

**UNIVERSITY OF KERALA
DEPARTMENT OF GEOLOGY**



M.PHIL. PROGRAMME IN GEOLOGY

SYLLABUS

(Under credit and semester system w.e.f 2016 admission)

UNIVERSITY OF KERALA
DEPARTMENT OF GEOLOGY

M.PHIL. PROGRAMME IN GEOLOGY

Programme objectives: The following are the objectives of the programme

- To introduce the students to advanced areas of research in geology
- To make the students competent in literature collection, especially the use of
- e-resources.
- To provide the students with knowledge, skills and competencies within the core subjects of the programme
- To introduce the students to sophisticated instruments
- To prepare the students to undertake research, carry out experiments and improve scientific communication skills.

Structure of the programme

Semester No.	Course code	Name of the course	Number of credits
I	GOL -711	Research methodology	4
	GOL -712	Recent Trends and Tools in Geosciences	4
	GOL -713 (i)	Advanced sedimentology	4
	GOL -713 (ii)	New trends in petrology	
	GOL -713 (iii)	Environment and advanced hydrogeology	
GOL -713 (iv)	Micropalaeontology		
GOL -713 (v)	Engineering geology		
II	GOL -721	Dissertation	20
		TOTAL CREDITS	32

Semester: I
Course Code: GOL-711
Course Title: RESEARCH METHODOLOGY
Credits : 4

Aim: To expose students to areas of creative thinking and critical reasoning which are relevant to his/her area of research and introduce the student to current research issues and processes. After completing this course the student is expected to be competent in literature and data collection, critical analysis of problems and communication of his/her observations and findings in a report.

Objectives: The course will consist of lectures and related activities that will help in developing good understanding of the method of research process and management. This should help in critical thinking, formulation of hypothesis, design of experiments and better scientific communication.

Course content

Module I

Objective and types of research: Motivation and objectives- Research methods vs methodology. Types of Research – Descriptive Vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.

Module II

Research Formulation: Defining and formulating the research problem- selecting the problem- Necessity of defining the problem- Importance of literature review in defining a problem- Literature review- primary and secondary sources- reviews, treatise, monographs- patents- web as a source – searching the web.

Module III

Research design and methods : research design – Basic Principles- Need of research design.- features of good design- Important concept relating to research design- observation and facts, Laws and Theories, Prediction and Explanation, Induction, deduction, Development of models.

Module IV

Data collection and analysis : Execution of research- Observation and collecting data- Methods of data collection- sampling methods- Data processing and Analysis strategies- Data analysis with statistical packages- Hypothesis – Testing- Generalization and Interpretation.

Module V

Reporting and Thesis writing: Structure and components of scientific reports- Types of report- technical report and thesis- Significance- Different steps in the preparation- Layout, Structure and language of typical reports- Illustration and tables. Bibliography, referencing and footnotes- Oral presentation- Planning and Preparation- Practice- Making presentation- Use of visual aids- Importance of effective communication.

References

- Banerjee, S., and Roy, R., 2008. Fundamentals of Research Methodology, Kitab Mahal.
- Bhattacharya, D.K., 2006. Research Methodology, second edition, Excel Books.
- Garg, B.L., Karadia, R., Agarwal, F and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA publishers.
- Kothari, C.R., 1990. Research methodology : Methods and Techniques. New Age International, 418p.
- Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, ESS ESS Publications. 2 Volumes.
- Trochim, W.M.K., 2005, Research Methods: The Concise knowledge base, Atomic Dog Publishing, 207p.
- Wadehra, B.L., 2000. Law relating to Patents, trademarks, copy right

Semester: I

Course Code: GOL-712

Course Title: RECENT TRENDS AND TOOLS IN GEOSCIENCES

Credits : 4

Aim: The aim of the course is to introduce and familiarize modern tools in Geoscience. After completing the course the student is expected to be capable of doing research which makes use of the lab facilities available in various scientific laboratories.

Objectives: The objective of the course is to introduce and equip the students in working with modern tools in geoscience. The course will consist of lectures and lab activities that will help in developing good understanding of the method of research process, data analyses and presentation.

