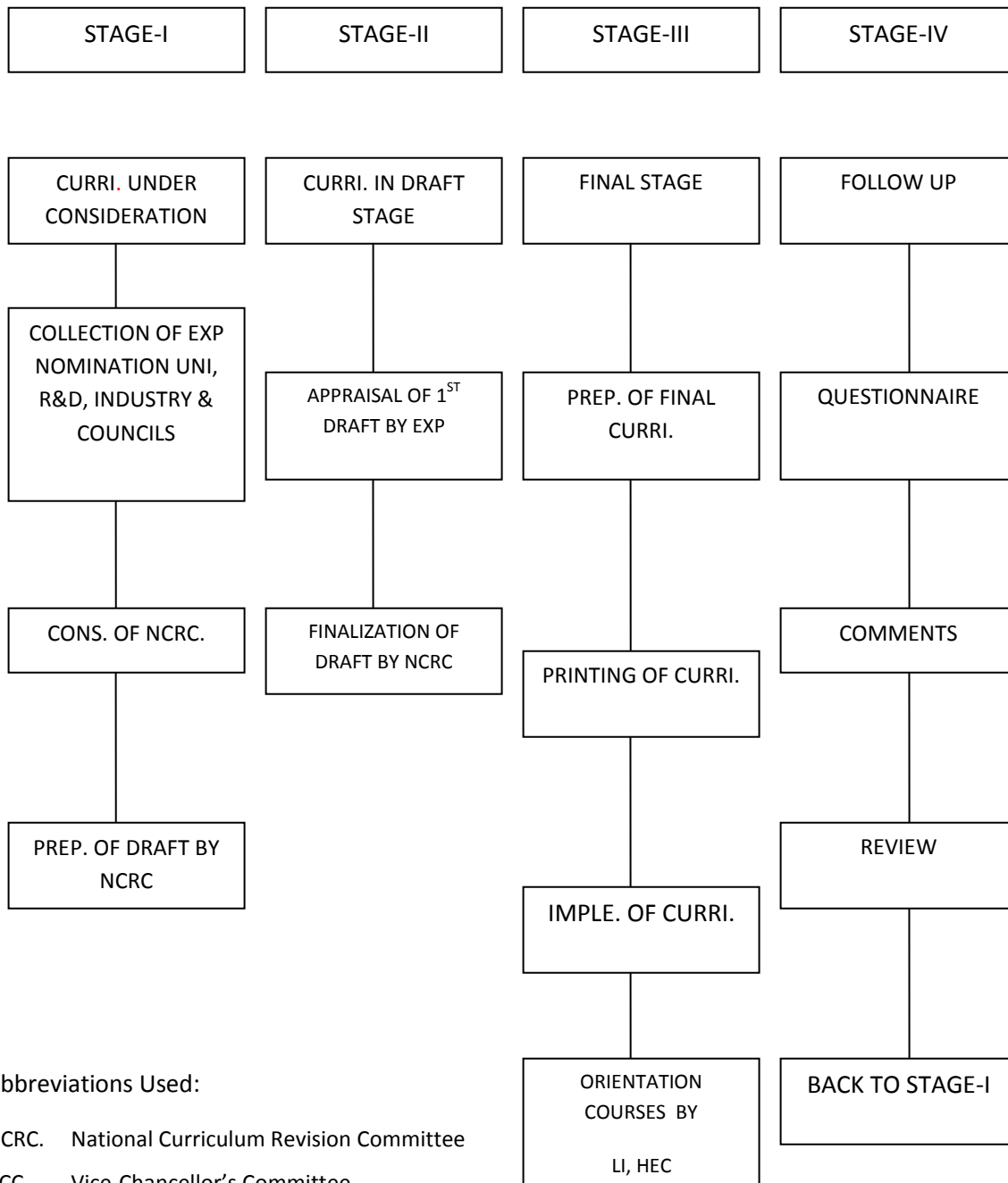
A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences, Agriculture and Engineering disciplines met in 2007 & 2009 and developed a unified template to standardize degree programmes in the country so as to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for Mining Engineering. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

**MUHAMMAD JAVED KHAN**  
**Adviser (Academics)**

**April, 2012**

# CURRICULUM DEVELOPMENT



**Abbreviations Used:**

- NCRC. National Curriculum Revision Committee
- VCC. Vice-Chancellor's Committee
- EXP. Experts
- COL. Colleges
- UNI. Universities
- PREP. Preparation
- REC. Recommendations
- LI Learning Innovation
- R&D Research & Development Organization

## INTRODUCTION

The final meeting of National Curriculum Revision Committee on Mining Engineering was held at HEC Regional Centre, Lahore from March 7-9, 2012 to review the BE/BS/BSc (4 years) and ME/MS/MSc (2 years) Mining Engineering Curriculum 2008. The following members attended the meeting:

Prof. Dr. Muhammad Mansoor Khan  
Professor,  
Department of Mining Engineering,  
University of Engineering & Technology,  
Peshawar. Convener

Prof. Dr. Syed Mohammad Ali Shah  
Professor / Chairman  
Department of Mining Engineering,  
Mehran University of Engineering & Technology,  
Jamshoro. Secretary/Member

Prof. Dr. Syed Abid Hussain  
Professor / Dean,  
Takatoo Campus, Airport Road,  
Balochistan University of Information Technology,  
Engineering & Management Sciences, Baleli,  
Quetta. 87300 Member

Prof. Dr. Muhammad Akram  
Professor / Chairman,  
Department of Mining Engineering,  
University of Engineering & Technology, Lahore. Member

Prof. Dr. Syed M. Tariq  
Professor,  
Department of Mining Engineering,  
University of Engineering & Technology,  
Lahore. Member

Prof. Dr. Noor Mohammad  
Professor & Chairman,  
Department of Mining Engineering,  
University of Engineering & Technology, Peshawar. Member

Engr. Abdul Sattar Mian  
Ex. DG Mines & Minerals,  
Ex. Chief Inspector of Mines,  
Punjab. Member

The meeting started with recitation from the Holy Quran by Prof. Dr. Noor Mohammad. Mr. Muhammad Raza Chohan, Director HEC, Regional Centre, Lahore welcomed all the participants. Malik Arshad Mahmood, Director (Curriculum) requested the convener to conduct proceedings of all technical sessions of the meeting for three days.

On the request of the convener all members gave their detailed comments on the preliminary draft of the Mining Engineering Curriculum. The committee during its deliberation considered the following objectives:

1. To finalize the curriculum in the discipline of Mining Engineering and to bring it at par with international standards.
2. To incorporate latest reading & writing material against each course.
3. To bring uniformity and develop minimum baseline courses in each and every course of study.
4. To make recommendations for promotion/development of the discipline.

Dr. Jamil Ahmed, member NCRC from Pakistan Institute of Engineering & Applied Science (PIEAS) could not attend the meeting and left for Islamabad on the early morning of 07-03-2012 due to sad demise of his uncle. Later, Committee offered Fateha for departed soul of Dr. Jamil's uncle.

After three days' long deliberations, the Committee unanimously approved final draft of the curriculum of the BE/BS/BSc (4-year) and ME/MS/MSc. (2-year) Mining Engineering degree programmes. Malik Arshad Mahmood, Director, Curriculum HEC Islamabad thanked the Convener, Secretary and all the members of the Committee for sparing their valuable time and for their quality contribution towards preparation of the preliminary draft curriculum of the BE/BS/BSc. (4-year) and ME/MS/MSc Mining Engineering program. He acknowledged that their efforts will go long way in developing workable, useful and comprehensive degree programmes in Mining Engineering.

The Committee highly admired the efforts made by the officials of HEC Regional Centre, Lahore, and Malik Arshad Mahmood, Director Curriculum for making excellent arrangements to facilitate the forming of the committee and their accommodation at Lahore.

The meeting ended with the vote of thanks to the HEC officials for providing an ideal environment to discuss the agenda. The convener of the NCRC also thanked the members for their inputs in re-engineering the teaching / learning landscape of the country to make it more practical, competitive and effective.

## FRAME WORK FOR BE/BS/BSc PROGRAMME IN MINING ENGINEERING

Duration:	4 years
Number of Semesters	8
Number of weeks per semester:	18 (16 for teaching and 2 for examinations)
Number of credit hours per semester:	11 – 19
Total number of credit hours:	133
Non-Engineering Courses (Maximum):	15 Courses, 43 Cr Hrs, 32.4 % of total
Engineering Course (Minimum):	26 Courses, 90 Cr Hrs, 68.4 % of total

<b>Non-Engineering Domain</b>							
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits
Humanities	English	English-I (Comprehension and Composition)	3	0	3	3	8
		English-II (Communication Skills)	3	0	3		
		English-III (Report writing skills)	2	0	2		
	Culture	Pakistan Studies	2	0	2	2	4
		Islamic Studies/Ethics	2	0	2		
	Social Sciences	*Social Sciences-I	3	0	3	2	6
*Social Sciences-II		3	0	3			
Management sciences		Engineering Management	2	0	2	2	4
		Engineering Economics	2	0	2		
Natural Science	Mathe-matics	Maths-I (Analytic Geometry and Calculus)	3	0	3	3	9
		Maths-II (Differential Equations)	3	0	3		
		Maths-III (Linear Algebra)	3	0	3		
	Physics	Applied Physics	3	1	4	3	12
	Elective	Applied Geology	3	1	4		
		Applied Chemistry	3	1	4		
<b>TOTAL</b>						<b>15</b>	<b>43</b>



Engineering Domain							
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits
Computing	Fundamentals	Numerical Methods in Computing	2	0	2	3	7
	Programming	Computer Programming	2	1	3		
		Probability and Statistics	2	0	2		
Engineering Foundation	Engineering Foundation	Mining Engineering Fundamentals	3	0	3	8	29
		Engineering Drawing and Graphics	1	2	3		
		Applied Thermo-dynamics	3	1	4		
		Fluid Mechanics	3	1	4		
		Mechanics of Materials	3	1	4		
		Basic Electrical Technology	3	1	4		
		Engineering Geology	3	1	4		
		Engineering Mechanics	3	0	3		
Major Based Core (Breadth)	Major Based Core (Breadth)	Rock Mechanics	3	1	4	6	22
		Underground Mine Design	3	0	3		
		Surface Mine Design	3	0	3		
		Mineral Processing – I	3	1	4		
		Surveying	3	1	4		
		Explosives Engineering	3	1	4		

Major Based Core (Depth)	Major Based Core (Depth)	Mine Hazards and Safety	3	1	4	5	20
		Mineral Processing-II / Coal Technology / Tunnel Engineering	3	1	4		
		Mine Ventilation	3	1	4		
		Mine Power, Drainage and Materials Handling	3	1	4		

		Mineral Exploration	3	1	4		
Inter-disciplinary Engineering Breadth (Electives)	Inter Disciplinary Engg. Breadth	Mining Law	2	0	2	2	6
		* (Optional )	3	1	4		
Senior Design Project		Senior Design Project – I	0	3	3	2	6
		Senior Design Project – II	0	3	3		
TOTAL			0	0	0	26	89
Industrial Training	Compulsory	First-Aid Training (Certification) Industrial Training / Internship	0	0	0		
Grand Total						41	133

### Interdisciplinary Optional Courses

Gemology  
 Solution Mining  
 Groundwater Aspects in Mining  
 Industrial Minerals  
 Finite Element Analysis  
 Drilling Technology  
 Strata Control  
 Mineralogy and Petrology

### Courses on Social Sciences (Optional I & II)

Logic & Critical Thinking  
 Understanding Psychology and Human Behaviour  
 Professional Ethics  
 Sociology and Development  
 Social Anthropology  
 Professional Psychology  
 Organizational Behavior  
 Introduction to Sociology  
 Any other course

### **Notes:**

- 1. One credit hour lab is equal to three contact hours.*
- 2. Social sciences courses have been proposed. Universities may select any two courses according to their own preferences.*
- 3. University has the option to shift course from one semester to another according to their facility and faculty.*

## SCHEME OF STUDIES MINING ENGINEERING

<b>First</b>	<b>Th + Lab</b>
Maths-I (Analytic Geometry and Calculus)	3+0
Applied Chemistry	3+1
Applied Physics	3+1
Engineering Drawing and Graphics	1+2
Applied Geology	3+1
	<b>13+5 = 18</b>
<b>Second</b>	<b>Th + Lab</b>
Maths-II (Differential Equations)	3+0
Applied Thermodynamics	3+1
Mining Engineering Fundamentals	3+0
Islamic Studies/ Ethics	2+0
English-I (Comprehension and Composition)	3+0
Social Sciences-I, Optional-I	3+0
	<b>17+1 = 18</b>
<b>Third</b>	<b>Th + Lab</b>
Social Sciences-II, Optional-II	3+0
Engineering Mechanics	3+0
Basic Electrical Technology	3+1
Fluid Mechanics	3+1
Surveying	3+1
	<b>15+3 = 18</b>
<b>Fourth</b>	<b>Th + Lab</b>
English-II (Communication Skills)	3+0
Computer Programming	2+1
Maths-III (Linear Algebra)	3+0
Pakistan Studies	2+0
Mechanics of Materials	3+1
Probability and Statistics	2+0
	<b>15+2 = 17</b>

<b>Fifth</b>	<b>Th + Lab</b>
English-III (Report writing skills)	2+0
Numerical Methods in Computing	2+0
Structural Geology	3+1
Mineral Exploration	3+1
Explosives Engineering	3+1

	<b>13+3 = 16</b>
<b>Sixth</b>	Th + Lab
Mine Power, Drainage and Materials Handling	3+1
Surface Mine Design	3+0
Rock Mechanics	3+1
*Mineral Processing/ Mineral Processing-I	3+1
**University Option	
	<b>12+3 = 15</b>
<b>Seventh</b>	Th + Lab
Mining Law	2+0
Mine Ventilation	3+1
Coal Technology / Mineral Processing-II / Tunnel Engineering	3+1
Senior Design Project – I	3+0
Engineering Economics	2+0
	<b>13+2 = 15</b>
<b>Eighth</b>	Th + Lab
Senior Design Project – II	3+0
Underground Mine Design	3+0
Mine Hazards and Safety	3+1
Engineering Management	2+0
Optional	3+1
First-Aid Training (Certification)	0
Industrial Training / Internship	
	<b>14+2 = 16</b>

### Optional:

1. Gemology
2. Solution Mining
3. Groundwater Aspects in Mining
4. Industrial Minerals
5. Finite Element Analysis
6. Drilling Technology
7. \*Mineral Processing I
8. \*Mineral Processing II

### Note:

\* Mineral Processing is a terminal course. If Mineral Processing-I is selected/taken then Mineral Processing-II will be mandatory.

