

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

COURSES AND SYLLABI

FOR

**M.PHIL APPLIED GEOLOGY
(MICROPALAEONTOLOGY / STRATIGRAPHY)**

DURATION: 2 YEARS
COURSE WORK: 24 CREDIT HRS
THESIS WORK: 06 CREDIT HRS

Course Code:	Course Title	Credit hrs
FIRST SEMESTER		
GEOL-501	REGIONAL GEOLOGY (CORE-SUBJECT)	03
GEOL-511	ADVANCE STRATIGRAPHY	03
GEOL-512	MICROPALAEONTOLOGY	03
GEOL-513	SEQUENCE STRATIGRAPHY	03
SECOND SEMESTER		
GEOL-505	RESEARCH METHODOLOGY AND TECHNICAL WRITING (CORE-SUBJECT)	03
GEOL-514	ADVANCE SEDIMENTOLOGY	03
GEOL-515	PETROLEUM GEOLOGY OF PAKISTAN	03
GEOL-516	PALYNOLOGY	03
GEOL-517	BASIN ANALYSIS	03
GEOL-518	TECTONICS OF PAKISTAN	03
GEOL-519	APPLICATIONS OF REMOTE SENSING AND GIS IN OIL EXPLORATION	03

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COURSE OUTLINE

**M.PHIL APPLIED GEOLOGY
(MICROPALAEONTOLOGY / STRATIGRAPHY)**

Duration: 2 years

Course Work 24 Credit hours

Thesis Work 06 Credit hours

FIRST SEMESTER

GEOL-501: REGIONAL GEOLOGY (CORE-SUBJECT, 03 Credit Hours)

The geology of Himalayas, Karakoram and Hindukush ranges. The geology and stratigraphy of the Salt Range, Sulaiman Range and Kirthar Range. The Katawaz Basin. The Makran and adjacent regions. The Chagai and adjacent regions. Ophiolites of the region. The Deccan traps and hot spots. The Geology of Indian Plate.

Books Recommended

1. Geology and tectonics of Pakistan by Kazmi, A.H., Jan, M.Q. (1997), Graphic Publishers, Karachi
2. Geodynamics of Pakistan, by A.Farah and K.DeJong, 1979, Elite Publishers, Karachi, Proceedings of the International Committee on Geodynamics.
3. Geology of Pakistan by Bender and Raza, 1995, Gebruder Borntraeger, Berlin.
4. Reconnaissance Geology of Part of West Pakistan, HSC, 1960.
5. Stratigraphy of Pakistan, S.M. Ibrahim Shah, 1997, GSP Memoir.
6. Stratigraphy of Pakistan, S.M. Ibrahim Shah, 2008, GSP Memoir (2nd Edition).
7. Stratigraphy of Pakistan, by Kazmi and Abbassi, 2008.

GEOL-511 ADVANCE STRATIGRAPHY (03 Credit hrs)

Detailed study of Stratigraphic Principles, Stratigraphy of Pakistan with reference to regional distribution. Correlation of different Stratigraphic units, Stratigraphic boundaries in the geological records, Major geological events of Pakistan stratigraphy and their implications, Global bioevents and their recognition in Pakistan stratigraphic framework

Lab.

Preparation of Stratigraphic sections and columns and their interpretation with reference to Event Stratigraphy. Identification of stratigraphic specimens and their interpretation with reference to Biostratigraphy.

Books Recommended:

1. Howell, J.A. and Aitken, J.F. (1996). High resolution sequence stratigraphy: innovations and applications, Geological Society Special Publication No. 04, USA.