Course content

Module I

Sedimentary Depositional Environments: Depositional environments of fluvial, alluvial and river systems. Mechanism of sedimentary basin formation, Plate tectonics and basins, Kinds of sedimentary basins. Geo-chemical environments and pattern of geo-chemical distribution, geo-chemical dispersion, geo-chemical anomalies, dispersion halos. Geo-chemical drainage survey.

Module II

Geographical Information System (GIS): Remote sensing of the Earth, applications of GPS and Total Station. Principles of GIS and introduction to basic GIS software.

Module III

Planetary Science: Earth as a Planetary System, Structure of Earth, Interacting Earth Systems; the crust-crustal types-oceanic, transitional and continental- the Mantle-seismic structure of the mantle, the lithosphere, Low Velocity Zone, the transition zone, the lower mantle- the Core-the inner core, age and origin of the core. Planetary evolution-condensation and accretion of planets-members of the solar system- General surface features and processes

of Mercury, Mars and Venus and comparison with that of the earth; satellites, asteroids and meteorites ; impact chronology of the inner planets, volcanism in solar system; evolution of atmosphere in the Earth, Venus and Mars.

Module IV

Climate Variability: Palaeoclimatic proxies and applications in palaeogeography and palaeoenvironment studies. Climatic cycles in the history of earth. Climatic zones of India.

Oceanography: Composition of sea water: Major, minor and trace elements in sea water. Waves : Wave characteristics, Small amplitude ocean waves, Wave height, Wave period. Origin, growth and propagation of wind waves, tidal waves, standing waves and internal waves. Ocean Currents : Formation of currents, Thermohaline circulation, Ekman spiral and Ekman transport, Upwelling and sinking. Tides : Formation and different types, Measurement of Tides.

Module V

Instrumentation in Geosciences : Principles and applications of XRF, XRD, Microprobe (EPMA), AAS, SEM, ICP-MS, etc. Preparation of standards and samples.

Quaternary Environments: Atmospheric circulation and environmental changes during Quaternary, volcanic and tectonic activities during Quaternary, Quaternary glaciation. Pattern of glacial and interglacial cycles. Glacial and interglacial desert environments. Evidences of Quaternary changes from oceans, rivers, lakes, deserts, terrestrial fauna and flora.

References

- Allen, J.R.L. 1985. Principles of Physical Sedimentology, Chapman and Hall and Sons, 567p.
- Barry, R.G. and Chorley, R.J. 2003. Atmosphere, Weather and Climate, Routledge-Taylor & Francis Group.
- Blatt, H; Middleton G and Murray, R. 1980. Origin of Sedimentary Rocks, Prentice-Hall, INC, Englewood Cliffs, New Jersey.
- Battarbee, W., and Binney, H.A. (Ed.) 2008. Natural Climate variability and Global warming – A Holocene Perspective, Richard, Wiley Blackwell.
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- Bloom, A.J. 2010. Global Climate Change – Convergence of Disciplines, Sinauer Associates, 398p.
- Bradley, R.S. 1999. Paleoclimatology – Reconstructing Climates of the Quaternary, Elsevier, 479p.
- Burrough, W.J.S.2005. Climate Change in Prehistory, Cambridge University Press, 298p.
- Condie, K.C. 2011. Earth as an Evolving Planetary System, second edition, Elsevier, Academic Press, New York, 574p.
- Cunningham and Saigo 2005. Environmental science, McGraw Hill Book Company, 640p.
- Hartmann, W. K. 1983. Moons and Planets, Belmont, CA: Wadsworth, 509p.