\*\*University may add one course according to their requirements up to 3 Credit Hours.

# DETAIL OF COURSES

## NON-ENGINEERING DOMAIN

### COURSES FOR HUMANITIES

#### COMPREHENSION AND COMPOSITION 3+0

**Prerequisites:** None

**Knowledge Area / Sub Area:** Humanities / English – I

**Objective:**

To enhance language skills and develop critical thinking

**Course Outline:**

Basics of Grammar, Parts of speech and use of articles, Sentence structure, Active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive, intransitive verbs, Punctuation and spelling.

**Comprehension:** Answers to questions on a given text

**Discussion:** General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

**Listening:** To be improved by showing documentaries/films carefully selected by subject teachers)

**Translation skills:** Urdu to English

**Paragraph writing:** Topics to be chosen at the discretion of the teacher

**Presentation skills:** Introduction

**Note:** *Extensive reading is required for vocabulary building*

**Recommended Text Books:**

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third Edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third Edition. Oxford University Press. 1997. ISBN 0194313506

- b) Writing
  - 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
  - 1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

## **COMMUNICATION SKILLS**

**3+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Humanities / English – II

### **Objective:**

To enable the students to meet their real life communication needs

### **Course Outline:**

**Paragraph writing:** Practice in writing a good, unified and coherent paragraph

**Essay writing:** Introduction

**CV and job application**

**Translation Skills:** Urdu to English

**Study Skills:** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

**Academic Skills:** Letter / memo writing and minutes of the meeting, use of library and internet resources

**Presentation skills:** Personality development (emphasis on content, style and pronunciation)

**Note:** *documentaries to be shown for discussion and review*

### **Recommended Text Books:**

- a) Grammar

1. A. J. Thomson and A. V. Martinet, *Practical English Grammar*. Exercises 2. Third Edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- b) Writing
1. Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet, *Writing. Intermediate*. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
  2. Rob Nolasco, *Writing. Upper-Intermediate*. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
1. Brian Tomlinson and Rod Ellis, *Reading. Advanced*. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
  2. John Langan, *Reading and Study Skills*
  3. Richard Yorky, *Study Skills*

## **REPORT WRITING SKILLS**

**2+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Humanities / English – III

### **Objective:**

To enhance language skills and develop critical thinking

### **Course Outline:**

#### **Essay writing**

Descriptive, narrative, discursive, argumentative

#### **Academic writing**

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

#### **Technical Report writing**

#### **Progress Report writing**

**Note:** *Extensive reading is required for vocabulary building*

### **Recommended Text Books:**

- a) Essay Writing and Academic Writing

1. Ron White, *Writing. Advanced.* Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
  2. John Langan, *College Writing Skills.* McGraw-Hill Higher Education 2004.
  3. Laurie G. Kirszner and Stephen R. Mandell, *Patterns of College Writing* (4<sup>th</sup> edition) by. St. Martin's Press.
- b) Reading
1. Janice Neulib et al. (Editors), *The Mercury Reader. A Custom Publication.* Compiled by Northern Illinois University. General Editors: (A reading which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

## **PAKISTAN STUDIES (Compulsory)**

**2+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Humanities / Culture

- Objective:**
- i To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan and
  - ii To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

### **Course Outline:**

#### **1. Historical Perspective**

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
  - i. Indus Civilization
  - ii. Muslim advent
  - iii. Location and Geo-Physical features.

#### **2. Government and Politics in Pakistan**

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99



f. 1999 onward

### 3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

#### Recommended Text Books:

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

**Prerequisites:** None

**Knowledge Area / Sub Area:** N/A

**Objective:**

This course is aimed at:

1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

**Course Outline:**

**INTRODUCTION TO QURANIC STUDIES**

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

**STUDY OF SELECTED TEXT OF HOLLY QURAN**

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

**STUDY OF SELECTED TEXT OF HOLLY QURAN**

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

**SEERAT OF HOLY PROPHET (S.A.W) I**

- 1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah
- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

**SEERAT OF HOLY PROPHET (S.A.W) II**

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

**INTRODUCTION TO SUNNAH**

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith

- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

## **SELECTED STUDY FROM TEXT OF HADITH**

### **INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE**

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

### **ISLAMIC CULTURE & CIVILIZATION**

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

### **ISLAM & SCIENCE**

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quran & Science

### **ISLAMIC ECONOMIC SYSTEM**

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

### **POLITICAL SYSTEM OF ISLAM**

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

### **ISLAMIC HISTORY**

- 1) Period of Khlaft-e-Rashida
- 2) Period of Ummayyads
- 3) Period of Abbasids

### **SOCIAL SYSTEM OF ISLAM**

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

### **Recommended Reference Books:**

- 1) Hameed ullah Muhammad, “**Emergence of Islam**” , IRI, Islamabad
- 2) Hameed ullah Muhammad, “**Muslim Conduct of State**”
- 3) Hameed ullah Muhammad, ‘**Introduction to Islam**
- 4) Mulana Muhammad Yousaf Islahi,”
- 5) Hussain Hamid Hassan, “**An Introduction to the Study of Islamic Law**” leaf Publication Islamabad, Pakistan.

- 6) Ahmad Hasan, “**Principles of Islamic Jurisprudence**” Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, “**Muslim Jurisprudence and the Quranic Law of Crimes**” Islamic Book Service (1982)
- 8) H. S. Bhatia, “**Studies in Islamic Law, Religion and Society**” Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, “**Introduction to Al Sharia Al Islamia**” Allama Iqbal Open University, Islamabad (2001)

## **SOCIAL SCIENCES COURSES**

(Any two courses of the following)

### **SOCIOLOGY AND DEVELOPMENT**

**3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

#### **Objective:**

The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

#### **Course Outline:**

##### **1. Introduction to Sociology**

- 1.1 What is sociology?
- 1.2 Nature, Scope, and Importance of Sociology
- 1.3 Social Interactions
- 1.4 Social Groups
- 1.5 Social Institutions

##### **2. Culture and Related Concepts**

- 2.1 Definition of Culture
- 2.2 Types of Culture
- 2.3 Elements of Culture

- 2.4 Role of Culture in Organization
- 2.5 Socialization and Personality

### **3. Interpersonal Relations**

- 3.1 Interpersonal Behaviour
- 3.2 Formation of Personal Attitudes
- 3.3 Language and Communication
- 3.4 Motivations and Emotions
- 3.5 Public Opinion

### **4. Social Stratification**

- 4.1 Factors of Social Stratification
- 4.2 Caste and class
- 4.3 Power, Prestige, and Authority
- 4.4 Social Mobility
- 4.5 Migration

### **5. Human Ecology**

- 5.1 Ecological Processes
- 5.2 Ecosystem and energy
- 5.3 Ecosystem and Physical Environment
- 5.4 Solid Waste Disposal
- 5.5 Pollution

### **6. Population Dynamics**

- 6.1 World Population Growth and Distribution
- 6.2 Population Dynamics in Pakistan
- 6.3 Causes and Consequences of Urbanization
- 6.4 Population Policy in Pakistan
- 6.5 Population and Development

### **7. Community Development**

- 7.1 Meaning, Scope, and Subject Matter of Community Development
- 7.2 Processes of Community Development
- 7.3 Community Development Programs in Pakistan
- 7.4 Community Organization and Related Services
- 7.5 Cooperation and Conflict in Community Development

### **8. Deviance and Crime**

- 8.1 Crime as a Social and Cultural Phenomenon
- 8.2 Crime and Social Organization
- 8.3 Organized Crime
- 8.4 Culture Based Crime
- 8.5 Economics of Crime

### **9. Sociology of Change and Development**

- 9.1 What is Social Change and Development?

- 9.2 Dynamics of Social Change
- 9.3 Role of NGOs in Development
- 9.4 World System and Development
- 9.5 Gender and Development

### **Recommended Readings:**

1. Allport, G. W. (1985). The Historical Background of Modern Social Psychology. New York, Random House.
2. Bernard, A. and T. Burgess (2004). Sociology, Cambridge University Press.
3. DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.
4. Gardezi, H. N., Ed. (1991). Understanding Pakistan: The Colonial Factor in Societal Development. Lahore, Maktaba Fikr-o-Danish.
5. Hafeez, S. (1991). Changing Pakistan Society. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).
6. Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" Asia-Pasific Population Journal **20** (1).
7. Macionis, J. J. (1999). Sociology 7<sup>th</sup> Edition, National Book Foundation, Islamabad
8. Maser, C. (1997). Sustainable Community Development: Principles and Concepts. Florida St. Lucie Press.
9. Nelson, N. and S. Wright (1995). Power and Participatory Development: Theory and Practice. London, Intermediate Technology Publications.
10. Syed, S. H. (2003). The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy. Islamabad, UNESCO: 1-30.
11. Utton, A. E. (1976). Human Ecology, West View Press.
12. Webster, A. (1990). Introduction to Sociology of Development. London, Nacmillan Education Ltd.
13. Weiss, A. M. (2001). Power and civil society in Pakistan, Oxford University press.

## **SOCIAL ANTHROPOLOGY**

**3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

### **Objectives:**

The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

## **Course Outline:**

### **I. Introduction**

1. Anthropology and Social Anthropology
2. Fields of Anthropology
3. Anthropological Research Methods
4. Social Anthropology and other Social Sciences
5. Significance of Social Anthropology

### **II. Culture**

1. Definition, Properties and Taxonomy
2. Evolution of Growth and Culture
3. Evolution of Man: Religious and Modern Perspectives
4. Evolution of Culture
5. Culture and Personality

### **III. Evolution and Growth of Culture**

1. Evolution of Man
2. Schools of Thought in Cultural Anthropology
3. Acculturation
4. Enculturation
5. Ethnocentrism and Xenocentrism

### **IV. Language and Culture**

1. Communication
2. Structural Linguistics
3. Historical Linguistics
4. Relationship between Language and Culture
5. Ethnography

### **V. Economic System**

1. Global Economic System
2. The Allocation of Resources
3. The Conversion of Resources
4. The Distribution of Goods and Services
5. Poverty and Inequality

### **VI. Marriage and Family**

1. Marriage and Mate Selection
2. The Family: Types and Functions
3. Kinship System
4. Structure and Function of Family
5. Gender Relations

### **VII Political Organization**

1. Political Sociology
2. Origin of Political Organization and Organizational System
3. Types of Political Organizations

4. Power Politics and Factionalism in Pakistan
5. Resolution of Conflict

## **VIII Religion and Magic**

1. The Universality of Religion
2. Comparative Religions
3. Religion and Society
4. Religious Beliefs and Practices
5. Witchcraft and Sorcery

## **IX Culture Change**

1. Forms of Art
2. Expressive Culture
3. Process of Cultural Change
4. Cultural Change in the Modern World
5. Cultural Change in Pakistani society

## **Recommended Text Books:**

1. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.
2. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
3. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
4. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
5. Ember, Carol R. & Ember Melvin. 2005. Anthropology, 11<sup>th</sup> ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
6. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
7. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
8. Haviland, W. A. (2005). Anthropology: The Human Challenge. New York, Thomson Learning Inc.
9. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press.
10. Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3<sup>rd</sup> ed. New York: Harcourt Brace College Publishers.
11. Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9<sup>th</sup> ed. Boston: McGraw Hill Higher Education.
12. Kennedy, Charles H. 1992. Pakistan London: Westview Press.
13. Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven
14. Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.



# **UNDERSTANDING PSYCHOLOGY AND HUMAN BEHAVIOUR**

**3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

## **Objectives:**

- To give introduction to Psychology
- To give basic understanding of human behaviour

## **Course Outline:**

- What is Psychology?
- Nature, Scope and Application with Special Reference to Pakistan
- Different Schools of Psychology
- Methods of Psychology
- Learning
- Intelligence and Artificial Intelligence
- Personality and its Assessment
- Understanding Maladjustive Behaviour
- Positive Emotional States and Processes
- Stress Management and Anger Management

## **Recommended Text Books:**

1. Atkinson R. C., & Smith E. E. (2000), Introduction to Psychology (13<sup>th</sup> Ed.), Harcourt Brace College Publishers.
2. Fernald, L. D., & Fernald, P. S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B. R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
4. Goodwin, C. J, (2000) Research in Psychology: Methods and Design, (3<sup>rd</sup> Ed.), New York: John Wiley & Sons.
5. Synder, C. R., & Lopez, S. J. (2007) Positive Psychology, USA, Sage Publications.
6. Allen, B. P. (1997), Personality Theories: Development, Growth and Diversity, (2<sup>nd</sup> Ed.), Boston: Allyn & Bacon.
7. Cohen, R. J., & Swerdlik, M. E. (2005) Psychological Testing & Assessment (6<sup>th</sup> Ed.), New York: McGraw-Hill.
8. Corcini, R., (2000). Current Psychotherapies. London: Thompson & Co Publishers.
9. Comer, R. J. (2004). Abnormal Psychology, USA: Freeman & Company.
10. Schwartz, B., Wasserman, E., & Robbins, S. (2002), Psychology of Learning and Behaviour, 5<sup>th</sup> Ed. Norton and Company.

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

**Objectives:**

To give understanding of different branches / fields of professional psychology.

**Course Outline:**

- Introduction to Professional Psychology
- Psychological Testing
- Educational Psychology
- Industrial/Organizational Psychology
- Social Psychology
- Health Psychology
- Clinical Psychology
- Positive Psychology
- Legal, Ethical, and Professional Issues.

**Recommended Text Books:**

1. Crow, L., & Crow, A. (2000) Educational Psychology, New Delhi: Euroasia Publishing House Ltd.
2. Spiegel, P. K., & Koocher, G. P. (1998), Ethics in Psychology, New York: Oxford University Press
3. Snyder, C. R., & Lopes, S. J. (2000), Handbook of Positive Psychology, New York: Oxford University Press.
4. Compton, W. C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
5. Debra, L. N. & James Compbell Quick, (2000) Organizational Behaviour (3<sup>rd</sup> Ed), Cincinnati: South Western.
6. Fred Luthans, Alexander, D.S. & Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.
7. Brannon, L. & Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4<sup>th</sup> Ed.), USA Wadsworth.
8. Donohue, W. & Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
9. Meyers, D. (2005), Social Psychology, 8<sup>th</sup> Ed. McGraw- Hill Inc.
10. Cooper, J. & Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
11. Halgin, R. P., Whitbourne, S. K., & Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw-Hill.
12. Thorndike R. L., & Hage, E. P. (1995), Measurement and Evaluation in Psychology and Education (4<sup>th</sup> Ed), New York, MacMillan.

