Department of Geology
IGNTU, Amarkantak

COURSEWORK
SYLLABUS
Ph.D. Geology

2019

Ph.D COURSE LAYOUT

A) Compulsory Courses (10 credits)

Course Code	Title	Nature	Credits
GEOCC-01	Research Methodology	Compulsory	**04**
GEOCC-02	Instrumentation & Techniques in Geological Sciences	Compulsory	**04**
GEOCC-03	Review of literature and presentation of a seminar on a research theme related topic approved by concerned DRC & RAC.	Compulsory	**02**

B) **Elective Courses (04 credits)**

Course Code	Title	Nature	Credits
Any one of the following -		Elective	**04**
GEOEC-01	Precambrian Crustal Evolution and Geochemistry		
GEOEC-02	Deformation : Its kinematics and dynamics		
GEOEC-03	Late Neogene Paleoceanography, Paleoclimatology and Biostratigraphy		
Total credit (A+B)			**14**
Duration of the entire course		06 Months (One semester)	

DETAILED COURSE CONTENTS

A) Compulsory Courses

GEOCC-01: RESEARCH METHODOLOGIES

Unit-I: Definition of research problem: Theory and philosophy of research concept in context to Geological sciences; techniques involved in defining a problem. Surveying the related literature.

Unit II: Research Design and Developing research plan: Subject of study; Place of study; Research objective; Type of data required; Method of data collection; Defining major concept in various operational terms; Periods of study; data analysis and interpretation.

Unit III: Techniques involved in solving the problem: Sampling technique/ field methods, parametric analysis and Quantitative and qualitative methods in Geosciences.

Unit IV: Scientific writing: Concepts of article, notes, reports, review article, monographs, dissertations, popular science articles. Outline preparation, drafting title, sub titles, tables, illustrations; Formatting tables- title, body footnotes; figures & graphs- structure, title and legends, bibliographies, impact factor, citation indices, plagiarism

Unit V: Computerised analysis: MS word™, MS excel™, MS power point™, Sigma plot™, Grapher™, Origin, Corel draw™, ArcGIS™

Unit VI: Numerical Analysis/figure plotting: Standard deviation/error; Correlation coefficient, types of correlation, regression equation, geological significance of correlation and regression; Test of significance, chi-square test, analysis of variance.

List of Recommended Books:

1. Qualitative Research Methods for Social Sciences by Bruce, L. B. 2001, Allyn and Bacon, Boston.
2. Computer Applications in the Social Sciences by Edward, E.B., 1990, Temple University Press, Philadelphia.
3. Survey Methodology by Robert, M. B, et al., 2009, Wiley, New Jersey.
4. Social Research Methods by Bryman, A. 2008, Oxford University Press, New York.
5. Research Design: Qualitative, Quantitative and Mixed Methods Approaches by John, W. C., 2011, Sage Publications, Thousand Oaks.
6. Against Method: Outline of an Anarchist Theory of Knowledge by Paul F., 1975, New Left Books, London.
7. Power/Knowledge: Selected Interviews and Other Writings by Michel, F., edited by Colin Gordon, 1980, Vintage, New York.

8. The Structure of Scientific Revolutions by Thomas K., 1996, University of Chicago Press, Chicago.
9. Social Research Methods: A Reader by Seale C., 2004, Routledge, London.

GEOCC-02: INSTRUMENTATION & TECHNIQUES IN GEOLOGICAL SCIENCE

Unit-I: Introduction to advanced laboratory techniques: Working principles and concepts of Differential Thermal Analysis (DTA), X-ray Diffractions (XRD), Scanning Electron Microscope (SEM), ICP MS, X-ray fluorescence (XRF), Energy-dispersive X-ray spectroscopy (EDS, EDX, or XEDS), Mass spectrometer, Electron Microprobe Analysis (EPMA).

Unit-II: Techniques of sample preparation for Differential Thermal Analysis (DTA), X-ray Diffractions (XRD), Scanning Electron Microscope (SEM), ICP MS, X-ray fluorescence (XRF), Energy-dispersive X-ray spectroscopy (EDS, EDX, or XEDS), Mass spectrometer in the field of geosciences.

Unit-III: Understanding of petrological and stereozoom microscopes. Identification of common rock forming minerals. Sample preparation techniques for petrological sections studies, geochemical and palaeontological studies. Selecting appropriate analytical technique sources of error in geochemical analysis.