2. Andrew D. Miall (1997). *The Geology of Stratigraphic Sequences*, Springer Verlag, Berlin, Heidelberg, Germany.
3. Henry W. Posamentier, Colin P. Summerhayes, Bilal, U. Haq and Goerg P Allen (1993). *The Sequence Stratigraphy and Facies Associations*, The International Association of Sedimentologists, Blackwell Scientific Publication, Oxford, UK.
4. Gary Nichols (2009). *Sedimentology and stratigraphy*, 2nd Edition, Willey Blackwell.
5. Angela L. Coe, Dan W.J. Bosence, Kavin D. Church, Stephen S. Flint, John A. Howell and R. Chris L. Wilson (2003). *The sedimentary record of sea-level change*, The Open University, Cambridge University Press, U.K.
6. S. M. Ibrahim Shah (2009). *Stratigraphy of Pakistan*, GPS Memoir, Vol. 22, published by Geological Survey of Pakistan, Quetta,

GEOL-512 MICROPALAEONTOLOGY (03 Credit hrs)

Classification of marine environments, Life history and paleoecology of foraminifera, Morphology of smaller and larger foraminifera, Planktonic foraminifera biozones and their importance in Upper Cretaceous Biostratigraphy, Planktonic foraminifera in Upper Cretaceous rock of Pakistan, Shallow Benthic Biozones in Paleogene Biostratigraphy, Larger foraminifera in Paleocene-Eocene rocks of Pakistan, Paleobiostratigraphy of larger Benthic foraminifera, Stratigraphic distribution of foraminifera in oil bearing rocks of Pakistan, Introduction to Conodonts and their importance in Pakistan Stratigraphy, Ostracodes and their salient features, Introduction to Stromatolites, Cocoliths and Nano-fossils, Micropaleontological correlation of sedimentary rocks

Lab.

Identification and description of characteristic foraminiferal species and their stratigraphic significance in Pakistan stratigraphy, Identification of Conodonts, Ostracodes, Slide preparation for the study of nano fossils, Identification of Nano fossils of oil bearing rocks of Pakistan.

Books Recommended:

1. Devesh K. Sinha (2006). *Micropaleontology* 1st edition, Narosa Publishing House, New Delhi and Alpha Science International Oxford, UK.
2. David Barnard Ericson and Goesta Wollin (1962). *Micropaleontology*, 1st edition, Freeman, San Francisco.
3. James D. McLean (1959). *Micropaleontological Techniques*, 1st edition, Mclean Meteorological Laboratory, Alexandria.
4. Martin F Glaessner (1947). *Principles of micropaleontology* 1st edition, John Willey & Sons, N.Y. USA.
5. James Douglas McLean (1963). *Manual of micropaleontological stratigraphy* 2 edition, Mclean Paleontological Laboratory Alexandria Victoria. U.K.
6. Ronald E. Martin (2000). *Environmental Micropaleontology (Topics in Geobiology)* 1 edition, Kluwer / Plenum.
7. Martin F. Glaessner (1947). *Principles of micropaleontology*, 1st edition, John Wiley & Sons, New York, USA.
8. James Douglas McLean (1963). *Manual of Micropaleontological Stratigraphy*, 2nd edition, McLean Paleontological Laboratory, Alexandria Victoria. U.K.
9. Ronald E. Martin (2000). *Environmental Micropaleontology (Topics in Geobiology)* 1st edition Kluwer / Plenum. Hardback.

GEOL-513 SEQUENCE STRATIGRAPHY (03 Credit hrs)

Introduction and Development of Sequence Stratigraphy, Concepts and principles of Sequence stratigraphy, Basin forming processes and basin margin concepts, relative sea-level and eustasy, Sequence Stratigraphic Tools: Seismic stratigraphy, Chronostratigraphy and Biostratigraphy, Application of Sequence stratigraphy to depositional systems like fluvial systems, deep and shallow marine clastic systems, carbonate system, organic rich facies and hydrocarbon source rocks

Lab.

Preparation of Stratigraphic section, columns and their interpretation with reference to Sequence stratigraphy, Identification of stratigraphic specimens and their interpretation with reference to Sequence stratigraphy.