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

**Objectives:**

This course introduces contemporary and controversial ethical issues facing the business community. Topics include moral reasoning, moral dilemmas, law and morality, equity, justice and fairness, ethical standards, and moral development. Upon completion, students should be able to demonstrate an understanding of their moral responsibilities and obligations as members of the workforce and society.

At the completion of the course requirements, the student will be able to:

- a. Define business ethics
- b. Describe the evolution of business ethics
- c. Describe major ethical perspectives
- d. Understand and apply an ethical decision-making framework
- e. Understand social responsibility from several dimensions
- f. Understand how the organization influences ethical decision-making
- g. Examine how significant others influence ethical decision-making
- h. Develop an effective ethics programme.
- i. Understand international business ethics.

**Course Outline:**

**An Overview of Business Ethics:** Business Ethics Defined, Social Responsibility, and Business Ethics, The Development of Business Ethics, Why study Business Ethics?, Framework for Studying Business Ethics.

**Ethical issues in Business:** Foundation of Ethical Conflict, Classifications of Ethical, Issues, Ethical Issues Related to Participants and Functional Areas of Business, Recognizing an Ethical Issue.

**Applying Moral Philosophies to Business Ethics:** Moral Philosophy Defined, Moral Philosophy Perspectives.

**Social Responsibility:** The Economic Dimension, The legal Dimension, The Ethical Dimension, the Philanthropic Dimension.

**An Ethical Decision-Making Framework:** Ethical Issue Intensity, Individual Factors: Stages of Cognitive Moral Development, Corporate Culture, Significant others, Opportunity, Business Ethics Evaluations and Intentions, Using the Ethical Decision-Making Framework to Improve Ethical Decisions.

**How the Organization Influences Ethical Decision Making:** Organizational Structure and Business Ethics, the role of Corporate Culture in Ethical Decision-Making, Group Dimensions of Organizational Structure and Culture, Implications of Organizational Relationships for Ethical Decisions.

**The Role of Opportunity and Conflict:** Opportunity, Conflict.

**Development of an Effective Ethics Programme:** An Effective Ethical Compliance, Programme, Codes of Ethics and Compliance Standards, High-Level Manager's Responsibility for Ethical Compliance Programme and the Delegation of Authority, Effective Communication of Ethical Standards, Establishing Systems to Monitor, Audit, and Enforce Ethical Standards, Continuous Improvement of the Ethical Compliance Programme, The Influence of Personal Values in Business Ethics Programmes, The Ethical Compliance Audit.

**International Business Ethics:** Ethical Perceptions and International Business, Culture As a Factor in Business, Adapting Ethical Systems to a Global Framework: Cultural Relativism, the Multinational Corporation, A universal Set of Ethics, Ethical Issues Around the Globe.

### **Recommended Text Books:**

1. Ferrell, O. C., and Fraedrich, John, Ethical Decision Making and Cases, New York: Houghton Mifflin.

## **ORGANIZATIONAL BEHAVIOUR**

**3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

### **Course Outline:**

- Introduction to Organizational Behaviour
  - Organizational Disciplines and topics
  - Psychological Perspective
  - Social-Psychological Perspectives
- Structure and Control in Organization
  - Introduction
  - Bureaucracy
  - Managerial Work
  - Contingency theory
  - Organizational Design
- Individual and Work Learning
  - Learning Theories
  - Learning and Work
- Stress

- Types of Stress and Work
- Occupational Stress Management
- Individual Differences
  - Personality and its factors
  - Personality dimensions and social learning
  - Intelligence
- Motivation and Job Satisfaction
  - Needs at Work
  - Theories of Motivation and job satisfaction
  - Correlates of Job satisfaction
  - Correlates of Job satisfaction
- Group and Work
  - Social Interaction
  - Dramaturgy and impression Management
  - Social Skill
- Group and Inter group Behaviour
  - Group Structure & Norms
  - Group Processes
  - How throne Studies
- Leadership
  - Leadership as an attribute
  - Leadership Style
- Patterns of Work
  - Work-the classical approach
  - Marx, Weber, & The critique of labor
  - Foucault & Disciplinary Power
- Conflict and Consent in Work
  - The labor Process debate
  - Work place control and resistance
  - Industrial conflict and industrial relations
- Organizational culture
  - Organizational culture and strategic management
  - Exploring organizational culture
  - Evaluating concept of culture

### **Recommended Text Books:**

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3<sup>rd</sup> Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5<sup>th</sup> Ed., McGraw-Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12<sup>th</sup> Ed), McGraw Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw- Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw-Hill Inc.

# INTRODUCTION TO SOCIOLOGY

3+0

**Prerequisites:** N/A

**Knowledge Area / Sub Area:** Social Science

## **Objectives:**

- To provide brief introduction of society
- To give understanding of different social institutions, culture, classes, stratification and social change.

## **Course Outline:**

- The Nature of Sociology
  - The study of social life
  - Exploring the global village
  - Sociology as a science
  - The Sociological imagination
  - The development of Sociology
  - Pioneers of Sociology
  - Nature, scope and subject matter of Sociology
  - Brief historical development of Sociology
  - Society and community
  - Relationship with other social sciences
  - Social Interaction Processes
- Social groups
  - Definition and functions
  - Types of social groups
- Social institutions
  - Definition
  - Structure and function of social institutions
  - Inter-relationships among various social institutions
- Culture and related concepts
  - Definition and aspects of culture
  - Elements of culture
  - Organization of culture
  - Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag
- Socialization and personality
  - Role and status
  - Socialization
  - Culture and personality
- Deviance and social control
  - Definition and types of deviance
  - Juvenile delinquency
  - Formal and information methods of social control
- Social stratification
  - Approach to study social stratification
  - Caste class and race as basics of social stratification

- Major perspectives in Sociology
  - Functionalist perspective
  - Conflict perspective
  - Interactionistic perspective
- Social Control and deviance
  - Agencies of social control
- Social stratification
  - Determinants of social stratification
  - Social mobility, types and definition
  - Dynamics of social mobility
- Concept of social movement
  - Theories of social movement
  - Social and cultural change
- Social and cultural change
  - Definition of social change
  - Dynamics of social change
  - Impact of globalization on society and culture
  - Resistance to change
- Collective behaviour
  - Definition
  - Characteristics
  - Causes
  - Types
  - Social movements
  - Mob and crowd behaviour

### **Recommended Text Books:**

1. Neulreck, Kenneth, J. 2005, Sociology: Diversity, Conflict and Change, Boston
2. Barnard, Andy. 2004. Sociology, Cambridge University Press
3. Giddens, Anthony, 2004, Sociology 4<sup>th</sup> Edition, Cambridge Polity Press
4. Albrow, Martin, 2003, Sociology, London Routledge.
5. Richard, T. Schaefer, 2003, Sociology 5<sup>th</sup> Edition, McGraw-Hill College
6. Kendall, Diana, 2004. Sociology in our Times, 4<sup>th</sup> Ed, Wadsworth
7. Tyler Melissa, Wallace Claire & Abbott Pamela, 2005, An Introduction to Sociology, 3<sup>rd</sup> Ed. Routledge.

### **CRITICAL THINKING**

**3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

#### **Objectives:**

To develop understanding of critical thinking.

## Course Outline:

- The Power of Critical Thinking
  - Claims and Reasons
  - Reasons and Arguments
  - Arguments in the Rough
- The Environment of Critical Thinking
  - Perils of Haunted Mind
  - Self and the Power of the Group
  - Subjective and Social Relativism
  - Skepticism
- Making Sense of Arguments
  - Arguments Basics
  - Patterns
  - Diagramming Arguments
  - Assessing Long Arguments
- Reasons for Belief and Doubt
  - Conflict Experts and Evidence
  - Personal Experience
  - Fooling Ourselves
  - Claims in the News
- Faulty Reasoning
  - Irrelevant Premises
  - Genetic Fallacy, Composition, Division
  - Appeal to the Person, Equivocation, Appeal to Popularity
  - Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  - Red Herring, Straw Man
- Unacceptable Premises
  - Begging the Question, False Dilemma
  - Slippery Slope, Hasty Generalization
  - Faulty Analogy
- Deductive Reasoning: Propositional Logic
  - Connectives and Truth Values
  - Conjunction, Disjunction, Negation
  - Conditional, Checking for Validity
  - Simple Arguments, Tricky Arguments
  - Streamlined Evaluation
- Deductive Reasoning: Categorical Logic
  - Statements and Classes
  - Translations and Standard Form
  - Terms, Quantifiers
  - Diagramming Categorical Statements
  - Sizing up Categorical Syllogisms
- Inductive Reasons
  - Enumerative Induction
  - Sample Size, Representativeness, Opinion Polls
  - Analogical Induction
  - Casual Arguments, Testing for Causes



- Casual Confusions
- Inference to the Best Explanation
  - Explanations and Inference
  - Theories and Consistency
  - Theories and Criteria
  - Testability, Fruitfulness, Scope, Simplicity
  - Conservatism
- Judging Scientific Theories
  - Science and Not Science
  - The Scientific method, Testing Scientific Theories
  - Judging Scientific Theories
  - Copernicus versus Ptolemy, Evolution Versus Creationism
  - Science and Weird Theories
  - Making Weird Mistakes
  - Leaping to the Weirdest Theory, Mixing What Seems with What is
  - Misunderstanding the Possibilities
  - Judging Weird Theories
  - Crop Circles, Talking with the Dead

### **Recommended Text Books:**

1. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.
2. Paulsen David W., Cederblom Jerry: 2000, Critical Reasoning, Wadsworth.
3. Restall Greg. 2005, Logic: An Introduction, Routledge.

## **INTRODUCTION TO PHILOSOPHY 3+0**

**Prerequisites: N/A**

**Knowledge Area / Sub Area: Social Science**

### **Objectives:**

To study the basic concepts of Philosophy

### **Course Outline:**

- Definition and Nature of Philosophy
- Theory of Knowledge
  - Opinion and Knowledge
  - Plato, the Republic Selection
  - Knowledge through Reason
  - Descartes Meditation on First Philosophy
  - Knowledge through Experience
  - Hume an Inquiry concerning Human Understanding (Selection)
  - Experience Structured by the Mind
  - Kant Critique of Pure Reason (Selection)
  - Knowing and Doing

- James Pragmatism (Selection)
- Knowledge and Emotion
- Jaggar Love and Knowledge (Selection)
- Philosophy of Religion
  - Proving that Existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying Religious Beliefs
  - Pascal Pensees (Selection)
  - James The will to Believe Selection
  - Freud the Future of An Illusion (Selection)
  - Confronting the Problems of Evil
  - Mackie Evil and Omnipotence (Complete)
  - Hick Philosophy of Religion (Selection)
- Metaphysics
  - Idealism and Materialism
  - Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
  - Armstrong Naturalism, Materialism and First Philosophy (Selection)
  - The Mid-Body Problem
  - Descartes Meditations on First Philosophy (Selection)
  - O'Hear Introduction to the Philosophy of Science (Selection)
  - Dennett The Origins of Selves (Complete)
  - Pali Canon (Selection)
  - Penelhum Religion and Rationality (Selection)
- Freedom to Choose
  - Libertarianism
  - James The Dilemma of Determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Hospers Meaning and Free Will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the Modern Mind (Selection)
  - Radhakrishnan Indian Philosophy (Selection)
- Ethics
  - Fulfilling Human Nature
  - Aristotle Nicomachean Ethics (selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One's Duty
  - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
  - Maximizing Utility
  - Mill Utilitarianism (Selection)

- Turning Values of Upside Down
- Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
- Creating Ourselves
- Sartre Existentialism is a Humanism (Selection)
- Hearing the Feminine Voice
- Gilligan In a Different Voice (Selection)
- Baier What do Women Want in a Moral Theory (Selection)
- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust
  - Rawls A Theory of Justice (Selection)
  - Nozick Anarchy, State, and Utopia (Selection)
  - Held Rights and Goods (Selection)
  - Women in Society
  - Wollstonecraft A Vindication of the Rights of Women (Selection)
  - De Behaviour The Second Sex (Selection)
  - The Value of Philosophy
  - Russel The Problems of Philosophy (Selection)
  - Midgley Philosophical Plumbing (Selection)

**Prerequisites:** N/A

**Knowledge Area / Sub Area:** Social Science

**Objective:**

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

**Course Outline:**

**Introduction:** The concept of entrepreneurship, The economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

**The Practice of Entrepreneurship:** The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

**Entrepreneurship and Innovation:** The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

**Developing Entrepreneur:** Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

**Entrepreneurship Organization:** Team work, Networking organization, Motivation and compensation, Value system

**Entrepreneurship and SMES:** Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

**Entrepreneurial Marketing:** Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

**Entrepreneurship and Economic Development:** Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

***Case Studies of Successful Entrepreneurs***

**Text Books:**

1. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
2. P. N. Singh: Entrepreneurship for Economic Growth
3. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker

## MANAGEMENT COURSES

### ENGINEERING ECONOMICS

2+0

**Prerequisites:** None

**Knowledge Area / Sub Area:** Management Sciences

#### **Objective:**

To familiarize the students with the concepts of engineering economics and analyze through different methods for the evaluation of engineering alternatives.

#### **Course Outline:**

**Introduction:** The decision making process, capital allocation, principles of engineering economy.

**Concepts & Analysis:** Simple & compound interest, concept of money value equivalence, compounding and discounting of discrete and uniform series of cash flows under different conditions, geometric sequence of cash flows, normal concept, continuous compounding.

**Applications of Money-Time Relationships:** Different capital budgeting techniques (PBP, ARR, IRR, NPV, PI, etc) and their comparison.

**Depreciation and Depletion:** Depreciation, its purposes and types, Depreciation methods, Depletion in mining, introduction of taxation effects, capital gains and losses.

**Effects of Inflation and Uncertainty:** General price inflation's elementary treatment of basic concepts, introduction to the risk and sensitivity analysis.

**Relationship of Engineering Economy to Accounting:** Accounting fundamentals, elements of cost and their use in engineering economy studies with emphasis on cost management.

#### **Recommended Text Books:**

1. W. G. Sullivan, J. A. Bontadelli and E. M. Wicks, Engineering Economy, 11<sup>th</sup> Ed., Prentice Hall Inc., 1999
2. Franklin and John Stermole, Economic Evaluation and Investment Decision Methods (9<sup>th</sup> Edition)
3. Vogely, H. S., Economics of Mineral Industries. Mud Series, AIME

#### **Recommended Reference Books:**

1. Chan S. Park, and Gunter P. Sharp-Bette, Advanced Engineering Economics, 10<sup>th</sup> Ed., John Wiley & Sons Inc., 1990

# NATURAL SCIENCES

## ***ANALYTICAL GEOMETRY AND CALCULUS* 3 + 0**

**Knowledge Area / Sub Area:** Natural Sciences / Math

### **Objective:**

Teach the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems.