Unit-IV: Thermobarometric study for mineral exploration. Dating techniques: Conept of Radioactive Isotopes dating, Radionuclide dating, fission track dating, luminescence dating.

List of Recommended Books:

1. Recent developments in geochemical microanalysis: Chemical Geology by Reed, S. J. B., 1990, Volume. 83, PP. 1-9.
2. Elements of X-ray Diffraction by Cullity B. D., 1978, Addison-Wesley Publishing Company.
3. Principles of isotope geology by Faure, G., 1986, John Wiley and Sons, Inc., New York.
4. Introduction to Analytical Electron Microscopy by Goldstein, J., 1979, Plenum Press, New York and London.
5. Introduction to X-ray Powder Diffractometry by Jenkins, Ron and Snyder, Robert L., 1996, Vol. 138, Wiley & Sons, New York.
6. Electron Microprobe and Scanning Electron Microscopy in Geology by Reed, S. J. B., 1996, Cambridge University Press, Cambridge.
7. Handbook of Instrumental Techniques for Analytical Chemistry by Frank A. Settle, 1997, Prentice Hall, Upper Saddle River, NJ.
8. Stable isotope geochemistry by Hoefs J., 1987, Springer-Verlag, Berlin, Germany.

9. Microprobe Techniques in Earth Sciences by Potts, P. J., Bowles, J. F. W., Reed, S. J. B., and Cave, M. R., 1995, Chapman and Hall, London.
10. Electron Microprobe Analysis by Reed, S. J. B., 1993, Cambridge University Press, Cambridge.
11. Quantitative Electron-probe microanalysis by Scott, V., and Love, G., 1983.: West Sussex, Ellis Horwood.
12. Atomic absorption spectroscopy: Chemical Analysis by Slavin, Morris, 1978, John Wiley and Sons, New York.
13. An Introduction to Optical Dating by Aitken, M.J. 1998, Oxford University Press

B) **Elective Courses**

GEOEC-01: PRECAMBRIAN CRUSTAL EVOLUTION AND GEOCHEMISTRY

Unit-I: The Precambrian geological record and petrological, chemical and tectonic evolution of the crust and mantle. Special emphasis on Indian Precambrian record.

Unit-II: Magmatism in relation to plate tectonics; Enrichment mechanism in mantle and crustal sources, partial melting (batch and fractional melting); Crystal fractionation (equilibrium and fractional (Rayleigh) crystallization).

Unit-III: Application of major, trace and Rare Earth elements in petrogenesis. Geological controls of trace elements distributions. Understanding of trace element partition coefficient (kds).

Unit-IV: Magma generation in different tectonic scenario: minor elements finger-printing (through spider-diagram and rare earth elements patterns) for source characterization and magma tectonics.

List of Recommended Books:

1. Marjorie Wilson, 1989. Igneous petrogenesis
2. Cox, KG, Bell, JD and Pankhurst, RJ, 1993. The Interpretation of Igneous Rocks. Chapman & Hall, London
3. Rollinson, HR 2007. Using geochemical data-evaluation, presentation and interpretation. 2nd edition. Longman Scientific & Technical
4. Blatt H., Tracy R.J. and Owens B.E. (2006): Petrology – Igneous, sedimentary and Metamorphic (3rd Edition), W.H. Freeman and Company, New York.
5. Bose M.K. (1997): Igneous Petrology. The World Press Pvt. Ltd.
6. Bowen N.L. (1928): The evolution of Igneous Rocks. Princeton Univ. Press. N. J.
7. Ehlers, E.G. and H. Blatt (1982): Petrology, Igneous, Sedimentary and Metamorphic, Freeman and company.
8. Hatch F.H., Wells A.K and Wells M.K. (1984): Petrology of the igneous rocks, CBS.
9. Philpotts A.R. (1994): Principles of igneous and metamorphic Petrology, Prentice Hall of India.
10. Philpotts, A and Ague, J (2009): Principles of igneous and metamorphic petrology, Cambridge University Press Publishers,
11. Turner F.J & Verhoogen J. (1951): Igneous and Metamorphic Rocks, McGraw Hill.
12. Williams H, Turner F.J & Gilbert C.M. (1955): Petrography, W.H. Freeman and company. San Francisco.
13. Winkler Helmut G.F. (1987): Petrogenesis of Metamorphic Rocks (Fifth Edition), Narosa Publishing House, New Delhi.
14. Winter J. D. (2001): An Introduction to Igneous and Metamorphic Petrology, Prentice
15. Winter, John D. (2010): Principles of igneous and metamorphic petrology, PHI learning Pvt. Ltd.