- Heide, F. and Wolzka, F.1994. Meteorites- messengers from space, Springer-Verlag, Berlin, 231p.
- Jian Guo Liu . 2016. Image processing and GIS for Remote Sensing
- Keller A.E. 1992. Environmental geology, VIIIth edition, Prentice Hall.
- Lal, D.S. 2003. Climatology, Sharda Pusthak Bhavan, 11, University Road, Allahabad.
- Lal, D.S. 2007. Oceanography, Sharda Pustak Bhawan, Allahabad.
- Leeder, M. 2011. Sedimentology and sedimentary basins- From turbulence to tectonics, Wiley-Blackwell.
- Letcher, T.M. (Ed.) 2009. Climate Change – Observed impacts on planet earth, Elsevier..
- Mazumder, R. 2017. Sedimentary Provenance- influences on compositional change from source to sink, Elsevier.
- Murck, B. W., Skinner, B. J., and Porter, S. C. 1996. Environmental geology, John Wiley.
- Murthy, P.B. 2004 Environmental Meteorology, I.K.International Pvt.Ltd.
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- Ningchuan Xio. 2016.GIS Algorithms: Theory and Applications for Geographic Information Science and Technology
- Picard, G.L. 1982. Descriptive Physical Oceanography, Oxford- Pergamon, 598p.
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- Saltzman, B. 2002 Dynamical Paleoclimatology – Generalized Theory of Global Climate Change, Academic Press.
- Sam Bogg, Jr. 2012. Principles of Sedimentology and Stratigraphy, Pearson Prentice Hall, USA.
- Shafi, S.M. 2005. Environmental pollution, Atlantic publishers, New Delhi.
- Siddhartha, K. 2002. Atmosphere, Weather and Climate, Kisalaya Publications Pvt.Ltd, 512p.
- Siddhartha, K., Oceanography. 2010. A Brief Introduction, Kisalaya Publishers Pvt.Ltd., New Delhi.
- Singh, S. 2008. Oceanography, Prayag Pustak Bhawan, Allahabad.
- Sirocko, F., Claussen, M., Goni, M.F.S. and Litt, T. (Eds.), 2008. The Climate of Past Interglacials, Elsevier.
- Williams, M.A.J., Dunkerley, D.L., De Dekker, P., Kershaw, A.P., and Stokes.T. . 1993. Quaternary Environments, Hodder & Stoughton, 329p.

Semester : I

Course Code: GOL-713 (i)

Course Title: ADVANCED SEDIMENTOLOGY

Credits : 4

Aim: The aim of this course is to study sedimentary rocks and to understand the depositional environments. The micro and macro structures and textures of common sedimentary rocks need to be studied in detail to decipher the geologic history.

Objective: Study the occurrence, composition, texture, and other overall characteristics of sedimentary rocks.

Module I

Sedimentary environments – continental, transitional and marine.
The processes and products. Geochemical environments.
Date collection and stratigraphic analysis.

Module II

Barrier islands. Marine shelf sedimentation.
Fluvial sedimentation. Deltas. Coastal dunes. Desert sedimentation. Deep sea sediments.
Turbidity currents and Turbidites. Methods of collecting marine sediments.

Module III

Sediment production - Role of weathering and climate. Parent rock and relief.
Erosion – Geological and accelerated.
Sediment load.
Methods of documenting erosion dates.
Fundamentals of sediment transport.

Module VI

Principles of fluid mechanics, shear stress.
Estimation of sediment transport rates and discharge.

Module V

Modern sedimentation in the shore and shelf zones.
Submarine fans and the sedimentary processes.

References

- Allen, J.R.L., 1985. Principles of Physical Sedimentology, Chapman and Hall.
- Blatt, H; Middleton G and Murray, R (1980) Origin of Sedimentary Rocks, Prentice-Hall, INC, Englewood Cliffs, New Jersey.
- Bogg, S. Jr. 2012. Principles of Sedimentology and Stratigraphy, Pearson, USA.
- Chorley, R.J., 1977. Introduction to fluvial processes, Harper and Row publishers.
- Krumbein, W.C., and Sloss, L.L, 1953. Stratigraphy and sedimentation, W.H Freeman and company.
- Leeder M.R. 1982 Sedimentology Process and Product, Chapman & hall.
- Leeder, M. R, 2011, Sedimentology and sedimentary basins- From turbulence to tectonics, Wiley-Blackwell.
- Mazumder, R., 2017, Sedimentary Provenance- influences on compositional change from source to sink, Elsevier.
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- Swift, D.J.P., Duane, D.B., and Pilkey, O.H., 1972. Shelf sediment transport: Process and pattern, Dowden, Hutchinson and Ross, Inc.