### **Course Outline:**

Introduction to functions, introduction to limit, derivatives and their applications, integral calculus with applications, vector algebra, vector calculus, introduction to analytical geometry, straight line in  $R^3$ , planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spheres, spherical trigonometry.

### **Recommended Books:**

1. George B. Thomas and Ross L. Finney, *Calculus and Analytic Geometry*, Ninth Edition, 1995, Addison-Wesley, ISBN: 0201531747.
2. George F. Simmons, *Calculus with Analytic Geometry*, Second Edition, 1996, McGraw-Hill, ISBN: 0070576424.
3. Gerald B. Folland, *Advanced Calculus*, First Edition, 2002, Prentice Hall, ISBN: 0130652652.
4. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, *Calculus*, 2002, Prentice Hall, ISBN: 0130918717.

## ***DIFFERENTIAL EQUATIONS***

**3+0**

**Knowledge Area / Sub Area:** Natural Sciences / Maths-II

### **Objective:**

To introduce basic techniques pertaining to matrices and formulation/ solution of differential equations.

### **Course Outline:**

**Matrices:** Basic concept, addition of matrices and its multiplication with a scalar number, Partitioning of matrices, Matrix multiplication and its properties, Special matrices, transpose of a matrix, Adjoin and inverse of a square matrix, Row operations Echelon & reduced Echelon form of matrix, rank of matrix, Application of Matrices, Eigen values and Eigenvectors

**First Order Differential Equations:** Basic concepts, formation and solution of differential equations by direct integration and by separating the variables. Homogeneous equations and equations reducible to homogeneous form. Linear differential equations of the 1st order and equations reducible to the

linear form, Bernoulli's equations and orthogonal trajectories, engineering application.

**Second and Higher Orders Equations:** Special types of 2nd order differential equations with constant coefficients and their solutions. The operator  $D$ , Inverse operator  $1/D$ , Solution of differential equations by operator  $D$  methods, Special cases, Cauchy's differential equations, Simultaneous differential equations, Simple application of differential equations in Engineering.

**Partial Differential Equations:** Basic concepts and formation of partial differential equations, Linear homogeneous partial differential equations and relations to ordinary differential equations, Solution of first order linear and special types of second and higher order differential equations, D'Alembert's solution of the wave equation and two dimensional wave equations, Lagrange's solution, Various standard forms.

**Fourier Series:** Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients. Expansion of functions with arbitrary periods, Odd and even functions and their Fourier series, Half range expansions of Fourier series.

### **Recommended Books:**

1. Ervin and Kreyszig, E. Advanced Engineering Mathematics, John Wiley and Sons, (Latest Edition).
2. Speigal M. R., Theory and Problems of Laplace Transforms, Schaum's Outline Series.

## ***LINEAR ALGEBRA***

**3+0**

**Prerequisite:** Calculus and Analytical Geometry

**Knowledge Area / Sub Area:** Natural Sciences / Math-III

### **Course Outline:**

Algebra of matrices; inverse of a matrix; Gauss-Jordan method for the solution of a system of linear algebraic equations; vectors in the plane and in three dimensions; vector spaces; subspaces; span and linear independence; basis and dimension; homogeneous systems; coordinates and isomorphism; rank of a matrix; determinant; inverse of a matrix; applications of determinants; determinants from a computational point of view; properties of determinants; eigenvalues and eigenvectors; systems of linear differential equations; diagonalization; Hermitian matrices; singular value decomposition; quadratic forms; positive definite matrices; non-negative matrices; floating-point numbers; Gaussian elimination; pivoting strategies; matrix norms and condition numbers; orthogonal transformations; eigenvalue problem; least square problems.

## Recommended Books:

1. Bernard Kolman and David Hill, Elementary Linear Algebra, Eighth Edition, 2004, Prentice Hall, ISBN: 0130457876.
2. Kenneth Hardy, Linear Algebra for Engineers and Scientists Using Matlab, First Edition, 2005, Prentice Hall, ISBN: 0139067280.
3. Stephen Goode, Differential Equations and Linear Algebra, Second Edition, 2000, Prentice Hall, ISBN: 013263757X.

## APPLIED PHYSICS

3+1

**Prerequisites:** None

**Knowledge Area / Sub Area:** Natural Sciences / Physics

### Objective:

To study the physical laws and principles governing several natural and artificial processes of relevance in the context of minerals and mining engineering.

### Course Outline:

**Introduction to Mechanics:** Forces and Newton's laws; Fluid statics and dynamics; Oscillations, wave motion, sound waves

**Magnetism:** Magnetic field; Relative permeability and dielectric properties of solids, Faraday's law of induction; Inductance; Superconductors

**Heat and Light:** Heat and Temperature, Conduction, convection and radiation, Heat insulation, Thermal properties of earthy materials. Surface reflectivity of and absorption of light by solid materials. Photometry, plane and polarized light, double refraction. Introduction to LASERs

**Atomic Physics:** Nature of matter; Atomic physics, hydrogen atom; Atom and the Nucleus, nuclear properties, Natural and artificial radioactivity; Radioactive decay, Half life,  $\alpha$ ,  $\beta$  and  $\gamma$  decay mechanisms; Detection and measurement of radioactivity, Fluorescence, phosphorescence and other secondary emissions. Nuclear Reactions, Fission, Fusion

**Introduction to Electronics:** Crystal lattices, unit cells, energy bands, conductors, insulators.

Semiconductors: Composition, purity, n- and p-type materials, carrier properties and distribution.

Carrier action: Diffusion, drift, generation, recombination. Conductivity, mobility, p-n junction diode, diode curve, diodes - their characteristics and applications.



## **Lab Outline:**

A minimum of eight experiments related to topics on mechanics, magnetism, optics, radiation detection, dosimetry, and electronics.

## **Recommended Text Books:**

1. R. Resnik, D. Halliday and K. Krane, Physics, John Wiley & Sons Inc., N.Y. 2007.
2. R. A. Serway, Physics for Scientists & Engineers with Modern Physics, vol. 1, Saunders College, Publishing, Philadelphia, 2007.
3. J. K. Shultis, D. S. McGregor, R. E. Faw, Fundamentals of Nuclear Science and Engineering, 3<sup>rd</sup> Ed., CRC Press, 2007.
4. H. D. Young, R.A. Freedman, T. R. Sandin and A. L. Ford, University Physics, Addison-Wesley, 2006.

## ***APPLIED GEOLOGY***

**3 +1**

**Prerequisites:** none

**Knowledge Area / Sub Area:** Natural Sciences / Elective

### **Objective:**

To acquaint the students with the basic knowledge of geology which is applicable in the field of mining engineering.

### **Course Outline:**

Scope in Mining Engineering. Introduction to various branches of geology. Origin of the earth and its place in universe, interior of the earth and chemical composition of the earth's crust.

Mountain building and valley formation, drainage patterns and their types, agents of weathering and erosion.

Deformational structural features of rocks, dip, strike, faults, folds, joints and fissures, unconformities etc.

Introduction to continued drift and plate tectonics, earth quakes and volcanism with special reference to Pakistan.

Formation of rocks and minerals, classification of rocks.

Occurrence of economic minerals and dimension stones of Pakistan.

### **Lab Outline:**

1. International geological symbols for rocks, structures and minerals
2. Measurement of dip and strike
3. Geological map reading
4. Moh's Scale Hardness

5. Identification of rock forming minerals
6. Study of wooden models of faults and folds etc.

### **Recommended Text Books:**

1. K. M. Banger, Text book of Geology
2. H. H. Read, Rutley's Mineralogy
3. Dana, Dana's Manual of Mineralogy
4. Santosh Kumar Grag, Text book of Geology
5. Raymond, L. A., *The Study of Igneous, Sedimentary and Metamorphic Rocks*, McGraw-Hill, 2002

### **Recommended Reference Books:**

1. Arthur Holmes and Dorris Holmes, Physical Geology
2. F. G. H. Blyth, Geology for Engineers

## **APPLIED CHEMISTRY**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Natural Sciences / Elective

### **Objective:**

To familiarize the student with the applications of the subject fundamentals in the pretext of chemical characterization and properties of important materials

### **Course Outline:**

**Physical & Analytical Chemistry:** Physico-chemical principles involved in chemical analysis, instrumental methods of analyses, industrial catalysis.

**Electro Chemistry:** Electrochemical cells; reaction in cells, electrode potential; secondary cells, electroplating, metallic corrosion; electro refining; pH - its significance and determination, fuel cells.

**Boiler Water Treatment:** Boiler water, scale and sludge, measurement of hardness, softening of hard water.

**Lubricants:** Lubricating oil from crude oil, de-waxing and refining greases, synthetic lubricants; composition and properties of lubricants in general.

**Corrosion and Protective coatings:** Introduction to Corrosion, Water paints, oil paints, cellulose paint, varnishes, lacquers, and metallic coatings.

### **Introduction to Chemistry of Explosives and Blasting Agents**

**Advanced materials:** Introduction to properties, synthesis and characterization of (i) composite materials (ii) nano-materials, and (iii) super-alloys

## Lab Outline:

1. Chemical analysis of cement.
2. Chemical analysis of fertilizers.
3. Chemical analysis of limestone/ marble and lime mortars.
4. Chemical analysis of iron ore.
5. Chemical analysis of copper ore.
6. Proximate and chemical analysis of coal.
7. Determination of calorific value of different fuels.
8. Study of the effects of temperature on the viscosity's of liquid fuels.
9. Qualitative analysis of mixture of salts containing four radicals.
10. Determination of water quality (pH, hardness, conductivity etc.)

## Recommended Text Books:

1. Gyngel, Applied Chemistry for Engineers.
2. V. I. Vogel, Inorganic Qualitative Analysis.

## Recommended Reference Books:

1. Adamson, Physical Chemistry
2. Warner Stumm, Principles of Surface Chemistry
3. C. C. Furants, Industrial Chemistry for Engineers

# DETAIL OF COURSES ENGINEERING DOMAIN

## NUMERICAL METHODS IN COMPUTING 2+0

**Prerequisites:** None

**Knowledge Area / Sub Area:** Computing / Fundamentals

### Objective:

To study and analyze important numerical and computational methods for solving engineering and scientific problems

### Course Outline:

Solutions of Equations in One Variable: Bisection methods, single fixed-point iteration, Newton-Raphson method and Secant Method.

Interpolation and Polynomial Approximation: Lagrange interpolating polynomials, Spline interpolation, Newton's divided difference methods.

Numerical Differentiation and Numerical Integration

Solution of Linear System of Equations

Initial Value Problems for Ordinary Differential Equations: Euler's method, Runge-Kutta method, system of equations

Boundary Value Problems for Ordinary Differential Equations: Shooting Method, Finite Difference method, Power Method

Approximation Techniques: principles of least-squares, multiple linear, nonlinear regression

Note: Exercises and assignment work is recommended, especially using MATLAB, or other programming tools and software

### **Recommended Text Books:**

1. Burden and Faires, Numerical Analysis, 8<sup>th</sup> Ed., 2005

### **Recommended Reference Books:**

1. Epperson, An Introduction to Numerical Methods and Analysis, 1<sup>st</sup> Ed., 2002
2. Schilling and Harris, Applied Numerical Methods for Engineers: Using Matlab and C, 2000

## **COMPUTER PROGRAMMING**

**2+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Computing / Programming

### **Objective:**

Introduction to computer programming and to problem solving techniques using computer programs with applications in engineering.

### **Course Outline:**

Computers and Programming: Programming languages, process of developing programs, algorithms, flow charts

Basic constructs of the programming language: variables and reading/writing, expressions, operators, data types, control statements, pointers, arrays

Functions: Function declaration, declaration scope and visibility, reference parameters, recursive functions.

Types: Enumerated data types; structures and unions

Object Oriented Program development: Basic concepts, Classes: Definition, constructors, destructors, Composition and Inheritance.

## **Lab Outline:**

Lab work should be based on Devising Program Logic and Flowcharting, Learning the Compiling Process, Constructing and Testing Functions, Implementation of fundamental algorithms, Implementation of Classes and their clients, and Documenting Test Cases

Implementation of some mathematical algorithms using MATLAB and other engineering packages can also be considered here.

## **Recommended Text Books:**

1. Dietel and Dietel, C++ How to Program. 4<sup>th</sup> Edition
2. Robert Lafore, Object Oriented Programming with C++

## **Recommended Reference Books:**

1. Bjarne Stroustrup, The C++ Programming Language

## **STATISTICS AND PROBABILITY**

**2+0**

**Prerequisites: None**

**Knowledge Area / Sub Area: Computing / Programming**

## **Objective:**

This course will enable the students to apply the knowledge of statistics and probability to analyze the data in a scientific way and to check the behavior of data so that they will be able to predict the future trends.

## **Course Outline:**

Frequency distribution. Mean, Median, Mode and other measures of central tendency. Standard deviation and other measures of dispersion. Coefficient of dispersion. Random experiments. Sample space. Definition of probability. Addition and product rules of probability, Bayer's theorem and Bayer's theorem of future events. Discrete and continuous random variables. Discrete and continuous probability distributions. Methods of best squares, Curve fitting, Linear Regression. Introduction to statistical computer packages.

## **Recommended Text Books:**

1. Murray R. Spiegel and Larry J. Stephens, Probability and Statistics, 3<sup>rd</sup> Edition.

## **Recommended Reference Books:**

1. S. C. Gupta and V. K. Kapur, Fundamentals of Mathematical Statistics
2. Freund, J. E., Mathematical Statistics

# FOUNDATION COURSES

## **MINING ENGINEERING FUNDAMENTALS**

**3+0**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

To introduce the scope and fundamentals of various aspects of mining engineering discipline.

### **Course Outline:**

An introduction to the field of mining engineering and its economic importance, brief review and production of minerals in Pakistan.

Prospecting and exploration, Development and exploitation, Drilling and boring, Explosive and blasting, Mine supports, Material handling, Mine Ventilation, Mine water and its disposal, Importance of safety aspects in mining, Mineral beneficiation, Mine sampling and valuation.

### **Field Trip:**

Field visit to some mine sites is an essential part of this course.

### **Recommended Text Books:**

1. R. S. Lewis and Clark, Elements of Mining, 3<sup>rd</sup> Edition, John Wiley and Sons. John Wiley & Sons, 1964
2. H. L. Hartman, Introductory Mining Engineering. 2<sup>nd</sup> Edition, John Wiley and Sons, 2002.

