

**PART B – MINING II: MINING TECHNICAL SERVICES. (METAL)**  
(Separate papers for metal & coal - priorities determine)

**A. Sustainable development.**

1. **Key aspects of sustainable development** – role of mining in the community, environmental care, due diligence, social responsibility, the role of ethics, operating within the legal framework, influencing the legal process
2. **Due diligence**  
Application of due diligence, risk assessment and risk management, International Standards, audits, competent persons, Codes of Practice in business, quality assurance
3. **The mining environment**  
Environmental Impact Assessments, environmental protection and management reports, rehabilitation provisions, threats to the environment from underground and surface mining and means of managing the risks, interested and affected parties, legal requirements, Ministries involved, effects of litigation  
Pollution products and their effect on the human being – the natural environment  
Economics of minimizing the pollution products. Control of pollution and environmental conditions – standards (legal and moral) – measurements with and the use of instruments – reports and recommendations.  
Monitoring systems – subsidence, water pollution, dust, noise, toxic waste  
Means of treatment of pollutants  
Environmental protection.
4. **Economic impact of mining** – the Minerals Policy Document, economics of mining, effects on community before, during and after mining, taxation, levies, education and training, employment.
5. **Selected technical literature**  
Minerals Policy document: Department of Minerals and Energy  
Environmental Management in South Africa: R.F.Fuggle, R.A.Rabie, Juta & Co Ltd., 1994

**B. Environmental Engineering.**

1. **Airflow.**  
All aspects of airflow on mines - control - calculations - pressure surveys - fans and fan curves - fan laws - economics of fan and layout selection.  
Modeling and simulation techniques
2. **Detail of pollution and pollution products**  
Gasses and dust. Light and illumination. Sound and noise. Water and purity. Fires and explosions. Heat and moisture – coolers and cooling. Sanitation. Ventilation planning, plans and ventilation equipment. Legal and threshold limits, pathological effects and treatment.  
Radiation, radon daughters – monitoring control.
3. **Heat and humidity , temperature and cooling.**  
Refrigeration plants – distribution of cooling – heat sources / cooling capacity –heat and moisture – psychometry. Pathological effects and treatment, threshold and legal limits. Economics of cooling.
4. **Risk assessment and analysis**  
Assessment of risks, audits, monitoring systems. Risk assessment applied to design. Management of risks. Risks associated with different mining methods, minerals, substances, old areas, etc .
5. **Roles of management**, employees and environmental personnel in managing environmental risks.
6. **Selected technical literature.**  
Environmental engineering in South African Mines : The Mine Ventilation Society of South Africa, 1989.

**C. Risk Management.**

1. **Theory and application of risk management**

Baseline, continuous and issue based risk assessments. How they are applied in technical areas.  
Systems used in each area.

Risk management techniques. Means of managing, minimizing or eliminating risk.

Computer methods and simulations.

The Manager's role in risk management. Due diligence.

**2. Emergency preparedness.**

Risk assessments translated into emergency plans. Monitoring systems, measurements.

Competent people, emergency teams, control rooms, responsibility of appointed persons.

Contingencies to be prepared for. Impact and inclusion in mine design.

**3. Emergency management.**

Fires and spontaneous combustion – explosions – flooding – seismic events and major rockfalls -  
labour unrest – emergency services – protection equipment and procedures. Prevention and  
dealing with these hazards e.g. stone dusting and stone dust barriers.

Emergency control rooms, procedures and responsibilities. Assessment of damage, safety of  
persons.

## **D. Rock Engineering**

**1. Theory of strength of materials** applied to rock masses.

Basic Rock Engineering – stress, strain, compressive, tensile, shear strength, uniaxial and triaxial  
strength. Poisson's ratio, Young's Modulus. Convergence, elasticity, lithostatic and hydrostatic  
pressure.

Design criteria for workings – ERR, elastic convergence, leads/lags, rock mass classifications.

Effects of geology – seismicity, ESS, dome failure, geotechnical considerations of orebody and  
sidewalls and rock slopes.

Rock characteristics as a support material.

Characteristics of other support unit materials – timber, steel etc. Measurement and  
instrumentation.

**2. Excavation design**

Tunnels, stopes and large excavations – design criteria, rules of thumb, rationale for design (from  
risk assessment).

Design process – responsibilities, modelling methods, factors to be taken into account.

Mining sequences – reasons for choices.

Deep level, intermediate and shallow for gold and platinum, also for massive mining and opencast  
mining.

