

PAKISTAN ENGINEERING COUNCIL

Syllabus for Engineering Practice Examination (EPE)

Mining Engineering

Total Marks: 60

PART-II

This is an open book breadth and depth examination, comprising 60 Multiple Choice Questions (MCQs) of one mark each (total 60 marks) with a duration of three hours. There shall be two sections of Part-II for each major discipline of EPE. Qualifying Marks for this part shall be **sixty per cent**.

SECTION-A / BREADTH

This section will generally confirm to latest (updated) B.E./equivalent qualification of Mining Engineering. The examination of this section shall comprise 25 MCQs (total 25 marks).

1. **MATHEMATICS AND STATISTICS FOR ENGINEERS** **7%**
 - i. Analytic geometry
 - ii. Matrix operations
 - iii. Differential equations
 - iv. Differential calculus
 - v. Measures of central tendencies and dispersions (mean, mode, standard deviation)
 - vi. Estimation (point, confidence intervals) for a single mean
 - vii. Regression analysis and curve fitting
 - viii. Hypothesis testing.

Suggested Books:

- Thomas, George G., Jr. and Finney, Ross L., "Calculus & Analytical Geometry", Addison-Wesley, 8th Ed. ISBN: 0201529297
- Hogg & Craig, "Introduction to Mathematics & Statistics", Prentice Hall, 2004.
- Murray, Spiegel and Larry J- Stephens, "Probability and Statistics"
- S. C Gupta and V.K Kapoor, "Fundamentals of Mathematical statistics"
- Erwin Kreyszig, "Advanced Engineering Mathematics," Ninth Edition, 2005, International Edition, John Wiley & Sons, ISBN: 0471728977.

2. CHEMISTRY 8%

- i. Nomenclature
- ii. Oxidation and reduction
- iii. Periodic table
- iv. States of matter
- v. Acids and bases
- vi. Equations (e.g. stoichiometry)
- vii. Equilibrium
- viii. Metals and nonmetals.

Suggested Books:

- R Gopalan, D Venkappayya Sulochana, "Engineering Chemistry" 2nd Ed, 1999
- David R. Klein, 2005, "General Chemistry as Second Language"
- ES Gyngell, "Applied Chemistry for Engineers", 3rd Ed., Edward Arnold, London (1960). Thorpe's
- Adamson, "Physical Chemistry", 3rd Ed. Academic Press (2005) ISBN: 0125083475
- C. C. Furants, "Industrial Chemistry for Engineers"

3. COMPUTER FOR ENGINEERS 8%

- i. Basic concepts (memory types, CPU, band rates, internet)
- ii. Spreadsheets (addresses, interpretation, "what if," copying formulas)
- iii. Structured programming (assignment statements, loops and branches, function calls)
- iv. Numerical analysis.

Suggested Books:

- Dietel and Dietel, "C++ How to Program", 2nd Ed. ISBN 0-13-513280-0
- Robert Lafore, "Object Oriented Programming with C++", 4th Ed.
- Sohilling Harris, Applied Numerical Methods for Engineers.
- Herbert Schildt Osborne, "Teach yourself C++", 3rd Ed. McGraw Hill.

4. ENGINEERING MECHANICS 7%

- i. Statics
 - Resultants of force systems
 - Friction.
- ii. Dynamics
 - Linear motion (force, mass, acceleration, momentum)
 - Angular motion (torque, inertia, acceleration, momentum)
 - Work, energy, and power as applied to: particles, rigid bodies, friction.

Suggested Books:

- Hibler, R.C. "Engineering Mechanics", 11th Ed, Prentice Hall, 2006
- Kurmi, R. S. "Engineering Mechanics", 19th Ed, S. Chand, 1990
- Meriam J.L And Kraige L.G, "Engineering Mechanics", John Wiley And Sons, ISBN 978-0-470-49977-1

5. STRENGTH OF MATERIALS 7%

- i. Shear and moment diagrams
- ii. Stress types (normal, shear, bending, torsion)
- iii. Stress strain caused by:
 - axial loads
 - bending loads
 - torsion
 - shear.
- iv. Deformations (e.g., axial, bending, torsion)
- v. Combined stresses
- vi. Columns
- vii. Indeterminate analysis
- viii. Plastic versus elastic deformation.