### **Recommended Reference Books:**

1. SME/AIME Mining Engineering Handbook Vol. I and II.
2. Directory of Mineral Deposits of Pakistan.

## **ENGINEERING DRAWING AND GRAPHICS**

**1+2**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

The aim of this course is to enable the student of acquire ability to read a working drawing and to produce a dimensional drawing or sketch of sufficient content to allow manufacture of simple items as apparatus and engineering components.

## **Course Outline:**

Use of instruments, planning drawing sheets, lettering orthographic projection, 1<sup>st</sup> and 3<sup>rd</sup> angle, auxiliary projection, interpretation curves.

Freehand sketching, conversion from pictorial to orthographic and vice versa.

Planning of a drawing sheet, projection of simple position, oblique and auxiliary planes.

Lettering and dimensioning, principal requirements of a working drawing.

Isometric and pictorial projections of solid figures, making of freehand sketches from solid objects and from orthographic projections.

Sections of solids, tangent planes to surfaces in contact, inter section of surfaces and inter penetration of surface and solids development of surfaces.

Screw thread systems, keys and cotters, couplings and simple bearing.

## **Lab Outline:**

1. To draw 1<sup>st</sup> and 3<sup>rd</sup> projections of a number of three dimensional objects.
2. Preparation of detailed and assembly drawing of Civil Engineering projects and surveys.

## **Recommended Text Books:**

1. A. C. Parkinson, First Year Engineering Drawing
2. N. D. Bhatt, Engineering Drawing and Graphics

## **Recommended Reference Books:**

1. T. E. French, C. J. Viereck and R. J. Foster, Engineering Drawing and Graphic Technology

## **APPLIED THERMODYNAMICS**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

An introductory course in thermodynamics that provides a solid background for further study in the mechanical and chemical systems.

### **Course Outline:**

Thermodynamics systems; state property, process and cycle, 1st Law of thermodynamics, internal energy, perfect gases and their laws, constant specific heat.

Expansion and compression of gases, properties of vapors, P-V diagrams, elementary cycles and applications.

Description and elementary theory of compressors, boilers, steam engines, I.C. engines, refrigerators, engine tests, heat balance, elementary theory and description of nozzles, steam turbines and gas turbines, combustion of fuels.

Reversible and irreversible processes; Application of the First Law to ideal and non-ideal gases; Thermochemistry; Second law; Entropy and free energy, Criteria for spontaneity.

Law of mass action; Ionic equilibria in solutions; pH and buffer solutions; Hydrolysis; Solubility product; Phase equilibria; Phase rule and its application to one-component and two-component systems; Colligative properties.

### **Lab Outline:**

A minimum of eight experiments related to theory.

### **Recommended Text Books:**

1. R. E. Sonntag, C. Borgnakke, Introduction to Engineering Thermodynamics, 2<sup>nd</sup> Edition, John Wiley & Sons, 2007
2. Svein Stølen, Tor Grande, and Neil L. Allan, Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects. 2004.

## **FLUID MECHANICS**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

To know about different fluid properties, behavior of fluid flow and different flow measuring techniques.

### **Course Outline:**

**Physical properties of fluids:** Density, specific weight, specific volume, specific gravity, surface tension and compressibility.

**Viscosity:** Newton's equation of viscosity, units of viscosity, measurement of viscosity, dissipation of energy in lubricated bearings.

**Fluid statics:** Pressure, pressure-specific weight-height relationship.

**Unit of pressure:** Absolute and gauge pressure.

**Measurement of pressure:** Bourden Gauge, manometers and differential manometers. Forces on submerged plane and curved surface and their application.

**Flow types:** Basic concepts about steady and unsteady flow. Laminar and turbulent flow. Uniform and non-uniform flow. Path lines, streamlines and



stream tubes. Velocity and discharge. Equation of continuity. Bernoulli's Theorem. Impulse-momentum equation.

**Flow measurement:** Measurements of velocity, pitot tube, measurement of discharge, venturimeter, orifices, notches and weirs. Concept of Vena-Contracta

**Steady flow through pipes:** Darcy Weisbach equation for flow in pipes, Chezy, Manning and Kutter's formula. Losses in pipe-lines, hydraulic and energy gradients, transmission of energy through pipes. Uniform flow through open channels. (Chezy's and Manning's formulae). Economical cross-section; rectangular, triangular and trapezoidal. Use of pumps and their characteristics.

### **Lab Outline:**

1. To determine the viscosity of given oil using a Redwood Viscometer.
2. To determine the viscosity of given oil using an Oil Flow Apparatus.
3. Determination of centre of gravity and metacentre of a floating body.
4. To determine the magnitude of hydrostatic thrust exerted on a submerged curved surface and to locate the centre of pressure.
5. To determine the coefficient of discharge of a Rectangular Notch and hence to calibrate it.
6. To determine the coefficient of discharge of a Triangular Notch and hence to calibrate it.
7. To determine the coefficient of discharge of a venturimeter and hence to calibrate it.
8. To determine the hydraulic coefficients for orifices of various shapes.

### **Recommended Text Books:**

1. R. L. Daugherty, J. B. Franzini and E. J. Finnermore, Fluid Mechanics with Engineering Applications, McGraw Hill.
2. E. H. Lewitt, Hydraulics and Hydraulic Machinery, Pitman and Sons.

### **Recommended Reference Books:**

1. A. C. Shaw and D. A. Johnson, Mechanics of Fluid, Longman.
2. Anthony Esposito, Fluid Power with Applications
3. R. W. Fox and Allan T. McDonald, Introduction to Fluid Mechanics. John Wiley and Sons.

## **MECHANICS OF MATERIALS**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

To analyze stresses in basic structures & design structures for different loads.

## **Course Outline:**

**Simple Stress:** Kinds of Stress and Strain; Load extension diagram for materials; Hook's law; Moduli of elasticity; Lateral strain; Volumetric strain; poisson's ratio; thermal stresses and compound bars.

Advanced cases of shear force and bending moment diagram for statically determinate beams. Relationship between load shear and bending.

**Stresses in Beams:** Theory of simple bending; position of neutral axis, moment of resistance and section modulus; design of homogeneous and non-homogeneous monosymmetric beams, shear stresses in monosymmetric beams.

**Deflection of Beams:** Double integration, moment area

**Column and Struts:** Short eccentrically loaded column, Core of a section. Long axially loaded column. Euler's treatment. Rankine Gordon formula for intermediate columns. Slenderness ratio.

**Torsion:** Theory of torsion of solid and hollow circular shafts.

**Strain Energy:** Strain Energy due to direct load, shear force, bending moment and torque. Stresses due to impact loads.

## **Lab Outline:**

1. To verify laws of shearing force and bending moment on a beam.
2. To Plot load deflection curve for a wire and hence determine the value of Elasticity.
3. To investigate the relationship between shear stress and shear strain for a rubber, to determine modulus of rigidity of the material.
4. To determine the central deflection of a clamped ended steel beam loaded at centre by a concentrated load.
5. To determine the modulus of rigidity of a given material of a circular shaft.
6. To perform a tensile test on Hounsfield Tensometer and to determine the mechanical properties.

## **Recommended Text Books:**

1. R. C Hibbler, Mechanics of Materials
2. Andrew Pytel and Ferdinand, Strength of Materials

## **Recommended Reference Books:**

1. F. R. Warnock and P. P Benhan, Mechanics of Solid and Strength of Materials, Macmillon Publishing Company, New York
2. Christopher Bise, Mining Engineering Analysis

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Foundation

**Objective:**

This course gives the students an understanding of some basic electrical circuits, electrical components like resistors, capacitors and inductors, and electrical machines like generators and transformers. Experiments are performed to show the important characteristics of these machines.

**Course Outline:**

**DC Machines:** Types of excitation, operation and characteristics of series, shunt and compound generators and motors, armature reaction, stators, selection of motors. Elementary transmission and distribution, DC and AC systems transmission voltages, elements of house wiring, its testing, distribution, switching and fusing from the utilization points of view.

**AC Circuits:** Series and parallel circuits and their combination, improvement of power factor by condensers, three-phase alternating currents, advantages over single-phase, vector diagrams for the balanced three-phase system. Earthing of apparatus.

**Transformers:** Basic principles, ratio of transformation, iron and copper losses, efficiency and regulation. Brief discussion and uses of instrument transformers and auto transformers, three-phase transformers, stars and delta connections, Scott connections. Constructional features, cooling and protection from fire hazards.

**AC Generators:** Construction and working principles of alternator frequency, simple EMF equation. Polyphase generation.

**AC Motors:** Concept of rotating field, polyphase induction motor, production of torque, slip, squirrel cage and slipring motors, starting of motors, construction of synchronous motor, production of torque and starting characteristics, selection of AC Motors, measuring instruments, basic principles of construction and operation of moving iron dynamometer and hot wire instruments, power and energy meters, elementary considerations.

**Storage Batteries:** Lead and nickel iron cells, charge and discharge, quantity and energy efficiencies.

**Mine Electrification:** Principles of mine electrical circuits and required power calculations. Design of electric cables and control devices

**Lab Outline:**

1. To draw vector diagrams of AC circuits containing (a) resistance

- and inductance in series, (b) resistance and capacitance in series, and (c) resistance, inductance and capacitance in series.
2. To study the effect of variation of frequency on an L-R-C series resonant circuit.
  3. To measure the resistance of different resistors by (a) Color code. (b) VOAM.
  4. To measure the power in an inductive load by using one voltmeter and one ammeter method.
  5. To determine the load characteristics and magnetic characteristics of a DC shunt generator.
  6. Load characteristics curves of a series generator.
  7. To find the voltage regulation of a single phase transformer.
  8. To measure the power of resistive network.
  9. To verify Ohms Law, Kirchoff's Voltage Law & Current Law
  10. To verify Current Division Rule & Voltage Division Rule
  11. To measure the magnitude of voltage, time period and frequency by oscilloscope

### **Recommended Text Books:**

1. Admiralty, *Examples in Electrical Calculations*
2. B. L. Theraja, *Electrical Technology*
3. Robert Stifenko, *Coal Mining Technology: Theory and Practice*

### **Recommended Reference Books:**

1. Electrical Circuits. Schaum's Series.
2. Erwin, *Circuit Analysis*

## **ENGINEERING GEOLOGY**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Foundation

### **Objective:**

To acquaint the students with properties and uses of earth materials and to be resourceful in using what is learned for engineering purpose such as slope stability, subsidence, tunneling, dams etc. Also to help them understand the nature in a scientific and technical way this enabling them to explore the hidden treasures of the earth.

### **Course Outline:**

**Engineering Fundamentals:** Data collection, interpretation applying analysis techniques, site investigation etc.

**Engineering soil:** Cohesive and non-cohesive soil, unified and other soil classification, engineering properties of solid

**Engineering properties of rocks:** rock strength, rock deformation, index properties, Rock Masses.

### **Characteristics of discontinuities**

Orientation, spacing, continuity, surface characteristics etc.,

**Rock mass deformation**, rock mass quality, rock mass dynamic elastic moduli, engineering classification of rocks

**Sub surface water** – occurrence, engineering significance & control of subsurface water

**Construction uses of rocks** – aggregate, geologic & performance characteristics

**Landslides & related phenomena** – evaluation landslide

Processes, mitigating the effects of landslides, subsidence, mitigating the effects of subsidence, expansive soils & mitigating their effects.

**Earthquake induced processes** – surface rupture, ground shaking, ground failure, tsunami and seiche so their occurrence .

### **Recommended Reference Books:**

1. Principles of engineering Geology by Robert B. Johnson
2. Geology for Engineering by Blyth & DeFreitas

## **ENGINEERING MECHANICS**

**3+0**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Engineering Foundation

### **Course Outline:**

Vectors: Addition and subtraction of vectors, scalar and vector products, differentiation and integration of vectors, laws of triangle, parallelogram and polygon forces, parallel forces, moments and couples, friction, resultant of coplanar forces, general conditions of equilibrium of coplanar forces, funicular polygon, common and parabolic category, mechanical advantage and efficiency of simple machines.

Motion along a straight line with uniform acceleration Tangential and normal components of acceleration, Banking of tracks, Simple harmonic motion projectiles.

Work and energy power, momentum and conservation of momentum and energy.

Mechanics practical, experiments illustrating principles of mechanics

# COURSES FOR BREADTH

## ROCK MECHANICS

3+1

**Prerequisite:** None

**Knowledge area /Sub area:** Major Based Core (Breadth)

### Objectives:

To develop an understanding of the fundamental principles of rock mechanics that are essentially required for undertaking design and stabilization/ support of excavations

### Course Outlines:

Concept of stress and infinitesimal strain; Linear elasticity; Physical and mechanical properties of rocks; Rock failure theories; Rock mass classification schemes and their application in excavation design and support selection; Estimation and measurement of in-situ stresses; Design of openings in massive jointed and weak rocks; Stability analysis and design of rock slopes and pillars. Subsidence, its prediction, measurement and control.

### Lab Outline:

1. UCS determination of rocks
2. Tri-axial tests
3. Brazilian Tests
4. Direct Shear Strength
5. Slake Durability tests
6. Point Load Index test
7. Schmidt Hammer Rebound Number determination tests
8. P and S wave determination
9. Determination of Rock Porosity and Permeability
10. Study of Creep Behaviour of Rocks

### Recommended Text Books:

1. Goodman, Introduction to Rock Mechanics, 1989, John Wiley and Sons
2. Brady and Brown, Rock Mechanics, 3<sup>rd</sup> Edition, Reprint in 2006, Springer
3. Hudson and Harrison, Engineering Rock Mechanics

### Recommended Reference Books:

1. Hoek, Practical Rock Engineering ([www.rocksciences.com](http://www.rocksciences.com))
2. Obert and Duvall, Rock Mechanics and the Design of Structure in Rock
3. Jaeger and Cook, Fundamentals of Rock Mechanics

## **UNDERGROUND MINE DESIGN**

**3+0**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Major Based Core (Breadth)

### **Objective:**

To elaborate the design principles for underground openings and selection of mining methods for a given deposit.

### **Course Outline:**

Description and classification of mining methods. Selection of mining methods, Design of mine layout & mode of development, Design of panel layout, mode of location and sequence of recovery; Selection of equipment and machinery, Underground mining practices in Pakistan.

### **Field Trip:**

Field visit to some mine sites is an essential part of this course.

### **Recommended Text Books:**

1. H. L. Hartman, Introductory Mining Engineering. John Wiley and Sons, 2<sup>nd</sup> Edition.
2. Peng, Coal Mine Ground Control
3. Hustrulid, Underground Mining Methods Handbook, AIME Publication, June 2001.

