

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

COURSES AND SYLLABI

FOR

**PhD Applied Geology
(Stratigraphy / Micropaleontology)**

DURATION: 3-5 YEARS

COURSE WORK: 18 CREDIT HRS

| Course Code | Course Title | Credit hrs |
|--------------------|--------------------------------------|-------------------|
| GEOL-710 | BIOSTRATIGRAPHY | 03 |
| GEOL-711 | EVENT STRATIGRAPHY | 03 |
| GEOL-712 | APPLIED SEDIMENTOLOGY | 03 |
| GEOL-713 | Exploration Petroleum Geology | 03 |
| GEOL-714 | REGIONAL TECTONICS | 03 |
| GEOL-715 | PALEOECOLOGY | 03 |
| GEOL-716 | ADVANCE SEQUENCE STRATIGRAPHY | 03 |
| GEOL-717 | SEISMIC STRATIGRAPHY | 03 |

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COURSES AND SYLLABI FOR PhD Applied Geology (Micropaleontology / Stratigraphy)

GEOL: 710 BIOSTRATIGRAPHY(03 Credit Hrs)

Detailed study of different groups of faunal remains specially foraminifera, radiolarians, conodonts and nanoplankton and their significance with reference to hydrocarbon exploration in Pakistan. Foraminiferal biostratigraphy of Jurassic, Cretaceous and Tertiary times and the biozones established by important groups of fossils and their applications in Pakistan biostratigraphy.

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 Wiley & Sons, N.Y. USA.
5. James Douglas McLean (1963). Manual of micropaleontological stratigraphy 2nd edition, Mclean Paleontological Laboratory Alexandria Victoria. U.K.
6. Ronald E. Martin (2000). Environmental Micropaleontology (Topics in Geobiology) 1st 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: 711 EVENT STRATIGRAPHY(03 Credit Hours)

Detailed study of major events of Pakistan Geology like Pre-Cambrian and Cambrian sequence. Permo-Triassic boundary exposed in Salt Range and its global comparison. Jurassic and Cretaceous deposits and their significance. K-T boundary in different parts of Pakistan. Molasse deposits of Pakistan and their significance with reference to vertebrate fauna.

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.

- 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.
- Gary Nichols (2009). Sedimentology and stratigraphy, 2nd Edition, Willey Blackwell.
- 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.
- S. M. Ibrahim Shah (2009). Stratigraphy of Pakistan, GPS Memoir, Vol. 22, published by Geological Survey of Pakistan, Quetta,

GEOL.712 APPLIED SEDIMENTOLOGY(03 Credit Hours)

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.

Books Recommended:

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

GEOL:713 EXPLORATION PETROLEUM GEOLOGY(03 Credit Hours)

Components of the course focus on all aspects of upstream geosciences, from initial exploration for new prospects, through field appraisal and development, to maximizing recovery from mature and declining fields. Topics covered include: seismic interpretation, petrophysical analysis, geochemical evaluation, structural analysis, and reservoir modeling. Skills in the analysis of the subsurface are further developed by field work on outcrops and by hands-on experience with core logging.

Books Recommended

- Davis, G.H. & Reynolds, S.J., (1996). Structural Geology of Rocks and Regions, John Wiley & Sons.
- Twiss, R.J. & Moores, E.M. (2007). Structural Geology, Freeman.
- Suppe, J. (1985). Principals of Structural Geology, Prentice Hall.
- Ramsay J.G. & Huber, M.I., (1983). The Techniques of Modern Structural Geology. V.I. Stress and Strain, Academic Press.
- Ramsay J.G. & Huber, M.I., (1987). The Techniques of Modern Structural Geology. V.II Folds & Fractures, Academic Press.

6. Applied Concepts of Structural Geology in Hydrocarbon Exploration. OGTI Manual GL-303.
7. Exploration in Fold and Thrust Belts: Principles and Practices. OGTI Manual.

GEOL: 714 REGIONAL TECTONICS(03 Credit Hours)

Plate motions, Properties of Oceanic Lithosphere, Plate Driving Mechanisms, Constructive Margins, Destructive Margins, Orogens, Plumes and hotspots, Palaeogeography, Tectonic setting of Sub-Continent and its surroundings, Central Asia and Europe, northern and southern America.

