



Mining Engineering – Mineral

Economics

Full Marks: 100 Time: 3 Hours

Instructions:

Attempt ALL questions.

Each question carries 10 marks

Assume suitable data wherever necessary and clearly state your assumptions.

Q1. Mine Project Evaluation and Investment Decisions (10 Marks)

(a) Define Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period in the context of mine investment.

(b) A manganese ore project requires an investment of ₹10 crore and generates annual cash inflows of ₹3 crore for 5 years. Compute NPV and IRR at a 10% discount rate.

(c) Discuss how these parameters influence mining investment decisions.

Q2. Mine Life and Ore Reserve Valuation (10 Marks)

(a) Explain the importance of ore reserve classification (proved, probable, possible) in mineral valuation.

(b) Describe methods of ore reserve valuation – e.g., Cost Approach, Market Approach, and Income Approach.

(c) Calculate the economic life of a mine producing 200,000 tonnes/year with 4 million tonnes of proven reserves.

Q3. Cost Estimation and Break-Even Analysis (10 Marks)

(a) Differentiate between fixed, variable, and semi-variable costs in mining operations.

(b) Define break-even point and explain its significance for open-pit mine design.

(c) A mine has fixed cost ₹30 million/year and variable cost ₹2,000 per tonne. If selling price is ₹3,000 per tonne, calculate break-even output.

Q4. Mineral Pricing and Market Mechanisms (10 Marks)

(a) Discuss how international mineral pricing is determined for major commodities like coal, copper, and iron ore.

(b) Explain the role of London Metal Exchange (LME) and Indian Bureau of Mines (IBM) in mineral price reporting.

(c) Describe the difference between administered pricing and market-based pricing in mineral trade.

Q5. Taxation and Royalty in the Mining Sector (10 Marks)

(a) Discuss different types of mineral taxes, royalties, and cesses applicable to mining projects in India.

(b) What are the implications of ad valorem royalty versus unit-based royalty?

(c) Explain how taxation policies influence investment attractiveness in the mining industry.

Q6. Mine Closure and Financial Assurance (10 Marks)

(a) Explain the concept of mine closure planning and its importance in mineral economics.

(b) Discuss financial instruments like mine reclamation bonds and closure cost provisioning.

(c) Prepare a brief cost model for estimating mine closure liability for a medium-scale manganese mine.

Q7. Risk and Uncertainty in Mineral Projects (10 Marks)

(a) Explain major sources of economic uncertainty in mining projects.

(b) Describe how sensitivity analysis and scenario analysis are used for risk evaluation.

(c) Given that project NPV = ₹500 million, determine sensitivity of NPV to $\pm 10\%$ change in selling price and operating cost.

Q8. Mine Financing and Capital Budgeting (10 Marks)

(a) Differentiate between equity financing, debt financing, and joint venture financing in mining.

(b) Explain how capital budgeting techniques are applied in mine development projects.

(c) Describe the role of financial institutions and international funding agencies (like World Bank, IFC) in mining project finance.

Q9. Resource Rent and Economic Sustainability (10 Marks)

(a) Define resource rent and explain its importance in sustainable mineral resource management.

(b) Discuss the concept of Hotelling's Rule for exhaustible resource pricing.

(c) How can governments ensure inter-generational equity in resource utilization through fiscal policies?

Q10. Mineral Policy and Economic Reforms (10 Marks)

(a) Summarize key economic reforms introduced under the MMDR Act (1957) and its amendments (2015, 2021).

(b) Evaluate how mining auctions have affected state revenues and private sector participation.

(c) Suggest policy measures to enhance economic efficiency and transparency in mineral allocation and production.

Model Answer & Marking Guide – Mineral Economics (Mining Engineering)

 Total Marks: 100  Duration: 3 Hours

Q1. Mine Project Evaluation and Investment Decisions (10 Marks)

Answer Outline:

(a) Definitions (3 marks)

NPV: Present value of future cash flows minus initial investment.

Payback period: Time required to recover investment from cumulative cash inflows.

(b) Example Calculation (4 marks)

Investment = ₹10 Cr; Cash inflow = ₹3 Cr for 5 years; Discount rate = 10%.

(c) Discussion (3 marks)

NPV > 0 → project viable.

IRR > discount rate → acceptable.

Payback useful for liquidity check.

✓ Marking: Definition 3, Calculation 4, Discussion 3 = 10 marks

Q2. Ore Reserve Valuation & Mine Life (10 Marks)

(a) Classification (3 marks)

Proved: High confidence (measured).

Probable: Moderate confidence (indicated).

Possible: Low confidence (inferred).

(b) Valuation Methods (4 marks)

Cost Approach: Based on exploration/development expenditure.