### **Recommended Reference Books:**

1. R. S. Lewis and Clark, Elements of Mining, John Wiley and Sons.
2. SME/AIME Mining Engineering Handbook Vol. I and II, 1992
3. Syd and Peng, Longwall Mining

## **SURFACE MINE DESIGN**

**3+0**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Major Based Core (Breadth)

### **Objective:**

At the end of the course, the student would be able to understand the fundamental concepts for the development and exploitation of geologic deposits by surface hard rock mining methods, involving bank stability, economics, safety and production considerations. The student would also develop skill in making the equipment operations as efficient as possible, consistent with good operating practices.

## **Course Outline:**

Introduction & Surface Mining Methods; Open Pit terminology & Purpose of Benches; Unit operations & Mining steps; Geometrical considerations in open pits ; Pit limits; Equipment selection; Drilling ; Slope stability; Quarrying ; Placer Mining; Case Histories

## **Field Trips:**

Some mining field visits are essential part of this course.

## **Recommended Text Books:**

1. E. P. Pfeider, Surface Mining
2. B. A. Kennedy, Surface Mining, SME, 1990
3. William Hustrulid and M. Kuchta, Open pit Mine Planning and Design, Vol. I, April 2006, 2<sup>nd</sup> Edition. Taylor and Frances.
4. James W. Martin, Surface Mining Equipment

## **Recommended Reference Books:**

1. B. A. Kennedy, Surface Mining, 2<sup>nd</sup> Ed., SME
2. W. Hustrulid and M.Kuchta, Open pit Mine Planning and Design, Vol. II (published by A. A. Balkema)
3. Abid S. H. TLR on Surface hard rock Mining. 2000. Ministry of Education, Pakistan.

## **MINERAL PROCESSING**

**3+1**

**Prerequisites:** none

**Knowledge Area / Sub Area:** Major Based Core (Breadth)

## **Objective:**

To acquaint the students with the principles and practical knowledge of comminution of ores, and the physical concentration processes in order to obtain value-added mineral products & including knowledge of concentration processes of ores and minerals.

## **Course Outline:**

**Introduction:** Economic justification and scope of mineral processing for upgrading ores and minerals, types of flow sheets, liberation and concentration.

**Comminution:** Definition and objectives of crushing and grinding. Conventional and non conventional methods of crushing and grinding. Laboratory and industrial crushers and grinding mills, grinding circuits. Use of micro waves in crushing.

**Laboratory Sizing and Industrial Screening:** Laboratory sizing, wet and dry sieve analysis, size distribution, sub-sieve techniques, movement of



solid in fluids, Stokes and Rittinger laws, industrial screening, performance of screens, types of screens, screening surfaces.

**Classification:** Principles of classification, free and hindered settling ratios, hydraulic and mechanical classifiers. Principles of cyclones and hydrocyclones.

**Gravity Concentration:** Principles of gravity concentration, gravity separators, jigging, Humphrey's spirals, flowing film concentration, tabling, concentration ratio, grade recovery relationship; heavy fluid and heavy media separation (H.M.S).

**FLOTATION:** Principles, machines and applications

**Magnetic and electrostatic Separation:** Principles, machines and applications

**Solid Liquid Separation:** Separation of Solids from fluid, dewatering filtration, drying and equipment used for solid liquid separation.

**Coal Preparation:** Introduction to coal cleaning and coal preparation.

### **Lab Outline:**

1. Sampling on a given lot of ore using Coning and Quartering and mechanical samplers
2. Use of jaw crushers for crushing limestone and gypsum
3. Use of Rolls for closed-sized crushing for iron ore and chromite
4. Use of ball-mill and rod-mill for grinding of a given ore sample
5. Wet and dry sieve analysis and graphical presentations of size distribution data.
6. Experimental determination of free and hindered settling ratios
7. Concentration of a given sample ore on Laboratory Jig
8. Concentration of a given sample ore on Shaking table
9. Float-Sink Analysis for a coal sample
10. Flotation of a given ore sample.
11. Flotation of coal sample from Pakistan
12. Concentration of an ore using dry / wet magnetic separators

### **Recommended Text Books:**

1. B. A. Wills, Mineral Processing Technology, 7<sup>th</sup> Ed., 2006
2. S. K. Jain, A. A. Balkema, Ore Processing, 1987

### **Recommended Reference Books:**

1. Spotiswoods and Kelly, Mineral Processing, 1986
2. SME Mineral Processing Handbook, 1990
3. Abid S. H., TLR on Mineral Processing. 2000. Ministry of Education. Pakistan.

# SURVEYING

3+1

**Prerequisites:** None

**Knowledge Area / Sub Area:** Engineering Major based (Breadth)

## Objective:

To learn principles and techniques of cartography.

## Course Outline:

**Fundamental Concepts:** Definitions, uses & types of surveys, survey measurements, errors and adjustments.

**Basic Survey Measurements:** Distance measurements, leveling, different methods and types of instruments, angle and direction measurements; description and adjustment of transit & compass; theory and practical uses of stadia surveying

**Surveying Operation:** Plane table traversing, Transit-tape traversing, triangulation, adjustment of traverse and triangulation network, construction & use of optical alidade, precise measurement of baseline, location of details and area measurement, determination of meridian by astronomical observation, topographic maps.

**Mine Surveying:** Transfer of co-ordinates, level and meridian underground, use of auxiliary telescope, laying out of curves, underground mine surveying.

**GIS:** Introduction to GIS

## Lab Outline:

1. Distance measurement
2. Leveling (Establishing vertical control by differential leveling method)
3. Compass Traverse
4. Triangulation (Establishing horizontal control)
5. Traversing
  - (a) Plane table Traversing
  - (b) Transit tape Traversing
6. Surveying using Total Station Theodolite and other modern equipment (e.g. GPS)

## Field Trip:

A field surveying camp is advised for a good field practice.

## Recommended Text Books:

1. Surveying by Davis and Foote, McGraw-Hill, 1968
2. Surveying and Levelling by Kanetker Vol.1&2, 1996

## **Recommended Reference Books:**

1. Introduction to Mine Surveying by Stanley
2. Surveying Handbook by Russell Charles Brinker
3. Abid. S.H. TLR on Mine Surveying. 2000. Ministry of Education, Pakistan.

## **EXPLOSIVES ENGINEERING**

**3+1**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Major Based Core (Breadth)

### **Objective:**

At the end of the course, the student would be able to make a proper selection of explosive for any given blasting situation and understand the basic principles involved in blast design. The student would also acquire the skill in fostering the safe and productive blasting practices.

### **Course Outline:**

Explosives history and development, ingredients and chemistry of explosives.

Explosion, properties, classification and characteristics of commercial explosives and blasting agents.

Initiation system; Rock breakage theories; Principles of priming and loading, Fundamentals of surface and underground blast designs, controlled blasting techniques; Ground vibrations and air blast, safety in explosive handling and blasting. Introduction to commercial explosives of Pakistan.

### **Lab Outline:**

1. Relevant Audio-visual programs demonstrating different safe blasting practices should be shown to the students.
2. Instructional tours may be arranged to visit various surface and underground mines to get the student familiar with various, initiation, priming, loading and other blasting practices.
3. Study the various inert (dummy) explosives and accessories manufactured by Wah Nobel Industries, write a short report on them indicating specifications, their uses etc.
4. Study the various inert explosives and inert accessories manufactured by Biafo industries and write a brief report stating their specification, uses etc.
5. Practice the recommended knots for detonating cord on inert detonating cord or nylon strings. This is to be studied and practiced on a field trip as well.
6. Study a Nonel detonator (inert) and various associated accessories and delays (inert) and practice its connection in class and also in the field.

7. Start a Nonel shock tube (actual) with the help of Nonel starter/initiator in the class and do the same with a remote Nonel initiator as well.
8. Study various instrumentation involved in electric initiation system and also practice the recommended wire splices.
9. Using inert electric detonators, determine the continuity and resistance of series, Parallel, and series-parallel circuits (use the firing line, connecting wire and bus wire in the circuit).
10. Practice with the help of detonators (inert) and primer (inert) the various proper techniques in making primers. Study them on field trips as well.
11. On a field trip, watch and practice general blasthole loading procedures.
12. Create mock ground vibrations and air blast in the class and monitor and take readings with the help of seismographs. Also monitor them in actual field conditions on a study tour.
13. Study the various components of a sequential blasting machine in the class and use it in the field where electric initiation is practiced and get familiar with its use.
14. Study the various components, and get familiar with the use of a lightening detector when storm is approaching.

### **Field Trips:**

Some mining field visits are essential part of this course.

### **Recommended Text Books:**

1. Dick, Fletcher & D'Andrea, Explosives and Blasting Procedures Manual (IC 8925), 1995
2. Explosive and Rock Blasting, Atlas Powder Company, 1987.
3. Stig O. Olofsson, Applied Explosive Technology for Construction and Mining
4. Blaster's Handbook, 18th Edition, ISEE, 2011

### **Recommended Reference Books:**

1. Gary B. Hemphill, Blasting Operation, McGraw-Hill
2. Rune Gustafsson, Swedish Blasting Technique. Published by SPI, Gothenburg, Sweden
3. Tariq M. TLR on Explosives and Blasting. 2000. Ministry of Education, Pakistan.

# COURSES FOR DEPTH

## MINE HAZARDS AND SAFETY

3+1

**Prerequisites:** None

**Knowledge Area / Sub Area:** Major Based Core (Depth)

### **Objective:**

To introduce the students about the mine emergencies (disasters) and different aspects of rescue work. Study of this subject also enables the students to understand the causes of fires in mines by introducing new and effective fire isolation systems.

### **Course Outline:**

**Mine Dust and Gases:** Source types, properties, effects, detection, analysis and precautions. Introduction to instruments used for detection and analysis.

**Mine Fires Types:** Causes, effects and prevention of underground fires, fire fighting equipment and organization mine explosions, ignition of fire damp, explosion of fire damp, coal dust explosions, stone dust barriers, mixed explosion, explosions in compressed air pipes, investigation of explosions.

**Mine Rescue:** Construction, types and uses of various kinds of mine rescue and breathing apparatuses, organization of recovery and rescue work opening of sealed areas, mine, diseases, their treatment and preventions.

**Safety:** Mine accidents, analysis, and their prevention. Protection against hazards in mines. Instrumentation for mine safety

### **Lab Outline:**

1. Determination of dust concentration using Aerosol Monitor.
2. Determination of dust concentration using Peizo-Balance Dust Counter.
3. Methane gas detection and estimation using mine safety lamp.
4. Measurement of methane gas using methane detectors.
5. Measurement of CO<sub>2</sub> using Infrared Monitor.
6. Measurement of H<sub>2</sub>S using Personal Monitor & Alarm for H<sub>2</sub>S.
7. Measurement of O<sub>2</sub> Deficiency / Excess.
8. Measurements of Carbon Mono oxide (CO)
9. Measurement of Nitrogen oxide (N<sub>2</sub>O)
10. Operation and usage of Self Rescuer.
11. Operation of Oxygen Breathing Apparatus and Oxygen Mask.

## **Field Trip:**

Field visit to some mine rescue stations is an essential part of this course.

## **Recommended Text Books:**

1. J. Strang and P. M Wood, A Manual on Mine Rescue, Safety and Gas Detection, 1985

## **Recommended Reference Books:**

1. Hein Rich, Industrial Accident Prevention
2. Bird. Loss Control Management
3. John Riley, Safety at Work
4. Jeffery, W. Vincoli, Accident Investigations
5. Safety Notes of Cornwall School of Mines
6. Tariq. M TLR on Mine Safety and Rescue. 2000. Ministry of Education, Pakistan

## **COAL MINING**

**3+1**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Major Based Core (Depth)

## **Objective:**

This course will provide the student to know how about the origin of coal, mining and handling of coal. After completing this course, the student will be able:

- to under stand the system of underground and surface coal mining.
- to deal with the unit operations and auxiliary operations that is essential to the output of coal.
- to manage a coal mine with a broad range of activities, from development and planning to marketing

## **Course Outline:**

**Geology of Coal:** Coal Classification; Coal Reserves in Pakistan; Mine Pre-Planning and Mine Development, Ground Control

**Underground Coal Mining Methods:** Room and Pillar Method; Longwall and short wall mining; Comparison of these methods ; Haulage system;

**Surface Coal mining:** Introduction, unite operation, overburden stripping equipment, stripping equipment selection, pit design, mining methods (conventional contour strip mining, lateral movement or Haulback method, Mountain top removal and valley fill, modified block cut mining etc.) environmental considerations.

**Auxiliary Operations:** Mine Drainage; Mine Ventilation; Mine Electrical Power and Lighting, and Communication; Coal Preparation; Coal Utilization; Environmental Considerations

**Lab Outline:**

- Based on theoretical work –

**Recommended Text Books:**

1. SME Elements of Practical Coal Mining (The Latest Edition), Edited by S. M. Cassidy, 1981.
2. SME Coal Preparation (The Latest Edition), Edited by J. D. Leonard and R. D. Mitchell.
3. R. Stefanko and C. J. Bise, Coal Mining Technology: Theory and Practice (The Latest Edition),
4. Colin R. Word, Coal Geology and Coal Technology (The Latest Edition)

**Recommended Reference Books:**

1. SME Mining Engineering Handbook (The Latest Edition), Edited by A. B. Cummins and L. A. Given.
2. Lewis R. S. & G. B. Clark, Elements of Mining (The Latest Edition).
3. Abid. S. H. TLR on Coal Mining. 2000. Ministry of Education, Pakistan.

**TUNNEL ENGINEERING**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Major Based Core (Depth)

**Objective:**

The objective of the course is to provide the students with the main concepts associated to the design and construction of tunnels. Tunnels excavated in hard and weak rock masses are given particular attention. Particular attention is devoted to rock mass characterization, excavation methods, improvement and reinforcement techniques, the available analysis methods and tunnel instrumentation and observation.

**Course Outline:**

Classifications of underground openings/ excavations; Site investigation for tunneling & excavation projects; Geological aspects of Tunnel & Shaft-sinking Design; Fundamental Concepts of Rock Breaking; Design of shape & size of tunnels & Shafts; Excavation methods: Drill & Blast, Mechanical Excavation (Road Headers, Tunnel Boring Machines, TBM's & New Austrian Tunneling Method (NATM)); Tunneling & Shaft Sinking in problematic grounds.; Ground Treatment and Water Control Methods ; Support and reinforcement of tunnels; Ventilation during Construction of Underground Structures;

Collection of design data and monitoring of Excavation during and after Construction

**Lab Outline:**

- Based on theoretical work –

**Recommended Text Books:**

1. Whittaker, B. N., Frith, R. C, Tunneling. Design, Stability and Construction 1990.

**Recommended Reference Books:**

1. Thomas R. Kuesel, Elwyn H. King, John O. Bickel, Tunnel Engineering Handbook ( Latest Edition)

**MINE VENTILATION**

**3+1**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Major Based Core (Depth)

**Objectives:**

To prepare the students for examination of mine atmosphere and detection of toxic, radioactive, explosive and other gases in mines. To enable them to determine the requirements of air supply for underground mines, both in qualitative and quantitative terms, and to plan the ventilation networks accordingly.