Books Recommended:

1. Emery, D. and Myers, K.J. (1996). Sequence Stratigraphy, 2nd editions, Blackwell Science
2. Gradstein, F.M., Sandvik, K.O and Milton, N.J (1998). Sequence Stratigraphy (Concept and Applications), Proceedings of the Norwegian Petroleum Society Conference, 6-8 September 1995, Stavanger, Norway, Elsevier, Amsterdam and New York.
3. Prabha Kalia (1989), Micropaleontology of the shelf sequences of India, Proceedings of XII Indian Colloquium on Micropaleontology and Stratigraphy, Papyrus Publishing house in New Delhi, India.
4. Sequences, Stratigraphy, Sedimentology, Canadian Society of Petroleum Geologists. Technical Meeting 2 editions - first published in 1988.
5. Wolfgang Schlager (2005). Carbonate Sedimentology and Sequence Stratigraphy 1 edition, Society of Economic Paleontologists and Mineralogists SEPM.
6. R. G. Loucks (1994). Carbonate Sequence Stratigraphy, 1 edition, American Association of Petroleum Geologists.
7. Octavian Catuneanu (2003). Sequence Stratigraphy of Clastic Systems, 1st edition, Geological Association of Canada.
8. Paul Weimer (1994). Siliciclastic Sequence Stratigraphy (Recent Development and Applications), AAPG Memoir, 1 edition, American Association of Petroleum Geologists, USA.
9. Octavian Catuneanu (2006). Principles of Sequence Stratigraphy (Developments in Sedimentology) 1 edition, Elsevier Science.
10. Dominic Emery, Keith Myers and George T. Bertram (1996). Sequence stratigraphy 2nd edition, Blackwell Science.
11. Norsk petroleumforening. Conference, F. M. Gradstein, K. O. Sandvik, and Nick J. Milton(1998). Sequence stratigraphy: concepts and applications 1st edition, Stavanger, Norway.
12. Colloquium(1989). Micropaleontology of the shelf sequences of India 1st edition, published by Indian Colloquium New Delhi, India)
13. Wolfgang Schlager and Lorenz Keim (2005). Carbonate Sedimentology and Sequence Stratigraphy 1st edition, Society of Economic Paleontologists and Mineralogists SEPM.
14. Octavian Catuneanu (2003). Sequence Stratigraphy of Clastic Systems1st edition, Geological Association of Canada.
15. Paul Weimer, and Henry W. Posamentier (1994). Recent Developments and Applications in Siliciclastic Sequence Stratigraphy 1st edition, South Boulder, Tusla, U.S.
16. Octavian Catuneanu (2006), Principles of Sequence Stratigraphy (Developments in Sedimentology) st edition, Elsevier Science.

SECOND SEMESTER**GEOL-505: RESEARCH METHODOLOGY AND TECHNICAL WRITING (CORE-SUBJECT
03 Credit Hours)**

Background and philosophy of research: concept of research, types of research, elements of research. Types of data for research. Various stages of research, research methods and methodology. Research proposal, selection of a research topic and problems, literature survey, reference collection, hypothesis, mode of approach, actual investigation, results and conclusion, presenting an oral scientific seminar, writing a report, research paper and thesis. Layout of a research report PhD thesis/ M.Phil dissertation. Plagiarism and its professional consequences.

GEOL-514 ADVANCE SEDIMENTOLOGY (03 Credit hrs)

Sedimentary processes, weathering, transportation and deposition, Sedimentary structures, Textures and structures of sandstone, nomenclature and their classification, diagenesis. Examples from Pakistan. Clay, shale, mudstone, their salient features and examples from Pakistan. Deposition and diagenesis of carbonate rocks, examples from Pakistan. Evaporites and organic rich sedimentary rocks and their examples from Pakistan. Residual deposits, their characteristic features and examples from Pakistan. Economic aspects of Sedimentology with reference to hydrocarbons.

Lab.

Study of different sedimentary structures, Microscopic study of sedimentary rocks for the recognition of microfacies, diagenesis and interpretation of their environments of deposition.

Books Recommended:

1. P. J. Brenchley (1985). Sedimentology, Recent Developments and Applied Aspects (Geological Society Special Publication), American Association of Petroleum Geologists.
2. Billy J. Barfield (1981). Applied hydrology and Sedimentology for disturbed areas, 1 edition, Oklahoma Technical Press in Hillcrest, Stillwater, Oklahoma.
3. H. Zimmerle (1995). Petroleum Sedimentology, 2 editions, Kluwer Academic Publishers.
4. Gary Nichols (1999). Sedimentology and stratigraphy, 2 editions, John Willey & Sons.
5. Lewis, D. W. and David McConchie (1994). Analytical Sedimentology, 1 edition, Chapman & Hall, New York, USA.
6. Gerald M. Friedman and John E. Sanders (1978). Principles of sedimentology, 1 edition, John Willey & Sons, New York, USA.
7. Maurice E. Tucker and V. Paul Wright (1990). Carbonate Sedimentology, 1 edition, Blackwell Science Publications.