Books Recommended

1. Kearey, P., Klepeis, K.A. and Vine, F.J. 2009. Global Tectonics. Wiley-Blackwell 3rd edition
2. Rogers, N., Blake, S., Burton, K., Widdowson, M., Parkinson, I. and Harris, N. 2008. An Introduction to Our Dynamic Planet. Cambridge University Press.
3. Leeder, M., 1999, Sedimentology and Sedimentary Basins: from turbulence to tectonics. John Wiley and Sons.
4. Bridge, JS. and Domecco, R. 2008. Earth Surface Processes, Landforms and Sedimentary Deposits. Cambridge University Press

GEOL: 715 PALEOECOLOGY(03 Credit Hours)

Introduction to the relationships of fossil organisms to one another and to their physical environment, focusing on terrestrial paleoecology of the past 2.5 million years. This class will introduce past environments, discuss common proxies for studying paleoecology, and examine ecological principles as applied to the past.

Explain and illustrate the collection, analysis and interpretation of paleoenvironmental, paleontological, physical and chemical data from marine and continental sediments that have accumulated through geologic time. Students will acquire skills needed to enable them to interpret a range of paleoclimatic, paleoecologic and paleoenvironmental data, as well as gain critical insight into current understanding of environmental change and the evolutionary adaptations of organisms to these changes.

The ecological factors affecting the distribution and abundance of fossil organisms, with emphasis on marine invertebrates. Invertebrates as a guide to environments of the past and as indicators of environmental change. Taphonomy of invertebrates.

Books Recommended

1. Lowe, J.J. and Walker, M.J.C., 1997. Reconstructing Quaternary Environments (second edition). Addison, Wesley and Longman, London
2. Prothero, D.ER., 2004. Bringing Fossils to Life: An Introduction to Paleobiology (second edition). McGraw-Hill.
3. Quade J, Cerling TE, Andrews P, and Alpagut B (1995) Paleodietary reconstruction of Miocene faunas from Pasalar, Turkey using stable carbon and oxygen isotopes of fossil tooth e Kaakinen A, Sonninen E, Lunkka JP (2006)
4. Stable isotope record in paleosol carbonates from the Chinese Loess Plateau: Implications for late Neogene paleoclimate and paleovegetation. Palaeogeography Palaeoclimatology Palaeoecology 237(2-4):359-369

GEOL: 716 ADVANCE SEQUENCE STRATIGRAPHY(03 Credit Hours)

Introduction, history, concept and significance of sequence stratigraphy, Seismic reflections and facies. Sea level changes, their causes and effects. Accommodation, eustatic sea level curve. Hierarchy of sequence stratigraphy elements. Types of sequences and systems. Tracts.

Books Recommended

1. Silici-clastic Sequence Stratigraphy in well Logs, Cores and Outcrops by Van Wagoner, J.C, et.al, 1990, AAPG Meth Expl. Ser. No. 7.
2. Sea level changes an integrated approach by Wilgus, B.S. et.al., 1988, SEPM.
3. Seismic Stratigraphy: Application to H-Carbon Exploration by Payton, C.W., 1977, AAPG Mem. 26.
4. Sequence Stratigraphy and Facies Association by Posamentier, H.W., et. Al., 1993, Blackwell.
5. Sequence stratigraphy by Emery, D., & Myers, K.J., 1996, Oxford, Blackwell.

GEOL. 717 SEISMIC STRATIGRAPHY(03 Credit Hours)

The stratigraphic significance of seismic reflectors, identification of depositional sequences, age determination of depositional sequences, recognition and analysis of the seismic facies present in terms of reflector geometry, continuity and amplitude and mapping their distribution, and Interpretations of relative changes of sea-levels. Hands-on exercises provide practice in: (i) identifying examples of reflection terminations (onlap, downlap, toplap), (ii) identifying depositional sequence boundaries on seismic sections on the basis of reflector terminations, (iii) determining the age of seismic sequences using appropriate borehole data, (iv) identifying different seismic facies on seismic sections, (v) making plots of coastal onlap and constructing chronostratigraphic summary chart from suitable seismic sections or geological cross-sections.

Books Recommended

1. C.L. Liner, (2004). Elements of 3D Seismology, Pennwell Corporation, U.S.A.
2. R.E. Sheriff, and L.P. (1995). Geldart, Exploration Seismology, Cambridge University Press.
3. W.M. Telford, L.P. Geldart, and R.E. Sheriff (1990). Applied Geophysics, Cambridge University. Press.
4. M.B. Dobrin, and C.H. Savit, (1988). Introduction to Geophysical Prospecting, McGraw Hill.
5. E.S. Robinson and C. Coruh, (1988). Basic Exploration Geophysics, John Wiley and Sons, New York,
6. G. Nichols, (1999). Sedimentology and Stratigraphy, Bloackwell Science Publisher.

(Prof. Dr. M. SaeedFarooq)
Director