**Course Outline:**

**Introduction:** Objectives of mine ventilation, air conditioning and control process.

**Quality Control:** Mine Gases: Nature of air, types, sources, properties and control of mine gases.

Determination of dilution requirements. Mine Dusts: Types, sources, properties, effects and control, air borne dust.

Air Flows: Air flow in ducts and air ways. Nature of fluid flow, energy changes in fluid flow. Bernoulli's equation, head losses, and mine heads, Atkinson's equation, air power.

**Heat and Humidity:** Sources of heat in mines, physiological effects of heat and humidity on work capacity and efficiency of personnel.



**Air Measurements:** Temperature, atmospheric pressure, air density and air velocity.

**Ventilation Survey:** Mine resistances, series flow, parallel flow, natural splitting, controlled splitting

**Principles of Natural Ventilation:** Pressure source, characteristics, direction of intensity determination.

**Ventilation Network Analysis:** Iterative techniques for network analysis. Kirchoff laws

**Economics of Air Flow:** The basics of economic design, effect of air way characteristics on power consumption, design of air ways.

**Mechanical Ventilation:** Classification of mechanical ventilation devices, network analysis by computer, theory and design of fans, fan characteristics, fan laws, different types of fans.

**Auxiliary Ventilation:** Importance and methods of auxiliary ventilation, systems used for auxiliary ventilation.

### **Lab Outline:**

1.
  - a. Measurement of atmospheric pressure, dry and wet bulb temperatures of air using aneroid barometer and psychrometer.
  - b. Determination of psychrometric and other properties of air from the measured data.
2.
  - a. Determination of average air velocity in circular duct/ Tubing using pitot tube.
  - b. Measurement of atmospheric pressure and temperature using aneroid barometer.
  - c. Finding expressions for volume and mass flow rates and calculating them from the measured data.
3. Determining true air velocity from a vane anemometer calibrating it against a pitot tube. Finding the state of flow / Reynolds number. Drawing the velocity profile.
4. Determining the effect of misalignment of a pitot tube and vane anemometer to an air stream.
5. Determining the characteristics of an axial fan with regard to the variation of pressure, power consumption and efficiency with quantity passed by the fan.
6. Determining the effect on characteristics of running two similar fans in series.
7. Determining the effect on characteristics of running two similar fans in parallel.

8. Determining the effect on characteristics of running two different fans in series.
9. Determining the effect on characteristics of running two different fans in parallel.
10. Determining the effect on characteristics of running two similar fans in series and a different fan in parallel to them.
11. Observing the smoke mixed helium gas layer on air in the layering apparatus in horizontal position.
12. Observing the smoke mixed helium gas layer on air in the layering apparatus in an ascensional air flow.
13. Observing the smoke mixed helium gas layer on air in the layering apparatus in a descensional air flow.

### **Recommended Text Books:**

1. H. L. Hartman, Mine Ventilation and Airconditioning, 1997
2. McPherson, Subsurface Environmental Engineering, (Latest Edition).

### **Recommended Reference Books:**

1. Pennman, Mine Ventilation
2. H. Rabia, Mine Environmental Engineering, (Latest Edition)
3. A. Roberts, Mine Ventilation
4. Abid. S. H TLR on Mine Ventilation. 2000. Ministry of Education, Pakistan.

## **MINE POWER, DRAINAGE AND MATERIAL HANDLING**

**3+1**

**Prerequisite:** None

**Knowledge Area / Sub Area:** Engineering – Depth

### **Objectives:**

The primary objective of this course is to provide an overview of the engineering parameters necessary for designing surface and underground materials handling systems, equipment (including haulage/hoisting, locomotive/rail, and belt conveyor) hydraulic power system and power distribution.

### **Course Outline:**

**Power:** various source of power available at mine, Compressed air theory, Compressed air system design; Electric Power, Selection of Power Cables, power-factor correction, load flow analysis and power cost; Hydraulic power systems, its design and selection procedures.

**Materials Handling:** Belt conveyor: General applications of belt conveyors design consideration material characteristics, belt capacity, width, speed and idler selection, belt tension power calculation.

**Haulage:** Application of different surface and underground methods of haulage and the equipment used. Locomotive tractive-effort and duty cycle calculation, Power requirement calculations.

**Hoisting:** Hoisting equipment, Basic hoisting systems and their special application to different mine conditions, Hoisting calculations, Steel rope design and selection.

**Drainage:** Different types of pumps, their characteristics, and applications. Calculation of power requirements. Pumping system analyses.

**Lab Outline:**

1. Compressed air System Design
2. Electrical system design
3. Belt conveyor system design
4. Rail haulage and power system design
5. Rope system Design
6. Hoisting system design

**Recommended Text Books:**

1. Christopher J. Bise, Mining Engineering Analysis, 2<sup>nd</sup> Edition. ISBN 0-87335-221-1.
2. Robert Stefanko, Coal Mining Technology: Theory and Practice, 1983
3. Howard L Hartman, Introductory Mining Engineering

**Recommended Reference Books:**

1. R.L. Peurifoy, Construction Planning Equipment and Methods, 3<sup>rd</sup> Ed.
2. SME Mining Engineering Handbook, Vol-I and II. 1992
3. Atlas Copco Manual

**MINERAL EXPLORATION**

**3+1**

**Prerequisites: None**

**Knowledge Area / Sub Area: Depth**

**Objective:**

To determine geometry/ outline, extent and worth of a mineral deposit using different geophysical and geostatistical techniques.

**Course Outline:**

Introduction to processes of formation of mineral deposits. Gathering and presentation of geological data, Exploration geophysics (gravity, resistivity, magnetism, and seismic methods), sampling methods including core drilling. Reserve estimation by classical methods. Geostatistical ore reserve estimation.

## **Lab Outline:**

1. Calculation of Sample Reduction error by Gy's Formula
2. Reserve estimation (Calculation of Tonnage and average grade)of an ore deposit by
  - a. Polygonal Method
  - b. Triangular Method
  - c. Inverse distance interpolation method
  - d. Contour Method
  - e. Cross Sectional Method
  - f. Geo-statistical Method
3. Resistivity surveys using resistivity measuring equipment.
4. Seismic surveys using seismograph

## **Recommended Text Books:**

1. Anthony Evans, Introduction to Mineral Exploration, May 1995
2. J.H Reedman, Techniques in Mineral Exploration
3. Isobel Clark, Practical Geo Statistics, 1979

## **Recommended Reference Books:**

1. Kearry, Mineral Exploration
2. Bateman, Economic Mineral Deposits
3. Peters, Mining Geology
4. McKinstry, Mining Geology
5. W.C. Peters, Exploration and Mining Geology, John Wiley & Sons, Inc., New York (1987)
6. Abid S. H. TLR on Mineral Exploration. 2000. Ministry of Education, Pakistan.

## **OPTIONAL COURSES/INTERDISCIPLINARY**

### **GEMOLOGY**

**3+1**

**Prerequisites:** none

**Knowledge Area / Sub Area:** Interdisciplinary / Optional II

### **Objective:**

To acquaint the students with the knowledge of identification of precious stones of Pakistan and to teach the techniques of polishing and cutting of these stones to make them value added gems.

### **Course Outline:**

Geology and exploration of gems, Gem producing countries of world, gem mining and its extraction, Gem storage, its proper identification and preventive measures of pilferage at mining sites, gem cutting and polishing techniques, identification techniques of gems for its quality. Gem pricing

and grading according to prevailing international standards, Pakistani gems and its quality, pricing and marketing.

### **Lab Outline:**

Based on theory

### **Recommended Text Books:**

1. Peter G. Read, Gemology, 3<sup>rd</sup> Ed. 2005

### **Recommended Reference Books:**

1. Cally Hall, Gemstones, 1994
2. M. O'Donoghue, Gems, 6<sup>th</sup> Ed., 2006

## **SOLUTION MINING**

**3+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary (Engineering Breadth) – Elective

### **Objective:**

To introduce the principles, strategies, practices and equipment related to this emerging mining method

### **Course Outline:**

Introduction, scope and applications of solution mining

**Physical and Chemical Amenabilities:** Depth, hydrostatic pressure, permeability of the deposit, the chemical nature of mineralizations, their dissemination in the ore body in relation of natural flow channels

**Laboratory and Field Testing:** Selective dissolution of mineralizations, factors effecting economic viability, preferred directions of lixiviant flows, lixiviant containment and recovery issues, solution chemistry and side reactions, batch and column leach testing, geochemical conditions of the formation

**Methods of Leaching and Equipment:** Operating regimes (acidic or alkaline), well-field design, well-testing, production strategy, operating and performance parameters, process hydraulics, submersible pumps, filters, well-linings

**Extraction Process:** Ion-exchange: principles, resins, equipment. Solvent Extraction

**Environmental Issues:** Impact Assessment, waste treatment, land reclamation, prevention and treatment of contaminated water

Case studies of sulfur, copper, uranium, gold and silver.

### **Recommended Text Books:**

1. R. W. Barlett, Solution Mining: Leaching and Recovery of Materials, 2<sup>nd</sup> Edition, 1998
2. W. J. Shlitt, D. A. Shock, Insitu Uranium Leaching and Ground Restoration. Society of Mining and Metallurgy, 1979

### **Recommended Reference Books:**

1. SME Mining Engineering Handbook, Hartman (Editor), AIME, 1994

## **INTRODUCTION TO GIS & REMOTE SENSING**

GIS Introduction, principles of GIS, Functional Subsystem, Raster Data Model, Vector Data Model, Attribute Data Model, Coordinate Systems Overview, Discrete Geo-referencing, Global Positioning Systems Overview, Projections and Transformations, Maps as Representations of the World, Data Transformation, Visualization of Spatial Data, Layers and Projections, Map Design Overlay Analysis, Spatial analysis, neighborhood function, Network and overlay analysis, buffering, Spatial Data Quality, Introduction to Remote Sensing-Basics of Remote Sensing and Photogrammetry, Data acquisition, image analysis, image classification, Sensor System, Platforms, Digital Image Processing, and Application etc with Case studies with use of software's to solve the geological problems.

Introduction to latest GIS software.

### **Recommended Books:**

1. Chakraborty & Sahoo. Fundamentals of Geographic Information System. Published by Viva books, 2009.

## **GROUND WATER ASPECTS IN MINING**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary – Optional II

### **Objectives:**

After the course the students should be able to:

- Understand the water cycle, water table and aquifers and equipotential surfaces
- Understand the fundamental principles for ground water flow and properties of aquifers
- Prepare and analyze the flow nets
- Determine parameters of aquifers i.e., storativity, specific storage, yield

through “Pumping Test”

- Design a drainage system and selection of the pump for general mining operations and dewatering

### **Course Outline:**

**The Water Cycle:** Processes, Equipotential Surfaces, Artesian Well, Residence Time

**Fundamentals of Fluid Flow:** Darcy’s Law, Specific Discharge and Hydraulic Gradient, Hydraulic Head and Fluid Potential, Hydraulic Conductivity, Permeability, Homogeneity and Anisotropy of Hydraulic Conductivity, Porosity & Void Ratio

**Flow Nets:** Piezometer and Piezometer Nests, Continuity Equation, Laws & Construction of Flow Nets

**Water Table & Aquifers:** Unsaturated Flow and Water Table, Moisture content, Negative Pressure heads and tensiometers, Perched and Inverted Aquifers, Aquifers and Aquitards, Steady State Flow and Transient Flow, compressibility and Effective Stress, Compressibility, Transmittivity, Storativity and Specific storage and Yield of Aquifers

**Pumping Test:** Transient Flow Equation, Radial Flow to a Pump, Pumping Test

**Drainage:** Reciprocating & centrifugal Pumps, Pumping Laws, Characteristic curves of a pump. Selection & Design of Drainage Systems for Mines, dewatering of mines. Water problems associated with mining

### **Lab Outline:**

1. Laboratory measurement of Parameter of Soil samples
  - a. Hydraulic conductivity & Permeability
  - b. Anisotropy & Homogeneity
  - c. Grain Size Analysis, Porosity & Void Ratio
2. Pumping Test
  - a. Measurement of aquifer properties through pumping test
  - b. Influence of Pumping on the aquifers
  - c. Measurement of Storativity & Transmittivity of aquifers
3. Characteristic Curves of centrifugal pumps
4. Design of drainage and dewatering systems for mines

### **Recommended Text Books:**

1. Allan Freez and Cherry, Ground Water, Prentice Hall Publishers, 1979
2. Robert Stefanko, Coal Mining Technology: Theory and Practice, 1983

### **Recommended Reference Books:**

1. C W Fetter, Todd Rayne, Applied Hydrogeology, 3<sup>rd</sup> Ed., Macmillan Publishing Company, New York

2. Christopher Bise, Mining Engineering Analysis
3. H.M. Raghunath, Ground Water, 3<sup>rd</sup> Ed., New Age Publishing Company, 2007.

## **INDUSTRIAL MINERALS**

**3+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Inter disciplinary (Optional – I)

### **Objective:**

To impart knowledge about the industrial minerals for economic reasons and export potential particularly with reference industrial minerals of Pakistan.

### **Course Outline:**

Introduction to Industrial minerals and brief geology, types of deposits, occurrences, exploration, mining, beneficiation, utilization and marketing of the following minerals:

Lime stone, silica sand, dolomite, magnesite, phosphate, barite, China clay, other clays, building stones: marble, limestone, granite, quartz, slate, sandstone, soap stone, gypsum, evaporates, asbestos, fluorite and feldspar.

### **Recommended Text Books:**

1. F. M Lea, *Chemistry of Cement and Concrete, 2004*, Butterworth-Heinemann.
2. A. M. Bateman, *Economic Mineral Deposits*, John Wiley & Sons, 1981
3. Mineral Directory of Pakistan – GSP Quetta.
4. Z. H. Syed, *Material of construction*

### **Recommended Reference Books:**

1. Reports about Industrial minerals from GSP and other organizations.

## **FINITE ELEMENT ANALYSIS**

**3+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary – Optional I

### **Objective:**

The aim of this course is provide to the students an introduction to the finite element method from an engineering point of view.