Suggested Books:

- G H Ryder, "Strength of Materials", 3rd Edition, Macmillan, 1969.
- Pytel, A. & F.L.Singer, "Strength of Materials", 4th Ed, Harper & row Publishers, 1987.
- Boreise, A.P. & O. M. Sidebottom, "Advanced Mechanics of Materials", 6th Ed, John Wiley & Sons, 2004.

6. MATERIAL PROPERTIES: 7%

- i. Properties: (chemical, electrical, mechanical, physical)
- ii. Corrosion mechanisms and control
- iii. Materials
 - Engineering materials
 - Ferrous metals
 - Nonferrous metals.

Suggested Books:

- M. F. Ashby and D. R. H. Jones, "Engineering Materials 2: An Introduction to Microstructures, Processing and Design", 2nd Ed. ISBN: 0136012604 Butterworth-Heinemann, 2005.
- William D. Callister Jr. "Materials Science and Engineering: An Introduction", 7th Ed. ISBN: 9780471736967
- Micheal Kohler and wolfgang Fritzsche, "Nano Technology and Introduction to Nano Structures", Wiley V.C.H, 2007

7. FLUID MECHANICS AND THERMODYNAMICS: 8%

- i. Fluid properties
- ii. Energy and momentum equations
- iii. Pipe and other internal flow
- iv. Flow measurement
- v. Thermodynamic Laws and cycles
- vi. Energy, heat, and work
- vii. Availability and reversibility
- viii. Ideal gases
- ix. Mixture of gases
- x. Phase changes
- xi. Heat transfer
- xii. Enthalpy and entropy.

Suggested Books:

- R. L. Daugherty, J. B. Franzini and E. J. Finnermore, "Fluid Mechanics with Engineering Applications", 9th Ed. McGraw Hill, ISBN: 0072432020
- E. H. Lewitt, "Hydraulics and Hydraulic Machinery", Pitman and Sons
- R. E. Sonntag, C. Borgnakke, "Introduction to Engineering Thermodynamics", 2nd Edition, John Wiley & Sons, 2007
- Svein Stølen, Tor Grande, and Neil L. Allan, "Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects", 2004
- R.W. Fox and Allan T. McDonald, "Introduction to Fluid Mechanics", 5th Ed. ISBN: 9780471742999, John Wiley and Sons.

8. PROSPECTING AND EXPLORATION 10%

- i. Prospective and Exploration Methods and Techniques
 - Fundamental physical and structural geology and stratigraphy
 - Geological surveying and mapping: aerial photography, strike and dip, three-point problems
 - Mineral related governing Laws.
- ii. Characterize Site Geologic and Geotechnical Conditions
 - Hydrology/hydrogeology
 - Sampling techniques: exploratory drilling, trenching, field samples
 - Analysis and interpretation: sample properties, rock mass classifications, ground stress
 - Basic modeling.
- iii. Estimate, Characterize, and Evaluate Resource/Reserves
 - Resource classification systems

- Economic geology: grade distribution, cut-off grade, stripping ratios
- Resource estimation techniques and interpretation: quality and quantity methodologies.

Suggested Books:

- Anthony Evans, "Introduction to Mineral Exploration", 2nd Ed. ISBN: 1405113170
- J.H Reedman, "Techniques in Mineral Exploration", 1st Ed. ISBN: 0853348510
- W.C. Peters, "Exploration and Mining Geology", 2nd Ed.
- Billings Marland P "Structural Geology", 3rd Ed. ISBN: 8120300599, Prentice Hall India
- Hussain Syed Abid, "TLR on Mineral Exploration". ADB/ Ministry of Education, August 2000.