GEOL-515 PETROLEUM GEOLOGY OF PAKISTAN (03 Credit hrs)

Introduction and concepts of Petroleum geology, History of petroleum exploration, offshore and onshore, Salient features of Reservoir and Source rocks and examples from Pakistan, Hydrocarbon potential rocks of Pakistan, Major Tectonic elements and their hydrocarbon potential, Producing and potential oil and gas reservoirs of Pakistan

Lab.: Specific assignments/projects

Books Recommended:

1. Allah Dino Memon (2005). Petroleum Geology and Hydrocarbon prospects of Sindh, Pakistan, 2 editions, published by Allah Dino, Hyderabad, Pakistan.
2. Muhammad Akhtar (2003). Bibliography and index of geology of the Punjab, Pakistan, 1 edition, published by Ministry of Petroleum and Natural Resources, Govt. of Pakistan.
3. Iqbal B. Kadri (1995). Petroleum Geology of Pakistan, 1 edition, Pakistan Petroleum Limited (PPL), Karachi, Pakistan.

4. Liverson (2006). Geology of Petroleum 2nd Edition, Cbs Pubs Dists (rs), India.
5. Selley (1997). Elements of Petroleum Geology 2nd Edition, Academic Press.

GEOL-516 PALYNOLOGY (03 Credit hrs)

Introduction of palynomorphs, their collection and preparation, Kinds and function of spores, history of pollens and spores, fossilization and paleoecology of palynomorphs, Morphological features of spores and pollen grains, their nomenclature and classification, Stratigraphic significance and application of palynology in Petroleum industry.

Lab.

Separation and mounting of Palynomorphs and their microscopic study, Preparation of correlation and biostratigraphic columns with reference to Stratigraphy of Pakistan.

Books Recommended:

1. M. R. Saxena (1993). Palynology 1st edition, Science Pub. Inc.
2. Robert H. Tschudy (1969). Aspects of palynology, 3 editions, Willey-Inter-science, New York, USA.
3. P. K. K. Nair (1966). Essentials of Palynology, 2 editions, Asia Publishing House, London, UK.
4. A. A. Manlen (1966). Marine palynology, 2nd International Conference on Palynology Utrecht, Published by Elsevier, Amsterdam, Netherlands.
5. P. Krishnan Kutty Nair (1964). Advances in palynology, 2 editions, Published by National Botanic Gardens, Lucknow, India.
6. Clair A. Brown (1960). Palynological Techniques, 1 edition, Published by University of Illinois at Urbana-Champaign, USA.
7. Maryalice Walker (2006). Entomology and palynology, 1 edition, Meson Crest Publishers, Philadelphia.
8. Gunnar Erdtman (1969). Handbook of palynology, 1 edition, Published by Manksqaards, Copenhagen, Denmark.

GEOL-517 BASIN ANALYSIS (03 Credit hrs)

Sedimentary basins and their classification, Sedimentation and plate tectonics, Basin model concept, Divergent and Convergent plate margin basins, Transform margins and pull apart basins, Basin associated with sutures, Factors controlling basin stratigraphy and tectonic mechanism, Eustatic sea level changes; causes and responses, The basin fill deposition style, deposition system and facies model, continental, coastal, near shore and deep sea depositional systems, Sedimentary basins of Pakistan

Lab.: Stratigraphic columns and their correlation. Textural and paleocurrent data interpretation.