### **Course Outline:**

Basic concepts of FEM



Introduction to variational methods of approximation: Ritz Method, The Method of Weighted Residuals

One-dimensional second order and fourth order equations: discretization, variational formulation, FEM formulation, Assembly, Imposition of boundary conditions, Post-processing of the solution

Isoparametric elements and numerical integration

Two-dimensional second order equations involving multivariable equations: Plane elasticity, incompressible fluid flow problems

Computer implementation of FEM solutions

### **Recommended Text Books:**

1. J. N. Reddy, An Introduction to Finite Element Method, McGraw Hill, 1993
2. Zienkiewicz, Finite Element Method, Butterworth-Heinemann; 6<sup>th</sup> Edition (March 19, 2000)

### **Recommended Reference Books:**

1. Cook, Concepts and Applications of Finite Element Method, Wiley, 2001.

## **MINING LAW**

**2+0**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary – Optional I

### **Objective:**

The objective of this course is to acquaint the mining engineering students with the mining laws being practiced in Pakistan as well as their implementation by the law enforcement agencies in the mining industry.

### **Course Outline:**

- The Mines Act, 1923.
- The Coal Mines Regulations, 1926.
- The Metalliferous Mines Regulations, 1926.
- The Mining Board Rules, 1951.
- Electricity rules relating to the mines
- The Consolidated Mines Rules, 1952.
- The Competency Certificates Examination Rules, 1981.
- The Central Rescue Station (Coal Mines) Rules, 1986.
- Introduction to the Pakistan Mining Concession Rules, 2002.

### **Recommended Text Books:**

1. M. Shafi and P. Shafi, Mining Labour Code, Bureau of Labour

- Publications, 2006 (Amended & Updated).
2. The Mining Concession Rules, 2002.
  3. M. Amir Sohail, Electricity Laws in Pakistan, Khyber Law Publishers, Lahore, 1999 (Chapter-X)

## **STRATA CONTROL**

**3+0**

**Prerequisites: None**

**Knowledge Area / Sub Area:** Interdisciplinary – Optional I

### **Objective:**

The aim of this course is provide to the students an in-depth view of ground control problems and their solutions for both surface and underground situations.

### **Course Outline:**

Design of gallery support: wooden sets, steel arches

Design of face support – concept of front and back abutment pressures in long wall faces

Design of section pillars, gate entry pillars, and barrier pillars

Pressure Arch Theory and Rock Bolting Systems and Design

Slope Stability Methods using Anchors and Wire Netting

Design and application of stowing systems

Subsidence prediction, prevention, control and remediation

Prediction and prevention of occurrence of rock bursts and coal bumps

### **Recommended Text Books:**

1. Bieniawski, Strata Control, John Wiley & Sons, 1987
2. Syd S. Peng, Coal Mine Ground Control, John Wiley & Sons, 1978
3. Syd S. Peng, Surface Subsidence Engineering, Society for Mining Metallurgy; 1 edition (March 1, 1992)
4. Hoek and Bray, Rock Slope Engineering, CRC Press, 1981
5. Syd and Peng, Longwall Mining, John Wiley & Sons, 1984

### **Recommended Reference Books:**

1. Holdings: Subsidence Engineer's Handbook, (Latest Edition)
2. FWA Rock Slope Engineering Course Manual

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary / Optional II

**Objective:**

To train students in theoretical and practical aspects of mineral and ore identification.

**Course Outline:**

**Crystallography:** Introduction to crystallography and crystal chemistry. Characteristics and systematic classification of crystal systems.

**Mineralogy:** Study of physical, chemical and optical properties of minerals, Classification of minerals and study of common rock forming, ore forming and industrial minerals. Identification of minerals with the help of their physical properties. Megascopic and microscopic study of common minerals and ores.

**Petrology:** The nature, composition and classification of igneous, sedimentary and metamorphic rocks. Megascopic and microscopic study of common igneous, sedimentary and metamorphic rocks. Textural and physical properties of rocks (porosity, permeability, hardness, strength etc.) relevant to engineering problems.

**Lab Outline:**

1. Identification of igneous rocks using thin and polished section studies
2. Identification of sedimentary rocks using thin and polished section studies
3. Identification of metamorphic rocks using thin and polished section studies
4. Microscopic identification of minerals using thin and polished section studies
5. Chemical analysis of minerals using XRD
6. Chemical analysis of minerals using XRF
7. Chemical analysis of minerals using Atomic Absorption Spectrophotometer
8. Determination of mineral properties such as hardness, specific gravity, and refractive index.

**Recommended Text Books:**

1. Dana's Manual of Mineralogy, 21<sup>st</sup> Edition, Wiley, 1998
2. H. H. Read, Rutley's Manual of Mineralogy, 1981
3. Alfred Harker, Petrology for Students, General Books, 2009.

## **Recommended Reference Books:**

1. Paul Kerr, Optical Mineralogy, McGraw-Hill, 1977.
2. D. Perkins, K. Henke, Minerals in Thin Sections, 2<sup>nd</sup> Ed. Prentice Hall, 2004.
3. W. D. Nesse, Introduction to Optical Mineralogy, Oxford University Press, 2003.

## **DRILLING TECHNOLOGY**

**3+1**

**Prerequisites:** None

**Knowledge Area / Sub Area:** Interdisciplinary / Optional II

### **Objective:**

This course describes the drilling rigs of different types, their systems and the mechanism of drilling used for mining and oil well drilling. After successful completion of this subject the students would become familiar with the different types of drill rigs, types of bits used for exploratory drilling which covers rock drilling as well as oil well drilling.

### **Course Outline:**

**Rock Drilling:** Drilling methods; Classification of methods; Basic systems of drilling rig. Field of application. Mining purposes.

**Mining Drills:** Rotary type drills; wagon, crawler, drifters, surface rigs, coal drills.

**Well Drilling:** On-shore, and Off shore drilling; Well Drilling machinery; Rig components and their functions of rotary drilling; Types of drilling fluids; Fishing; Causes of fishing; Fishing tools, procedures; directional drilling; Diamond drilling ; Blowout, kick, and its causes; Killing procedures; Prevention of blowout; Blowout control equipments; Drill cost calculations; Casing and cementing of wells; Bore hole logging to deduce lithology; porosity and formation fluids; Sampling and coring; rock strength and drill ability; Factors affecting the penetration rate; Planning and computations of drilling project cost.

### **Lab Outline:**

1. To measure the viscosity, gel strength and pH of mud.
2. Study of rotary drilling rig.
3. Study of cable tool percussion rig.
4. Study of wire line core barrel
5. Study of various types of bits

## **Recommended Text Books:**

1. C. P. Chugh, Drilling Technology, 1985.

2. G. K. Pradhan, Ajoy K. Ghose, Drilling and blasting, MINTECH Publications, 1996.

## **MINERAL PROCESSING – I**

**3+1**

**Knowledge Area / Sub Area:** Major Based Core (Breadth)

### **Objective:**

To acquaint the students with the principles and practical knowledge of comminution of ores, and the physical concentration processes in order to obtain value-added mineral products.

### **Course Outline:**

**Introduction:** Economic justification and scope of mineral processing for upgrading ores and minerals, types of flow sheets, liberation and concentration.

**Communication:** Definition and objectives of crushing and grinding. Conventional and non-conventional methods of crushing and grinding. Laboratory and industrial crushers and grinding mills, grinding circuits. Use of micro waves in crushing.

**Laboratory Sizing and Industrial Screening:** Laboratory sizing, wet and dry sieve analysis, size distribution, sub-sieve techniques, movement of solid in fluids, Stokes and Rittinger laws, industrial screening, performance of screens, types of screens, screening surfaces.

**Classification:** Principles of classification, free and hindered settling ratios, hydraulic and mechanical classifiers. Principles of cyclones and hydrocyclones.

**Gravity Concentration:** Principles of gravity concentration, gravity separators, jigging, Humphrey's spirals, flowing film concentration, tabling, concentration ratio, grade recovery relationship; heavy fluid and heavy media separation (H.M.S).

**Metallurgical Accounting and Control:** Sampling and weighing the ore, moisture and assay sampling, on stream analysis automatic control in mineral processing.

### **Lab Outline:**

1. Sampling on a given lot of ore using Coning and Quartering and mechanical samplers
2. Use of jaw crushers for crushing limestone and gypsum
3. Use of Rolls for closed-sized crushing for iron ore and chromite
4. Use of ball-mill and rod-mill for grinding of a given ore sample

5. Wet and dry sieve analysis and graphical presentations of size distribution data.
6. Determination of Bond's Work Index using ball mill or Work Index equipment
7. Experimental determination of free and hindered settling ratios
8. Operation of air and water cyclones
9. Concentration of a given sample ore on Laboratory Jig
10. Concentration of a given sample ore on Shaking table
11. Float-Sink Analysis for a coal sample

### **Recommended Text Books:**

1. B. A. Wills, Mineral Processing Technology, 7<sup>th</sup> Ed., 2006
2. S. K. Jain, A. A. Balkema, Ore Processing, 1987.

### **Recommended Reference Books:**

1. Spotiswoods and Kelly, Mineral Processing, 1986
2. SME Mineral Processing Handbook, 1990
3. Abid S. H., TLR on Mineral Processing. 2000. Ministry of Education. Pakistan.

## **MINERAL PROCESSING – II**

**3 +1**

**Prerequisites:** Mineral Processing-I

**Knowledge Area / Sub Area:** Major-based / Depth

### **Objective:**

To acquaint the students with the practical knowledge of concentration processes of ores and minerals as used in industry for producing commercial products.

### **Course Outline:**

**FLOTATION:** Flotation, chemical and physical aspects, process, uses with examples. Flotation reagents, absorption mechanism, types and applications of reagents, and differential flotation of complex ores.

**FLOTATION MACHINIES:** Laboratory and industrial flotation machines, pneumatic and mechanical types. Column flotation

**FLOCCULATION AND DISPERSION:** Introduction to electrical double layer theory, flocculation, coagulation and dispersion phenomena, mechanism and application

**MAGNETIC AND ELECTROSTATIC SEPARATION:** Magnetic, electrostatic and electro-dynamic separation: principles, machines and applications.

**NON-CONVENTIONAL PROCESSES:** Treatment of minerals by non-conventional processes such as color sorting, radiation sorting, and heating.

**SOLID LIQUID SEPARATION:** Separation of solids from fluid, dewatering, filtration, drying, and equipment used for solid-liquid separations.

**AUXILIARY OPERATIONS AND FLOW SHEETS:** Auxiliary operations plant flow sheets and circuit diagrams.

**COAL PREPARATION:** Introduction to coal cleaning and coal preparation

**Lab Outline:**

1. Synthesis of xanthate collectors
2. Flotation of a given ore sample
3. Flotation of a coal sample from Pakistan
4. Flocculation of a sample using synthetic/ polymer flocculants
5. Dispersion of a sample using suitable dispersants
6. Removal of impurities using dry / wet magnetic separators from a sample of industrial mineral
7. Concentration of an ore using dry / wet magnetic separators
8. Removal of impurities from a given ore sample using electrostatic separator

**Recommended Text Books:**

1. B.A. Wills, Mineral Processing Technology, 7<sup>th</sup> Ed.
2. S. K. Jain, A. A. Balkema, Ore Processing

**Recommended Reference Books:**

1. Spotiswoods and Kelly, Mineral Processing
2. SME Mineral Processing Handbook, Society of Mining Engr. Of AMIMMPE Inc. New York, 1986
3. R. K. Senha, Industrial Minerals, Aa Balkema, 1983
4. Crozier, Flotation Pergamon, 1992
5. Flotation: A. M. Gaudin memorial volume, Volume 1, American Institute of Mining, Metallurgical, and Petroleum Engineers, 1976, Digitized in 2007.

# Scheme of Studies

## for ME/MS (Mining Engineering)

### ME/MS in Mining Engineering

The award of ME/MS degree requires successful completion of thirty (30) credit hours of graded post-graduate level courses and successful completion of six (6) credits hours of thesis research. The requirements for the ME/MS degree are as follows:

#### Eligibility for Admission:

- BE/BS Engineering (Mining, Geological, Petroleum, Geotechnical)
- Minimum GPA as per university policy
- GRE General/NTS (min 50% score) or alternative examination stipulated by Higher Education Commission of Pakistan

#### Course Requirement:

##### Core Courses:

At least six of the following courses are to be taken by the students in the field of specialization concerned.

Course Title	Credit Hours	Course Title	Credit Hours
Core Course – I	3/4	Core Course – XI	3/4
Core Course – II	3/4	Core Course – XII	3/4
Core Course – III	3/4	Core Course – XIII	3/4
Core Course – IV	3/4	Core Course – XIV	3/4
Core Course – V	3/4	Core Course – XV	3/4
Core Course – VI	3/4	Core Course – XVI	3/4
Core Course – VII	3/4	Core Course – XVII	3/4
Core Course – VIII	3/4	Core Course – XVIII	3/4
Core Course – IX	3/4	Core Course – XIX	3/4
Core Course – X	3/4	Core Course – XX	3/4

**Elective Courses:** At least two of the following courses are to be taken by the students on the advice of course supervisor

Course Title	Credit Hours	Course Title	Credit Hours
Elective Course – I	3/4	Elective Course – VI	3/4
Elective Course – II	3/4	Elective Course – VII	3/4
Elective Course – III	3/4	Elective Course – VIII	3/4
Elective Course – IV	3/4	Elective Course – IX	3/4
Elective Course – V	3/4	Elective Course – X	3/4



**Thesis requirement:**

ME/MS Thesis (06 credit hours) is compulsory.

**Note:**

The syllabus of each core and elective courses will be prepared by respective Board of Studies of University/Institution.

## RECOMMENDATIONS

1. Courses prepared by the Committee are given in the semester system format. It may be adopted by the respective university according to their own regulations in vogue.
2. The field trainings, industrial visits and tours to the mining and industrial sites for students are essential.
3. Teacher training programme and refresher courses should be arranged to train teachers with state of the art mining techniques.
4. Teachers should be encouraged to write manuals both for theory and practical with latest knowledge from books and websites.
5. Mining soft-wares be made available related to the subjects and the expertise be developed in the universities.
6. Latest editions of text books and the reference books should be available in the departmental seminar library as well as main library. Special funding be provided by HEC.
7. Audio Visual Aids (multimedia) and smart boards be provided in every lecture hall.
8. Grading Criteria of HEC should be followed
9. The committee noted with concern that the recommendations given in the NCRC meeting held in 2003 & 2008 are partially full filled. The committee has suggested that in order to implement HEC guidelines all the recommendations should be followed.