

PAKISTAN ENGINEERING COUNCIL

Curriculum for Engineering Practice Examination (EPE) (Mining Engineering)

Total Marks: 100

MAIN OBJECTIVE:

The main objective of Engineering Practice Examination (EPE) is the assessment of competence, knowledge and skills of a Registered Engineer (RE), after having attained a minimum of five years of practical experience in relevant field of engineering from a recognized engineering organization, institution or allied service, and has earned requisite CPD (Continuing Professional Development) credit points.

PART-I (COMMON TO ALL DISCIPLINES)

This is common to all disciplines comprising of 30 questions of one mark each (total marks 30) with the duration of 2 hours, dealing with engineering related management, communication skills and ethics.

MANAGEMENT (ENGINEERING RELATED)

34%

- i. Quality Issues: fundamental concepts, application and role
- ii. Finance: cost analysis, financial discipline
- iii. Procurement/Legal: bidding, contracts, arbitration, guarantees, liabilities
- iv. Latest Trends: emerging technologies and their applications.

Suggested Books:

- PEC bidding/contract documents (www.pec.org.pk; www.picc.org.pk)
- FIDIC documents
- W.G. Sullivan, J.A. Bontandelli and E.M. Wicks, "Engineering Economy", 11th Ed., Prentice Hall Inc., 1999
- Franklin and John Stermole, "Economic Evaluation and Investment Decision Methods" (9th Edition)
- Project Management Institute , A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition, Published by Project Management Institute, weblink: [A Guide to the Project Management Body of Knowledge \(PMBOK® Guide\) - Fourth Edition](#), 2008.

2. WRITTEN COMMUNICATION SKILLS

33%

- i. English Language Communication Skills
 - Paragraph and essay writing
 - Academic and presentation skills
- ii. Technical Report Writing Skills
 - Project/ research proposals

- Monitoring and evaluation
 - Progress and financial reporting
- iii. Knowledge Management and Leadership Skills

Suggested Books:

- Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41
- Hargie, O. (ed.) Handbook of Communications Skills, Routledge
- Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992, ISBN 0 19 435407 3
- Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1, 3rd Ed., Oxford University Press, 1997. ISBN 0194313492
- Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top, Prima Lifestyles - 2005
- Oxford English Dictionary or equivalent, (Latest Edition)

3. ETHICAL AND SOCIAL ISSUES

33%

- i. Code of ethics
- ii. Professional obligation of engineers
- iii. Role of opportunity and conflict
- iv. Interpersonal relations, social stratification and culture

Suggested Books:

- PEC Code of Ethics (http://pec.org.pk/code_ethics.aspx)
- PEC Code of Conduct (http://pec.org.pk/code_conduct.aspx)
- Ethics in Engineering, Martin M. W., Martin M. and R. Schinzinger, McGraw-Hill, (Latest Edition)
- Ethics in Engineering Practice and Research, Whitbeck C., Cambridge University Press, (Latest Edition)
- Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behavior, 3rd Ed., Oxford.
- Project Management Institute , A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition, Published by Project Management Institute, weblink: [A Guide to the Project Management Body of Knowledge \(PMBOK® Guide\) - Fourth Edition](#), 2008.

PART-II (BREADTH)

This part attempts to assess the breadth of Mining Engineering. The examination of this part would comprise 30 multiple choice questions (total 30 marks) for 2-hours duration.

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. Pfeider, “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
 - Lewiss 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-III (DEPTH)

This part aims to assess the depth of Mining Engineering. The examination of this part would comprise 40 multiple choice questions for 3-hours duration. Each candidate can 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

- i. Organizing rescue and recovery operations managing emergencies
- ii. Use and maintenance of various gadgets/ apparatuses for rescue and recovery operations
- iii. Mine hazards identification and controls
- iv. Mines environment sampling and testing
- v. 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

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

Suggested Books:

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