Semester : I
Course Code: GOL-713 (ii)
Course Title: NEW TRENDS IN PETROLOGY
Credits : 4

Aim: To make the student competent to pursue research in the field of igneous/metamorphic petrology. Latest tools in geochemistry, mineral chemistry and geochronology will be introduced.

Objective: To give a firm grip to the student on the properties, chemical composition, structure, phase changes and physico-chemical conditions of formation of important mineral groups which form the bulk of igneous and metamorphic rocks. To make the student competent to understand the relationship of magmatism and tectonic environment and to pursue research in igneous and metamorphic petrology

Module I

Rock forming minerals: Chemical composition, Structure, Physical and Optical properties of: olivine, pyroxene, amphibole, feldspar, feldspathoid, mica, silica, spinel, garnet, aluminosilicate and carbonate groups.

Module II

Minerals in the mantle and phase changes

Origin and evolution of magmas, influence of volatiles and oxygen fugacities in magmatic crystallization.

Granites and their origin- types of granites- pegmatites- their nature, occurrence and origin

Magmatism in relation to plate tectonic settings- mid ocean ridges, island arcs, oceanic plateaus, continental margins, continental rifts and continental intraplates

Module III

Lunar Rocks: Introduction, Lunar mineralogy, Lunar petrology- the igneous rocks, the fines and microbreccias, comparison with Terrestrial rocks, meteorites and Tektites, lunar geochemistry.

Module IV

Concept of metamorphism: Classification and types of metamorphism, Factors of metamorphism, Metamorphic facies and grade, Textures and structures on metamorphic rocks.

Fluids and metamorphism: Fluids in the Earth crust, Sources of fluids in metamorphism, Metasomatism.

Module V

Phase Equilibria: Application of phase rule in metamorphic petrology, Graphical representation of mineral assemblages, ACF, AKF and AFM diagrams.

Geothermobarometry: and P-T-t paths, Geothermometry and geobarometry Tectonic evolution of metamorphic belts, paired metamorphic belts, Heat flow and metamorphism, Plate tectonics and metamorphism

References

- Bucher and Frey, 2000. Petrogenesis of Metamorphic Rocks, Springer.
- Condie, K. C. 2011. Earth as an Evolving Planetary System, second edition, Elsevier, Academic Press, New York, 574p.
- Deer, W. A., Howie, R. A. and Zussmann, J. 1996. The Rock Forming Minerals, Longman.
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- Nordstrom, D. K. and Munoz, J. L. Geochemical thermodynamics, Blackwell.
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- Winter J D .2012. Principles of Igneous and Metamorphic Petrology, 2nd Edn.

Semester : I

Course Code: GOL-713 (iii)

Course Title: ENVIRONMENT AND ADVANCED HYDROGEOLOGY

Credits : 4

AIM: The aim of the course is to introduce the latest developments in the field of environmental geology and hydrogeology, with the aim to inculcate ideals of societally relevant research in students.

COURSE OBJECTIVE: To make the student understand fundamental and advanced concepts of environmental science and hydrogeology.

Module I

Place of humans in the environment. Earth system, cycles, structure and materials. Hazardous geologic processes – earthquakes, volcanoes, tsunamis, landslides, mass wasting, subsidence and floods. Hazards of ocean and weather. Meteorite impacts.

Nature of earth resources-fossil fuels, mineral resources, water resources, near shore water and resources. Human impacts on environment – waste disposal contaminate in geologic environment, atmospheric change.

Module II

Tools of study – Environmental geologic maps and mapping.

Data sources and data storage. Archival data and baseline data.

Application of remote sensing data products.
Sampling of geological materials for environmental analysis.
Methods of collection, preservation and pre-treatment.
Types of instrumentation analysis in environment geochemistry.
Environmental geochemistry - Geochemistry and water quality. Geochemistry and agriculture. Geochemistry and man.

Module III

Metal pollution of soils, rivers and estuaries.
Coal mining and human health.
Radio activity in the environment.

Module IV

Groundwater movement.
Surface and subsurface investigations for groundwater.
Groundwater and well hydraulics.
Pollution of groundwater.
Groundwater modeling techniques.
Water balance studies.

