

**INSTITUTE OF GEOLOGY, UNIVERSITY OF THE PUNJAB
LAHORE**

COURSES AND SYLLABI

FOR

PhD Applied Geology (Mineralogy / Petrology)

DURATION: 3-5 YEARS

COURSE WORK: 18 CREDIT HRS

Course Code	Course Title	Credit hrs
GEOL-701	AGGREGATE OF PAKISTAN	03
GEOL-702	GEOLOGICAL RESOURCES AND ENVIRONMENT	03
GEOL-703	AGGREGATES	03
GEOL-704	ORE GEOLOGY, MINING AND PROCESSING	03
GEOL-705	MINERAL DEPOSITS	03
GEOL-706	PETROLOGY	03
GEOL-707	METAMORPHIC PETROLOGY	03
GEOL-708	APPLIED GEOCHEMISTRY	03
GEOL-709	INDUSTRIAL MINERALS OF PAKISTAN	03

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FOR

PhD Applied Geology

(with Specialization in Mineralogy / Petrology)

GEOL-701 AGGREGATE OF PAKISTAN (03 Credit hrs)

Lithostratigraphy and aggregate geology of Pakistan, igneous, metamorphic and sedimentary sources and their petrographic characteristics. Fluvial river channel, flood plain, river terrace and glacial and glaciofluvial deposits and their geological and petrographic characteristics. Main quarry areas of Pakistan, Azad Jammu and Kashmir and their characteristics. Fine aggregate deposits and their characteristics.

Petrographic physical, chemical mechanical and durability properties of Pakistani aggregates ASR and ACR potential of Pakistani aggregates.

Books Recommended

1. Selected research papers
2. Unpublished technical reports
3. Collis, L., and Smith, M.R. (1993). Aggregates, Geological Society of London, Special Publication, No. 09, pp 339.
4. Ibrahim Shah, (2009). Stratigraphy of Pakistan Memoir of The geological survey of Pakistan Vol22

GEOL-702 GEOLOGICAL RESOURCES AND ENVIRONMENT (03 Credit hrs)

Introduction to environment and environmental impact assessment Fossil and mineral fuel resources, their exploitation and impacts on environment. Ore deposits their exploitation and environmental impacts. Aggregate deposits, their exploitation and impacts on environment. Industrial minerals their exploitation and impacts on environment.

Books Recommended

1. Lefond
2. Evan
3. NEPA, USA (1969).
4. PEPA Punjab (2012)
5. National Environmental Protection Act USA (1969)

GEOL-703 AGGREGATES (03 Credit hrs)

Introduction. Aggregates from igneous, metamorphic and sedimentary rocks. Introduction to aggregate petrography. Geology of gravel, sand and conglomerate deposits. River channel, river terraces and flood plain deposits of braided and meandering streams. Alluvial fans and colluvial deposits. Glacial and glaciofluvial deposits. Coastal and marine deposits.

Weathering and alteration of aggregate deposits. Exploration, mapping and reserve estimation of mining, quarrying and dredging. Crushing, classification and processing of aggregates. Testing of aggregates. Physical tests, mechanical tests, durability tests, chemical tests, XRD, Microprobe and XRF tests. Aggregates for cement concrete, bitumen concrete, mortars, railway ballast, filter media and various types of pavements.

Detailed aggregate petrography. Petrographic, chemical, XRD, XRF and ACR. Cement and Cement additives to control ASR and ACR use of chemical additives and agents. Rehabilitation of deteriorating concrete structures.

Books Recommended

1. Collins, L and Smith, M.R (1993). Aggregates. Geological Society of London, Special publication No. 09, pp. 339
2. Neville, A.M. (2000) Properties of concrete, Longman, U.K, 4th Edition, pp 1-844.
3. Swamy, R.N. (1992). The Alkali-silica reactions in concrete, the Blackie publishing Group, Bishopbriggs, Scotland, cements and Concrete composition, volume 14, Issue 1, pp 72-74.
4. Selected Research papers

GEOL 704: ORE GEOLOGY, MINING AND PROCESSING (03 Credit hrs)

Formation of minerals deposits and their classification. Mineral potential of Pakistan. Distribution of ore deposits in relation to plate tectonics . Ore reserve calculations. Mining methods and introduction to mining machinery. Ore dressing, Physical and chemical beneficiation methods.. Important metallic ore minerals and rocks and their applications. Environmental aspects of mining processing of ores

Practical

Identification of of metallic and non metallic minerals as hand specimens. Study of some important metallic minerals under polarizing microscope. Ore reserve calculation of different types of deposits.

