Curriculum Division, HEC

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Composed by: Mr. Zulfiqar Ali, HEC, Islamabad
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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

STAGE-I

STAGE-II

STAGE-III

STAGE-IV

CURRI. UNDER
CONSIDERATION

COLLECTION OF EXP
NOMINATION UNI,
R&D, INDUSTRY &
COUNCILS

CONS. OF NCRC.

PREP. OF DRAFT BY
NCRC

CURRI. IN DRAFT
STAGE

APPRAIAL OF 1ST
DRAFT BY EXP

FINALIZATION OF
DRAFT BY NCRC

PRINTING OF CURRI.

IMPLE. OF CURRI.

ORIENTATION
COURSES BY
LI, HEC

FINAL STAGE

PREP. OF FINAL
CURRI.

COMMENTST

REVIEW

FOLLOW UP

QUESTIONNAIRE

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.

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

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

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

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

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

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

<table>
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<tr>
<th>Knowledge Area</th>
<th>Subject Area</th>
<th>Name of Course</th>
<th>Lec CH</th>
<th>Lab CH</th>
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### Interdisciplinary Optional Courses

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<th>Courses on Social Sciences (Optional I &amp; II)</th>
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<td>Groundwater Aspects in Mining</td>
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<td>Industrial Minerals</td>
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<td>Finite Element Analysis</td>
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<td>Drilling Technology</td>
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<td>Strata Control</td>
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<td>Mineralogy and Petrology</td>
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<td>Logic &amp; Critical Thinking</td>
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<td>Understanding Psychology and Human Behaviour</td>
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<td>Professional Ethics</td>
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<td>Organizational Behavior</td>
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<tr>
<td>Introduction to Sociology</td>
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<tr>
<td>Any other course</td>
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### 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

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<td>Engineering Drawing and Graphics</td>
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<td><strong>13+5 = 18</strong></td>
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<td>Mining Engineering Fundamentals</td>
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<td>Islamic Studies/ Ethics</td>
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<tr>
<td>English-I (Comprehension and Composition)</td>
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<td>Maths-III (Linear Algebra)</td>
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<td>Pakistan Studies</td>
<td>2+0</td>
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<td>Mechanics of Materials</td>
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<td>Coal Technology / Mineral Processing-II / Tunnel Engineering</td>
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<td>First-Aid Training (Certification)</td>
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**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.**
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
b) Writing

c) Reading/Comprehension

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 recourses

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

Note: documentaries to be shown for discussion and review

Recommended Text Books:
a) Grammar
b) Writing

c) Reading
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


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**
   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:
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
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,”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
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 subordinates 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:

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:
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:
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:
PROFESSIONAL ETHICS 3+0

Prerequisites: N/A

Knowledge Area / Sub Area: Social Science

Objectives:
This course introduce 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:


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.


The Role of Opportunity and Conflict: Opportunity, Conflict.


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:

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:
INTRODUCTION TO SOCIOLOGY

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

**Recommended Text Books:**

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

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:**

3. Vogely, H. S., Economics of Mineral Industries. Mud Series, AIME

**Recommended Reference Books:**

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 R3, planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spheres, spherical trigonometry.

Recommended Books:

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, Eugen 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:**

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**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:

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


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:

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

**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:
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. Vogal, Inorganic Qualitative Analysis.

Recommended Reference Books:
1. Adamson, Physical Chemistry
2. Warrner 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


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\textsuperscript{th} Ed., 2005

Recommended Reference Books:
1. Epperson, An Introduction to Numerical Methods and Analysis, 1\textsuperscript{st} Ed., 2002

**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. 4th 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:


Recommended Text Books:

Recommended Reference Books:
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:

Recommended Reference Books:
1. SME/AIME Mining Engineering Handbook Vol. I and II.