Market Approach: Comparable market transactions.

Income Approach: Discounted cash flow (DCF).

(c) Economic Life (3 marks)

✓ Marking: (a) 3 + (b) 4 + (c) 3 = 10 marks

Q3. Cost Estimation & Break-even Analysis (10 Marks)

(a) Cost Classification (3 marks)

Fixed: Equipment, admin, insurance.

Variable: Fuel, explosives, wages.

Semi-variable: Maintenance, power.

(b) Break-even Definition (3 marks)

Level where total cost = total revenue.

(c) Example Calculation (4 marks)

$F = ₹30M, V = ₹2000/t, P = ₹3000/t$

✓ Marking: Concepts 6 + Calculation 4 = 10 marks

Q4. Mineral Pricing & Market Mechanisms (10 Marks)

(a) Price Determination (4 marks)

Based on supply-demand, grade, logistics, metal content, global indices (LME, Platts, etc.).

(b) Role of LME & IBM (3 marks)

LME: Global benchmark for metals (Cu, Zn, Al).

IBM: Publishes domestic average sale price (ASP) for royalty computation in India.

(c) Pricing Mechanisms (3 marks)

Administered Pricing: Govt. fixed (coal, lignite).

Market-based Pricing: Competitive (iron ore, bauxite).

✓ Marking: 4 + 3 + 3 = 10 marks

Q5. Taxation & Royalty (10 Marks)

(a) Types of Taxes (4 marks)

Royalty (unit/ad valorem), DMF, NMET, GST, corporate tax.

(b) Ad Valorem vs Unit-based (3 marks)

Ad valorem: % of sale value – adjusts with market price.

Unit-based: ₹/tonne – stable but ignores market variation.

(c) Investment Impact (3 marks)

High royalty reduces profitability.

Stable tax policy → encourages foreign investment.

✓ Marking: 4 + 3 + 3 = 10 marks

Q6. Mine Closure & Financial Assurance (10 Marks)

(a) Concept (3 marks)

Ensures environmental restoration and social rehabilitation post-mining.

(b) Instruments (3 marks)

Financial surety, escrow funds, reclamation bonds.

(c) Cost Model Example (4 marks)

For a 200 ha mine:

Regrading ₹2 lakh/ha

Re-vegetation ₹1 lakh/ha

Monitoring ₹0.5 lakh/ha

Total = ₹3.5 lakh × 200 = ₹7 crore

✓ Marking: 3 + 3 + 4 = 10 marks

Q7. Risk & Uncertainty in Mineral Projects (10 Marks)

(a) Sources (3 marks)

Geological variability, market price, policy changes, cost overruns.

(b) Sensitivity & Scenario Analysis (4 marks)

Sensitivity: One-variable change (price, cost).

Scenario: Multi-variable change under different cases (optimistic, base, pessimistic).

(c) Example (3 marks)

If NPV = ₹500M

±10% price change → NPV = ₹550M or ₹450M

±10% cost change → NPV = ₹450M or ₹550M

→ Sensitivity ratio = $\Delta\text{NPV} / \Delta\text{Variable} = 1.0$

✓ Marking: 3 + 4 + 3 = 10 marks

Q8. Mine Financing & Capital Budgeting (10 Marks)

(a) Financing Types (3 marks)

Equity: Ownership-based, no repayment.

Debt: Loan-based, interest-bearing.

Joint Venture: Shared investment and risk.

(b) Budgeting Techniques (4 marks)

Payback period

NPV

IRR

Profitability Index

Used for project comparison.

(c) Role of Agencies (3 marks)

IFC, World Bank, EXIM, NABARD, SIDBI, NMDC financing for mining ventures.

✓ Marking: 3 + 4 + 3 = 10 marks

Q9. Resource Rent & Economic Sustainability (10 Marks)

(a) Resource Rent (3 marks)

Surplus income after all normal returns; belongs to the state as resource owner.

(b) Hotelling's Rule (4 marks)

(c) Inter-generational Equity (3 marks)

Creation of sovereign wealth funds.

DMF & NMET for long-term community benefit.

✓ Marking: 3 + 4 + 3 = 10 marks

Q10. Mineral Policy & Economic Reforms (10 Marks)

(a) Key Reforms (4 marks)

MMDR Act 1957 → amended in 2015 & 2021.

Introduction of auction-based allocation, seamless exploration, private participation.

(b) Effects of Auctions (3 marks)

Increased transparency and state revenue.

Delay in mine start-up and loss of small players.

(c) Policy Recommendations (3 marks)

Ease of doing business, faster EC/FC, incentive for beneficiation, clear fiscal regime.

✓ Marking: 4 + 3 + 3 = 10 marks

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