Books Recommended

1. Introduction to Ore Forming Processes by Robb, L., 2005, Blackwell Science LTD
2. Geology of Mineral Deposits by Smirnov, V.I. and Creighton H.C., 2001, New Chand & Bros
3. An Introduction to Economic Geology & its Environmental impact by Evans, A. M., 1997
4. Ore Geology and Industrial Minerals by Evans, A.M., 1993, Blackwell Publishers
5. Ores and Minerals by Barnes, J. W., 1988, Open University Press
6. Metal Deposits in Relation to Plate Tectonics by Sawkins, F.J., 1984, Springer-Verlag, New York.
7. An Introduction to Ore Geology by Evans, A. M., 1987, Blackwell Scientific
8. Ore Deposit Geology by Edward, R. and Atkinsons, K., 1986, Chapman and Hall
9. Mineral Deposits and Global Tectonic Setting by Mitchell, A.H.G. and Garson, M.S., 1981, Academic Press

GEOL: 705 MINERAL DEPOSITS (03 Credit hrs)

Genesis, occurrence and important features of deposits of chromite, platinum group elements, gold and uranium deposits. Important features of porphyry deposits, Cu-Ni-Fe deposits, volcanic hosted massive sulphide deposits, Mississippi valley type deposits, carbonatites, greisen deposits, skarn deposits and placer deposits. Occurrence, distribution and utilization of metallic mineral deposits in Pakistan.

Books Recommended

1. Geology of Mineral Deposits by Smirnov, V.I. and Creighton H.C., 2001, New Chand & Bros
2. Metallogeny and Mineral Deposits of Pakistan by Kazmi, A.H. & Abbas, S.G., 2001, Orient Petroleum
3. Geology and Tectonics of Pakistan by Jan, M.Q. & Kazmi, A.H., 1997, Graphics Publishers, Karachi
4. Geochemistry, Mineralogy and Genesis of Gold Deposits by Necrosov I., 1996
5. Geology of Pakistan by Bender and Raza, 1995, Gebruder Borntraeger, Berlin
6. Geology of Ore deposits by Park and Freeman, D., 1995
7. Ore Geology and Industrial Minerals by Evans, A. M., 1993, Blackwell Publishers
8. Mineral and Rocks for Industries by Ahmad, Z. & Siddiqi, R.A., 1992, Geological Survey of Pakistan
9. An Introduction to Ore Geology by Evans, A.M., 1988
10. Directory of Mineral Deposits of Pakistan by Ahmad, Z., 1969, Geological Survey of Pakistan.

GEOL: 706 PETROLOGY (04 Credit hrs)

Magmatic evolution. Fractionation in magmas. Convection and mixing in magma chambers. Contamination. Mixing of magmas. Hybridization. Assimilation. Partial melting. Phase Rule. Binary diagrams. Lever Rule. Fractional crystallization and melting. Congruent melting. Systems MgO-SiO₂; albite-anorthite and forsterite-fayalite. Ternary diagrams (one system).

Basalts. Basalt petrogenesis in relation to tectonic environments. Alpine peridotites. Serpentinization. Ophiolites. Semail ophiolite. Troodos ophiolite. Ophiolites of Pakistan. Kimberlites. Lamprophyres. Layered intrusions.

Books Recommended

1. Igneous Rocks: A Classification and Glossary of Terms, Recommendations of the International Union of Geological Sciences Sub-commission on the Systematics of Igneous Rocks, 2nd edition Edited by Le Maitre, R.W., Streckeisen, A., Zanettin, B., Bas, M. J. Le., Bonin, B. and Bateman, P., 2005
2. Petrology by Raymond, L.A., 2002. McGraw Hill
3. Igneous and Metamorphic Petrology By Myron G., 2002
4. Dynamic Earth: Plates, Plumes and Mantle Convection by Geoffrey, F. D., 2000
5. Petrology, 2nd Edition: Igneous, Sedimentary, and Metamorphic by Blatt, B. and Tracy, R., 1995
6. Igneous Petrogenesis by Wilson, M., 1989, Unwin Hyman.
7. Basalts & Phase Diagram by Morse, S.A., 1980, Springer-verlag New York

GEOL: 707 METAMORPHIC PETROLOGY (03 Credit Hours)

Field relations of metamorphic rocks. Deformation, Fabric, structures and textures of metamorphic rocks. Measurement of metamorphic structures. Metamorphic rocks of the ocean floor. ACF and AFM diagrams. The concept of metamorphic facies. Facies of regional metamorphism. Facies of contact metamorphism. Cataclastic metamorphism. Metasomatism. Metamorphic complexes of Pakistan.