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 quire 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, 1st and 3rd 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 1st and 3rd 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:**


**FLUID MECHANICS**

**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

**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:**

**Recommended Reference Books:**
2. Anthony Esposito, Fluid Power with Applications

**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; poison’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 selection modules; 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:**
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
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.
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. Admirality, 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

**Prerequisities:** 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:
3. Hudson and Harrison, Engineering Rock Mechanics

Recommended Reference Books:
1. Hoek, Practical Rock Engineering (www.rocksciences.com)
2. Obert and Duvall, Rock Mechanics and the Design of Structure in Rock
UNDERGROUND MINE DESIGN

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:
2. Peng, Coal Mine Ground Control

Recommended Reference Books:
1. R. S. Lewis and Clark, Elements of Mining, John Wiley and Sons.
3. Syd and Peng, Longwall Mining

SURFACE MINE DESIGN

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. PfLeider, Surface Mining
2. B. A. Kennedy, Surface Mining, SME, 1990
4. James W. Martin, Surface Mining Equipment

Recommended Reference Books:
1. B. A. Kennedy, Surface Mining, 2nd Ed., SME
2. W. Hustrulid and M.Kuchta, Open pit Mine Planning and Design, Vol. II (published by A. A. Balkema)

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.

Communition: 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:**
2. S. K. Jain, A. A. Balkema, Ore Processing, 1987

**Recommended Reference Books:**
1. Spotiswoods and Kelly, Mineral Processing, 1986  
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:**
Recommended Reference Books:
1. Introduction to Mine Surveying by Stanley
2. Surveying Handbook by Russell Charles Brinker

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

Recommended Reference Books:
2. Rune Gustafsson, Swedish Blasting Technique. Published by SPI, Gothenburg, Sweden
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.
6. Measurement of H$_2$S using Personal Monitor & Alarm for H$_2$S.
8. Measurements of Carbon Mono oxide (CO)
9. Measurement of Nitrogen oxide (N$_2$O)
10. Operation and usage of Self Rescuer.
Field Trip:

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

Recommended Text Books:

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

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 understand 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:
3. R. Stefanko and C. J. Bise, Coal Mining Technology: Theory and Practice (The Latest Edition),

Recommended Reference Books:

TUNNEL ENGINEERING

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:**

**Recommended Reference Books:**

**MINE VENTILATION**

**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.


**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 descentional air flow.

**Recommended Text Books:**

**Recommended Reference Books:**
1. Pennman, Mine Ventilation
3. A. Roberts, Mine Ventilation

**MINE POWER, DRAINAGE AND MATERIAL HANDLING**

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:
3. Howard L Hartman, Introductory Mining Engineering

Recommended Reference Books:
1. R.L. Peurifoy, Construction Planning Equipment and Methods, 3\textsuperscript{rd} Ed.

MINERAL EXPLORATION \hspace{1cm} 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:
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:
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

OPTIMAL 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, 3rd Ed. 2005

Recommended Reference Books:
1. Cally Hall, Gemstones, 1994

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:**

**Recommended Reference Books:**
1. SME Mining Engineering Handbook, Hartman (Editor), AIME, 1994

**INTRODUCTION TO GIS & REMOTE SENSING**


**Recommended Books:**

**GROUND WATER ASPECTS IN MINING**

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:**


**Recommended Reference Books:**

INDUSTRIAL MINERALS  

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:  
4.  Z. H. Syed, *Material of construction*

Recommended Reference Books:  
1.  Reports about Industrial minerals from GSP and other organizations.

FINITE ELEMENT ANALYSIS  

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:**

**Recommended Reference Books:**

**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:**

STRATA CONTROL 3+0

Prerequisites: None

Knowledge Area / Sub Area: Interdisciplinary – Optional I

Objective:

The aim of this course is to provide students with 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:
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)

Recommended Reference Books:
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:
Recommended Reference Books:

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:
MINERAL PROCESSING – I

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

Objective:
To acquaint the students with the principles and practical knowledge of communication 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.


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:**

**Recommended Reference Books:**
1. Spotiswoods and Kelly, Mineral Processing, 1986

**MINERAL PROCESSING – II**  

**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, 7th Ed.
2. S. K. Jain, A. A. Balkema, Ore Processing

**Recommended Reference Books:**
1. Spotiswoods and Kelly, Mineral Processing
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.

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

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<td>Elective Course – I</td>
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<tr>
<td>Elective Course – X</td>
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</table>
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.