9. MINE PLANNING, DEVELOPMENT AND OPERATIONS: 10%

- i. Plan, Design, and Implement Mining Methods and Layouts
- Assessment of infrastructure availability and support
 - Deposit access: adits, tunnels, incline, shafts, access roads
 - Surface mining methods and planning: contour strip, open pit/area, quarries, dredging
 - Underground mining methods and planning (artificially supported system or otherwise).

Suggested Books:

- H. L. Hartman, "Introductory Mining Engineering", 2nd Ed. John Wiley And Sons
 - Hussain Syed Abid, "TLR on Underground Hard Rock Mining", ADB/ Ministry Of Education, 2000.
 - B.A Kennedy, "Surface Mining", SME/ AIME Publications.
 - E. P. Pfeleider, "Surface Mining"
 - W. Hustrulid And M.Kuchta, "Open Pit Mine Planning And Design" ,Vol. II (Published By A.A. Balkema)
- ii. Plan, Design, Select, and/or Construct Mine Equipment, Facilities, and Systems
- Production equipment and systems
 - Rock fragmentation
 - Material handling and transportation
 - Ventilation equipment and system
 - Power distribution equipment
 - Pumping, dewatering, and drainage
 - Communication, monitoring, and control
 - Fire fighting, rescue and recovery.

Suggested Books:

- Robert Stefanko, “Coal Mining Technology: Theory And Practice” ISBN-10: 0895204045
- Lewis and Clark, “Elements Of Mining”, John Wiley And Sons.
- Raj K. Singhal, “Mine planning and Equipment Selection”, Balkema Publisher.
- H. L. Hartman, “Mine Ventilation and Air-conditioning”.
- John Sinclair, “Quarrying, Open Cast Mining And Alluvial Mining”, Pitman London.
- Hussain Syed Abid, “TLR on Underground Hard Rock Mining”, ADB/ Ministry Of Education, 2000.

iii. Evaluate and Design Ground Control

- Surface and underground ground control analysis and methods.

Suggested Books:

- Hussain Syed Abid, “TLR on Underground Hard Rock Mining”, ADB/ Ministry Of Education, 2000.
- Hustrulid, “Underground Mining Methods Handbook”, AIME Publications.
- Hussain Syed Abid, “TLR on Coal Mining”, ADB/ Ministry Of Education, June 2000
- C. Biron & E. Arioglv, “Design of Support in Mines”, Wiley Inter science, N.Y.
- E.H. Kaiser & Bawden, “Support of Underground Excavation in Hard Rock”, Balkema Publisher.

iv. Operate and Manage Mines and Systems

- Mine surveying and mapping
- Resource requirements evaluation: equipment, materials, personnel, logistical support
- Mine maintenance systems
- Reservoir conservation strategy.

Suggested Books:

- R. McAdam, “Colliery Surveying”, Robert Cunnigham & Sons, London.
- W.W. Staley, “Introduction to Mine Surveying”, Stanford University Press.
- W.W. Staley, “Mine Plant Design”, McGraw Hill Publisher.
- Hussain Syed Abid, “TLR on Mine Surveying”, ADB/ Ministry Of Education, Sep 2000.
- SME/AIME Mining Engineering Handbook Vol. I and II. AIME Publications.

10. ENVIRONMENT AND RECLAMATION:**10%**

- i. Characterize Site, Mining, and Process Environment

- Surface water, groundwater, and air characterization and contaminant transport
- Environmental chemistry, geochemistry, geology, and ecology
- Waste characterization
- Characterization of site conditions using field and laboratory data.

Suggested Books:

- Moral & Stumm, “Environmental and Aqueous Chemistry”, John Wiley & Sons.
 - H.M Rangunath, “Ground Water”, New Age Publishers.
- ii. Plan and Design to Mitigate Prospect Exploration, Mining, and Processing Impacts
- Waste containment systems: tailings and slurry impoundments, caps, liners, leakage recovery and detection systems
 - Potable, process, and wastewater treatment systems
 - Mining and processing solid waste treatment systems
 - Pollution monitoring and prevention measures: sediment control, surface water discharge, dust, air filtration systems
 - Site water balance preparation.