Module V

Artificial recharging of aquifers.
Isotope Hydrogeology
National Groundwater Status
Groundwater conditions in Kerala.

References

- Cunningham and Saigo 2005. Environmental science, McGraw Hill, 640p.
- Fetter, C.W., 2014. Applied Hydrogeology, Fourth edition, Pearson.
- Hiscock, K.M., and Bense, V, F., 2014. Hydrogeology Principles and Practice, Wiley Blackwell.
- Keller A.E.1992. Environmental geology, 8th, Prentice Hall.
- Murck, B. W., Skinner, B. J. & Porter, S. C. 1996., Environmental Geology, John Wiley and Sons, 567p.
- Neill, P.O. 1998, Environmental chemistry, George Allen & Unwin, UK.
- Shafi, S.M. 2005, Environmental pollution, Atlantic publishers, New Delhi.
- Thangarajan, M., and Singh, V.P., 2016. Groundwater Assessment modeling and management, CRC Press.
- Todd, D.K., and Mays, L.W., 2015. Groundwater Hydrology, Wiley.

Semester : I

Course Code: GOL-713 (iv)

Course Title: MICROPALAEONTOLOGY

Credits : 4

Aim: The aim of this course is to make the student competent to pursue research in the field of micropaleontology.

Objective: To develop skills in microfossil identification and its application to various geoexploration and environmental studies.

Module I

Environmental distribution of Foraminifera and Ostracoda.
Deep sea record and stable isotopic study of foraminifera.

Module II

Boundary Problems and micro fossils.
Environmental significance of micro fossils.

Module III

Micro fossils as tools for palaeo-environmental, palaeo-ecological and palaeo-oceanographic studies.

Module IV

Micro fossils as pollution indicators.

Module V

Application of microfossils and pollen analysis in Quaternary sea level studies.

References

- Brasier, M.D., 1980. Microfossils, George Allen and Unwin Ltd.
- Jones, R.W., 2004. Micropalaeontology in petroleum exploration, Oxford University press Inc.
- Kathall, P.K., 2011. Applied Geological Micropalaeontology, Scientific publishers.
- Sinha, D.K., 2007. Micropalaeontology- Application in stratigraphy and paleoceanography. Narosa publishing house, New Delhi, 381pp

Semester : I

Course Code: GOL-713 (v)

Course Title: ENGINEERING GEOLOGY

Credits : 4

Aim: To make the student acquainted with the application of geology in the field of civil engineering.

Objective: The student would be provided with an insight about the role of a geologist in handling engineering geologic applications.

Module I

Engineering properties of rocks: Specific gravity, porosity, Sorption, Strength of rocks, compressive strength, tensile strength, Compression and shear tests on rocks.

Module II

Applied Geology: Surface and subsurface geological and geophysical investigations in major civil engineering projects. Geological studies of dams and reservoir sites, Geological studies for selection of tunnels and underground excavations.

Module III

Soil profile, soil particles, soil structure, plasticity and swelling, concrete aggregates, cement aggregate reaction.

Module IV

Landslides – Stability of slopes, Minor soil and rock displacement, causes of landslide, Types and causes of landslides. Prevention of landslides.

Module V

Landslides studies in India and Kerala.

References

- Bell, F.G., 2012. Fundamentals of Engineering Geology, B S Publication.
- Bromhead, E.N., 1995. The stability of slopes, Blackie Academic and Professional.
- Fletcher. 2016. Geology for Ground Engineering Projects. Taylor & Francis, 256p
- Geotectonics, CBS Publishers & Distributors Pvt Ltd, 730p
- Gokhale, K.V.G.K., 2005. Principles of Engineering Geology, B S Publication.
- Krynine, D.P., William, R. and Judd 2005. Principles of Engineering Geology

Semester: II

Course Code: GOL-721

Course Title: Dissertation

Credits : 20

Aim: The programme aims to make the students competent in formulating a research problem in geology and in developing a deeper understanding of field methods and data-collection practices. Skills for scientific writing and thesis preparation will also be developed.

Objectives: The objective of the course is to introduce and equip the students in understanding of the method of research process, field work, laboratory work, data analyses and presentation.