Books Recommended

1. Metamorphic Rocks: A Classification and Glossary of Terms, Recommendations of the International Union of Geological Sciences Sub-commission on the Systematics of Metamorphic Rocks Edited by Fettes, D. and Desmons, J., 2007
2. Igneous and Metamorphic Petrology by Myron G., 2002
3. Petrology by Raymond, L.A., 2002. McGraw Hill
4. Petrogenesis of Metamorphic Rocks By Bucher, K. and Frey, M., 2002
5. Petrology, 2nd Edition: Igneous, Sedimentary and Metamorphic by Blatt, H. and Tracy, R., 1995
6. Petrogenesis of Metamorphic Rocks by Bucher, K. and Frey, M., 1994, Springer-verlag, New York
7. An Introduction to Metamorphic Petrology by Yardley, B., 1989, Longman Earth Science Series Longman Scientific & Technical, UK
8. Metamorphic Petrology by Francis, J. and Turner, 1981, Hemisphere publishing Corp
9. Metamorphism and Metamorphic Belts by Miyashiro, A., 1973, George Allen & Unwin

GEOL: 708 APPLIED GEOCHEMISTRY (03 Credit hrs)

Variation diagrams. Geochemistry as petrogenetic indicator. Trace elements and rare earth elements geochemistry. General chemical properties and abundances of rare earth elements. Meteorites, their classification, mineralogy and composition. Use of rare earth elements in meteorites as reference standards. Isotopes geochemistry, Use of geochemistry in mineral exploration. Presentation of chemical data of rock and mineral analyses. Eh-pH diagrams. Various types of chemical surveys. Primary and secondary dispersion of elements. Introduction of environmental geochemistry.

Books Recommended

1. Principles of Stable Isotope Geochemistry, 1/e by Sharp, Z., 2006
2. Trace Elements in Magmas: A Theoretical Treatment by Denis, M.S., 2006

3. Essentials of Geochemistry By John,V.W.,2005
4. Geochemistry an Introduction by Albarede,F., 2003 Cambridge University Press.
5. Principles and Applications of Geochemistry by Faure,G., 1998
6. Introduction to Geochemistry by Krauskope.,1995
7. Simulating the Earth: Experimental Geochemistry by Holloway, JR., 1988

GEOL: 709 INDUSTRIAL MINERALS OF PAKISTAN (03 credit hrs)

The geology, origin, occurrence and classification of the chief categories and deposits of commercial, non metallic industrial minerals and rocks. The requirements of industry as regard the physical and chemical properties of industrial minerals. Industrial minerals of Pakistan, Existing industries ie. Glass, ceramics, limestone and lime, cement, gypsum and anhydrite, bentonite, soapstone, marble, graphite, rock salt, rock phosphate, travertine, china clay, Feldspar and common clays. Dimension stone, Slate, Magnesite, , Kaolinite, Bentonite Dunitite and serpentinite, Nepheline syenite, Natural abrasive materials, Fluorite and Barite

Commodity reports on the materials covered in theory and of the Al_2SiO_5 minerals, asbestos, graphite, lithium minerals, perlite, sepolite, talc, wollastonite, anhydrite, diomite, iron oxide pigments, manganese ores, pumice, rutile, trona and zeolites. Interpretation of normal geological maps in terms of industrial rock and mineral potential.

Books Recommended

1. Ibrahim Shah, 2009). Stratigraphy of Pakistan Memoir of The geological survey of Pakistan Vol22
2. Minerals: Their Constitution and Origin by Wenk, H.R. and Bulakh., 2004, A Cambridge University Press
3. Metallogeny and Mineral Deposits of Pakistan by Kazmi, A.H. & Abbas, S.G., 2001, Orient Petroleum
4. Geology and Tectonics of Pakistan by Jan, M.Q. & Kazmi, A.H., 1997, Graphics Publishers
5. Geology of Pakistan by Bender and Raza., 1995, Gebruder Borntraeger, Berlin
6. Manual of Mineralogy 21st Edition by Klein, C., 1993
7. Principles of Mineralogy by Blackburn., 1992
8. Mineral and Rocks for Industries by Ahmad, Z. & Siddiqi, R.A., 1992, Geological Survey of Pakistan.
9. Directory of Mineral Deposits of Pakistan by Ahmad, Z., 1969, Geological Survey of Pakistan
10. Industrial minerals and rocks by Lefond, S.J (1983) American Institute of Mining and metallurgical and petroleum Engineering, Inc.

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Director