Suggested Books:

- Mackenzie L. Davis, David A. Cornwell, “Introduction to Environmental Engineering”, McGraw Hill.
 - Bharat B. Dhar & D.N Thakur, “Mining Environments”, Oxford and IBH Dehli.
- iii. Operate and Manage Environmental, Reclamation and Rehabilitation Plan
- Site monitoring and analysis: subsidence, ground and surface water, vibration, noise, air
 - Environmental planning and cost estimation
 - Reclamation planning and cost estimation
 - Rehabilitation planning and cost estimation.

Suggested Books:

- Dawn Christopher & Stocks, “Environmental Impacts of Mining”, John Wiley & Sons, N.Y.
 - Volcan V.S & Lene R.D, “Environmental Engineering in Mines”.
- iv. Close and Reclaim the Site
- Earthwork techniques and equipment: grading, cutting, filling, ripping
 - Post-mining land configuration and erosion control system design: riprap, ditches, silt fences, matting, and sedimentation ponds.

Suggested Books:

- Christopher Bise, Mining Engineering Analysis.
- H. Rabia, Mine environmental Engineering.

11. COAL AND MINERAL PROCESSING

10%

i. Perform Laboratory and Pilot Testing/Analyses

- Lab-scale metallurgical, mineral processing, and analytical test procedures: atomic absorption, diagnostic leaching, solvent extraction, bond work index, coal washability, physical separations
- Integration of mineralogical and chemical characteristics for selection of appropriate processing techniques.

Suggested Books:

- SME Mineral Processing Handbook, AIME Publications.
- Krishna Moorthy, "Modern Ore Testing", Khanna Publishing Dehli.

ii. Design and Evaluate Process Flowsheets

- Laboratory and pilot results interpretation, process flowsheet determination, and production level scale-up
- Hydrometallurgical principles: electrochemistry, biohydrometallurgy, leaching, solvent extraction, precipitation, crystallization
- Pyrometallurgical principles: fluid bed roasting, smelting, calcination
- Comminution, classification, and beneficiation principles and techniques
- Solid/liquid separation principles: thickening, filtration
- Material, water, heat, and energy balances.

Suggested Books:

- Denver, "Mineral Processing Flowsheets", Denver Co. Publishers.
- B.A. Wills, "Mineral Processing Technology", Pergamon Press.
- SME Coal Preparation (The Latest Edition), Edited by J.D. Leonard and R.D. Mitchell. AIME Publications.

iii. Plan, Design, Select, and/or Construct Plant Equipment, Facilities, and Systems

- Site considerations and plant layout
- Unit operations and equipment selection and sizing: tank sizing, pumping, piping, conveying.

Suggested Books:

- Spotiswoods and Kelly, "Introduction to Mineral Processing", John Wiley, N.Y.
- Hussain Syed Abid, "TRL on Mineral Processing", ADB/ Ministry of Education, Dec 2000.

iv. Operate and Manage Plants and Facilities

- Control of plant performance to maintain product quality: operate mill or preparation plant equipment; process control systems
- Maintenance of mill or preparation plant systems
- Resource requirements evaluation: reagents, materials, personnel, mill feed, logistical support

- Use of modular plants.

Suggested Books:

- SME Coal Preparation (The Latest Edition), Edited by J.D. Leonard and R.D. Mitchell. AIME Publications.
- B.A. Wills, "Mineral Processing Technology", Pergamon Press.

12. MINE ECONOMICS AND MARKETING: 8%

- i. Introduction to principles of accounting, daily cash book, ledgers
- ii. Differentiation between cost and expenses, depreciation and amortization, break-even point, study of cost-benefit ratio (financial or economics)
- iii. Project planning matrixes
- iv. Project planning
- v. Pre-feasibilities and feasibility studies
- vi. Marketing trends and viable space with or without value addition.