Books Recommended:

1. I. Lerche (1990). Basin analysis 2 editions, Academic Press, USA.
2. P. A. Allen (1990). Basin analysis, 2 editions, Blackwell Scientific Publication.
3. Paul Edwin Potter and F.J. Pettijohn (1963). Paleocurrents and basin analysis, Springer.
4. Andrew D. Miall (1984). Principles of sedimentary basin analysis, 4 editions, Springer.
5. C. E. B. Conybeare (1979). Lithostratigraphic analysis of sedimentary basins, 1 edition, Academic Press, New York, USA.

GEOL-518 TECTONICS OF PAKISTAN (03 Credit hrs)

Introduction to Tectonics, concept of Pangea and Gondwana supercontinents, Permian separation, Early Cretaceous split and northward flight of Indian, Concept of MMT, MBT, MKT, MCT and HFT, Closure of Neotethys and collision tectonics, Himalayan orogeny; constrains on the timing of India-Eurasia collision, Tectonic zonation of Pakistan, Kohistan-Laddakh Island arc terrane, The Himalayas; internal and external zones, Indus platform and foredeep, Indus delta

Lab.: Specific assignments/projects

Books Recommended:

1. Ali H. Kazmi and M. Qasim Jan (1997). Geology and tectonics of Pakistan, 1 edition, Muze Inc. UK.
2. Mazhar Qayyum (1997). Sedimentation and tectonics in the Tertiary Katawaz Basin, NW Pakistan 1 edition, Graphic Publishers, Karachi, Pakistan
3. Herald Drewes (1995). Tectonics of the Potwar Plateau region and the development of syntaxes, Punjab, Pakistan, US Geological Survey, Washington, USA.
4. Mazhar Qayyum (1991). Crustal shortening and tectonic evolution of the Salt Range in Northwest Himalaya, Pakistan, 1 edition,
5. Ishtiaq Ahmad Khan Jadoon (1991). Thin-skinned tectonics on continent/ocean transitional crust, Sulaiman Range, Pakistan 2 editions.
6. Steven C. Jaumé (1986). The mechanics of the Salt Range-Potwar Plateau, Pakistan, 1 edition, Thesis (M.S.), Oregon State University, USA.
7. Philip L. Verplanck (1986). A field and geochemical study of the boundary between the Nanga Parbat-Haramosh massif and the Ladakh arc terrane, northern Pakistan by 1 edition, Thesis (M.S.), Oregon State University, USA.

GEOL-519 APPLICATION OF REMOTE SENSING AND GIS IN OIL EXPLORATION (03 Credit hrs)

Fundamentals of remote sensing, digital image data formats, image rectification and restoration techniques - geometric correction, radiometric correction and noise suppression, image histograms, density slicing, image enhancement techniques contrast manipulation, spatial filtering and edge enhancement, multi-image manipulations spectral rationing, vegetation indices, principal components analysis, multi-spectral image classification involving supervised and unsupervised algorithms, Recent developments and applications.

Fundamentals of GIS, vector, raster and attribute data models, vector and raster data structure, spatial data input and editing, visualization and query of spatial data, spatial data transformations, spatial analysis, case studies of geological applications, current issues and trends in GIS. Principles of global positioning systems (GPS) and its applications. Some Case Studies in Petroleum exploration.

Lab.

Practical application of remote sensing, GIS in Petroleum Geology, Hands on practice on Arc GIS, IDRISI Softwares for Petroleum Exploration.

Books Recommended

1. Jensen, J.R. (1996). Introductory Digital Image Processing: a Remote Sensing Perspective, Prentice Hall, New Jersey
2. Gupta, R.P. (2002). Remote Sensing Geology, 2nd edition, Springer-Verlag, Heidelberg.
3. Lillesand, T.M. and Kiefer, R.W. (2000). Remote Sensing and Image Interpretation, John Wiley & Sons, New York.
4. Benhardsen, T. (2002). Geographic Information Systems: an Introduction, John Wiley & Sons, New York, 2002.
5. Bonham-Carter, G.F. (1994). Geographic Information System for Geoscientists Modelling with GIS, Pergamon Press, Oxford, U.K.
6. Coburn C. Timothy and Yarus M. Jeffrey (2000). Geographic Information Systems in Petroleum Exploration and Development (AAPG Computer Applications in Geology, No. 4), American Association of Petroleum Geologists.