GEOEC-02: LATE NEOGENE PALEOCEANOGRAPHY, PALEOCLIMATOLOGY AND BIOSTRATIGRAPHY

Unit I: Introduction to the Late Neogene Time scale; Magnetic Stratigraphy in Paleoceanography; Late Neogene Events Paleoceanography; Late Neogene Tectonic Events; Introduction to Paleoclimate; Important Late Neogene Paleoclimatic events and their causes; Deep-Sea Sediment Cores; Ice-Cores.

Unit II. Proxies in Late Neogene Paleoceanography and Paleoclimatology; Introduction to low latitude inter-ocean exchange systems. Planktic Foraminifera- detailed taxonomy, applications in Paleoceanography and paleoclimatology.

Unit III: The Use of Oxygen and Carbon Isotopes of Foraminifera in Paleoceanography; Radiocarbon Dating of Deep-Sea Sediments; Elemental Proxies for Reconstructing Cenozoic Seawater Paleotemperatures from Calcareous Fossils.

Unit IV: Concept of Biostratigraphy; Types of Biozones and their formulation; Biostratigraphic Correlation; Graphic Correlation; Applications of Biostratigraphy.

List of Recommended Books:

1. Armstrong, H. and Brasier, M. (2005). Microfossils, Blackwell publishing.
2. Berggren, W.A. and van Couvering, J.A., (1974). Late Neogene: Biostratigraphy, Geochronology and Paleoclimatology of the Last 15 Million Years In Marine And
3. Bolli, H.M., Saunders J. B. and Perch Nielson, K., (1985). Plankton Stratigraphy, Cambridge Univ. Press, Cambridge.
4. Bradley, R.S., (1999). Paleoclimatology: Reconstructing the Climates of Quaterenary, Elsevier.
5. Continental Sequences, Elsevier.
6. Gradstein, F.M., Ogg, J.G., Schmitz M., and Ogg, G. 2012. The Geologic Time scale 2012. Elsevier
7. Haq, B.U. and Boersma, A., (1998). Introduction to Marine Micropaleontology, Elsevier.
8. Hillare-Marcel, C. and Vernal, A. De, (2007). Proxies in Cenozoic Paleoceanography, Elsevier.
9. Kennett, J.P. and Srinivasan, M. S., 1983. Neogene planktonic foraminifera A Phylogenetic Atlas, Hutchhinson Ross. Publ. Co., U.S.A.
10. McGowran, B. (2005). Biostratigraphy: Microfossils and Geological Time, Cambridge University Press.

GEOEC-03: DEFORMATION: ITS KINEMATICS AND DYNAMICS

Unit-I: Methodologies and approaches to understand Neotectonics; River dynamics; River responses to neotectonics

Unit-II: Concept of rock deformation. Stress and Strain in rocks, 2-D stress and strain analysis; Strain ellipses of different types and their geological significance. Behaviour of rocks under stress: elastic, plastic, viscous and viscoelastic responses and their geological significance. Mechanics of rock fracturing: fracture initiation and propagation; Coulomb's criterion and Griffith's theory.

Unit-III: Introduction to ductile shear zones: significance of mylonite, cataclasite, gouge.

Unit-IV: Introduction to Experimental Structural Geology: High P-T experiments with rock samples: basic concepts and important examples. Analog modeling of deformational structures and its geological importance: concept of experimental scaling. Published examples of sandbox/shear box experiments and their extrapolation to natural situations

List of Recommended Books:

1. Condie, Kent. C. (1982): Plate Tectonics and Crustal Evolution, Pergamon Press Inc.
2. Park, R. G. (2004) Foundations of Structural Geology.Chapman & Hall.
3. Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall.
4. York Fossen, H. (2010): Structural Geology, Cambridge University Press
5. Ghosh, S.K. (1993): Structural Geology: Fundamental and Modern Development. Pergamon Press.
6. Twiss, R.J. and Moores EM 2007 Structural Geology Freeman
7. Van der Pluijm,. B.A. and Marshak, S 2004. Earth Structure: an introduction to structural geology Tectonic.W.W. Norton and Company Ltd.
8. Anderson R.S. and Burbank, D.W., 2008. Tectonic Geomorphology, Blackwell.