**3. Support units**

Pillars, packs, props, fill, pillar design – especially coal.

Development support units – yielding and non-yielding.

Design criteria – support resistance, energy absorption.

The need for active or passive support.

Dynamic and static loading.

Regional, local and face area support – purposes, differentiation, interaction and examples.

Permanent and temporary support – examples and interdependence.

Quality assurance in support design, production and installation

Design and examples of support systems for any application.

Latest developments in support design.

Economics of support design and system application – cost benefit analysis.

**4. Regional support**

Purpose of regional support in mines – deep and shallow

Design of regional support systems – design criteria, convergence, foundation failure of pillars,  
effects on footwall development layouts.

Mixed systems, pillars, fill systems

Pillar design

Regional support in massive mining – crown pillars, filling systems for cut and fill and drift and  
fill, surface subsidence effects.

- Economic of regional support, extraction ratios, comparative costs
5. **Risk assessment and risk management**  
 Elements and areas of risk in rock engineering  
 Risk assessment processes in rock engineering – baseline, continuous, issue based  
 Risk assessment systems – audits, mining alert level, panel ratings, modelling, simulations, seismic monitoring and analysis, closure/rock movement/direct measurement, in-situ stress, rockmass condition etc.  
 Risk management – designs, layouts, quality assurance and control of support systems, role of the rock engineer and his recommendations.  
 Management decision making using RE systems available
  6. **Rock Mechanics of shaft pillars and their removal**  
 Risk assessment  
 Designs, design criteria, extraction sequences, support systems – reasons and benefits  
 Economic assessments, risk/reward ratios  
 Case studies of pre-extraction and post extraction methodologies  
 Monitoring systems
  7. **Seismology**  
 Cause and effect of seismic events  
 Means of amelioration of effects of rockbursts and rockfalls  
 Monitoring systems – purpose, operation and utilisation of information  
 Triggerring, pre-conditioning, alert/alarm/scram  
 Local and regional networks  
 Effect of seismicity on massive and opencast operations
  8. **Slope stability**  
 Basic terminology – slope angles, benches, berms  
 Factors affecting slope stability  
 Design criteria used  
 Monitoring systems  
 Blasting methods
  9. **Selected technical literature**  
 Handbook on hard-rock strata control: A J S Spearing, S.A.I.M.M. 1995  
 An Industry Guide to Methods of Ameliorating the Hazards of Rockfalls and Rockbursts: Chamber of Mines 1988

## **E. Technology**

1. **Computer applications in mining**  
 Introduction to computer programmes for mine design, rock mechanics, environmental control, risk assessment, process monitoring (surface and underground), planning  
 Simulation programmes used for design, airflow, heatflow, process control  
 The purpose of management information systems and their role for management  
 Use of information systems in risk management  
 Data logging and its advantages
2. **Latest technology**  
 Developments in technology from recent papers  
 Effects on safety and productivity  
 Economic justification  
 Systems engineering of new technology implementation
3. **Selected technical literature**  
 Mine Managers Association papers

## **F. Mineral Resource Management**

1. **What is MRM?**  
 Economic definition and potential of ore  
 Planning for optimal extraction

Tools and systems for MRM  
Feasibility studies and valuations  
Cutoff grades and profitability  
Mine design economics  
Effects of new technology on value

**G. Mine economics**

1. Sampling methods - Basic principles and definitions  
Gold mine underground  
Other ore bodies including coal  
Shafts  
Dumps  
Stockpiles
2. Averaging and weighing of sampling results:
  - Regular and irregular sampling interval
  - Weighing by length, area or mass
  - Tonnage calculations - Sampling reports
3. Ore-flow tabulation for gold mines underground to final discard - Monthly returns and control factors - Sorting of ore.
4. Ore-flow tabulation for non gold mines especially collieries (underground and opencast).
5. Pay limit calculations - overall, stoping, incremental, development, sub-economic, marginal differential and operating pay limit.
6. Grade control - Survey discrepancy (sources and effect) - Quality control - Manipulation of grade (planning for required grade, stoping widths and waste, rescue mining) - Gold accounting.
7. Forecasting and life of mine calculations. Short and long term planning. Life of mine estimates (gold, coal, base mineral, etc.) Revenue and cost estimations.
8. Geostatistics - introduction to the use of statistical techniques in mine valuation.
9. Washability curves - proximate analysis - consistency bands - mineral reserves.