Suggested Books:

- W. G. Sullivan, J. A. Bontadelli and E. M. Wicks, "Engineering Economy", Prentice Hall Inc.
- F. Willcox, "Mine Accounting and Financial Administration", Pitman London.
- Vogely, W.A., "Economics of Mineral Industries", Mud Series, AIME
- D.W. Gentry & T.J. O'Neil, "Mine Investment Analysis", AIME
- J.R. Meredith & S.J. Mantel, "Project Management".
- I.C. Runge, "Mining Economics and Starategy", John Wiley N.Y.

PART-II

SECTION-B / DEPTH

This section shall be based on practical concepts framed to judge the practical experience and field based knowledge of Registered Engineers (REs). The examination of this section shall comprise 35 MCQs. Each candidate may attempt the only opted area of practice, among the followings.

1. QUARRY/OPEN PIT DEVELOPMENT AND OPERATIONS

- i. Drilling and blasting patterns
- ii. Use of explosives: charge calculations
- iii. Rip-rap blasting and fragmentation
- iv. Crushing and grinding
- v. Vibration impacts
- vi. Material handling and transportation
- vii. Operation management and economics.

Suggested Books:

- Stig O Olofsson, "Applied Explosive Technology", Applex Sweden.
- E.I DuPont, Blasters Handbook.
- R. McAdam & Westwater, "Mining Explosives", Oliver and Boyd London.
- L. Adler & H.E. Naumann, "Analysis Excavation and Material Handling Equipment", Virginia Polytech Blacksburg, U.S.A.
- J. Sinclair, "Quarrying open Cast and Illuvial Mining", Elsevier Publishers. N.Y.

2. UNDERGROUND MINING OPERATIONS AND DEVELOPMENT

- i. Planning of development entries
- ii. Selection of mining method(s)
- iii. Strata control and ground support design
- iv. Ventilation design and management
- v. Material Handling and Transportation
- vi. Operation Management and Economic
- vii. Mine hazards and controls.

Suggested Books:

- Lewis & Clark, "Elements of Mining", John Wiley & Sons N.Y.
- SME/ AIME, Mining Engineering Handbook Vol; 1 & 2.
- Hustrulid, "Underground Mining Methods Handbook", AIME.
- Hartman H.L. "Mine Ventilation And Air-conditioning".

- Hussain Syed Abid, “TLR on Mine Ventilation”, ADB/ Ministry of Education, 2000.
- D.A. Sloan, “Mine Management”, Chappman & Hall.

3. MINE RESCUE AND SAFETY ENGINEERING

- Organizing rescue and recovery operations managing emergencies
- Use and maintenance of various gadgets/ apparatuses for rescue and recovery operations
- Mine hazards identification and controls
- Mines environment sampling and testing
- Safety management.

Suggested Books:

- Strang & P.M. Wood, “A manual on Mine Rescue and Safety and Gas Detection”.
- U.S.B.M., “Advanced Training Material (Coal, Metal & non-Metal)”.
- M.A. Ramlu, “Mine Disasters and Mine Rescue”, Oxford and IBH Delhi.
- MHSa, Handbook of Training in Mine Rescue and Recovery, Ministry of Labor, Ontario Canada.
- Bharat & Thakkur, “Mining Environments”, Oxford & IBH Publishers Dehli.

4. MINE MANAGEMENT AND REGULATORY REGIME

- Constitutional Provisions and Mineral Policy(s)
- Mineral Concession and Safety Laws
- Other regulatory provisions applicable to mines: labor, environment, electricity, boiler, explosives, etc.
- Contract Acts
- Project Planning and Evaluation of data/ feasibility studies.

Suggested Books:

- Shafi M.A., “Mining Labor Code”.
- Abid, “Mineral Concession Rules”.