PG 2nd Semester

Paper: GLG801C (Core)
Igneous Petrology
L+T+P=3+1+0= 4 credits

Total Number of Theory classes (*Lectures*) : 48 (48 hours)
Total Number of Tutorial classes (*Tutorials*) : 16 (16 hours)

THEORY

Igneous Petrology : *Number of Lectures: 48*

Magma: Composition, physical properties and origin; Magmatic crystallisation, differentiation and assimilation; Nucleation and growth; Interpretation of common igneous textures with respect to nucleation and crystal growth; Role of partial melting in igneous petrogenesis

The phase equilibrium of binary and ternary systems and their relation to magma genesis and crystallization in the light of modern experimental works; Classification of igneous rocksconcept of mode and norm

Plate tectonics and generation of magmas in different tectonic settings; Igneous rocks in different tectonic settings: mid-oceanic ridge, oceanic intraplate, subduction and continental rift related settings; Geochemical characteristics of igneous rocks: major, trace and isotopic composition of igneous rocks in the context of petrogenesis; Compatible and incompatible trace elements; Application of trace elements in petrogenesis and source characterization; Geochemical criteria for identification of palaeotectonic settings; Mobility of elements during post-crystallization processes

Petrology and petrogenesis of the following igneous rocks with suitable Indian examples:
(i) Komatiites, anorthosites and ophiolites
(ii) Large igneous provinces, boninites and layered complexes
(iii) Alkaline rocks, carbonatites, kimberlites and lamprophyres
(iv) Adakites and sanukitoids

Recommended Books:

1. Best, M.G., 2002. *Igneous Petrology,* 2nd Edition, Blackwell Publishers
2. Bose, M.K., 1997. *Igneous Petrology,* World Press, Kolkata.
3. Hall, A., 1997. *Igneous Petrology,* Longman.
4. Phillpotts, A.R., 1994. *Principles of Igneous and Metamorphic Petrology,* Prentice Hall of India.
5. Vernon, R.H., 2004. *A Practical Guide to Rock Microstructure,* Cambridge University Press.
6. Winter, J.D., 2010. *Principles of Igneous and Metamorphic Petrology,* Pearson Prentice Hall.
7. Gill, R., 2010. *Igneous Rocks and Processes: a practical guide,* John Wiley & Sons.
8. Philpotts, A. and Ague, J., 2009. *Principles of Igneous and Metamorphic Petrology,* Cambridge University Press.
9. Wilson, M., 1989. *Igneous Petrogenesis: A Global Tectonic Approach.* Chapman and Hall publishing.
10. Frost, B.R., Frost, C.D., 2014. *Essentials of Igneous and Metamorphic Petrology.* Cambridge University Press.

Paper: GLG802C (Core)
Metamorphic Petrology
L+T+P=3+1+0= 4 credits

Total Number of Theory classes (*Lectures*) : 48 (48 hours)
Total Number of Tutorial classes (*Tutorials*) : 16 (16 hours)

THEORY

Metamorphic Petrology : *Number of Lectures: 48*

Structures and Textures of Metamorphic Petrology**:** The processes of Deformation, recovery and recrystallisation. Textures of contact metamorphism; High-strain metamorphic textures, Regional orogenic metamorphic textures; Analysis of Polydeformed and Polymetamorphosed rocks; Crystallographically controlled inclusions; Replacement textures and reaction rims; Textural geochronology.

Introduction to Thermodynamics: Gibbs Free Energy,The Gibbs Free energy for a phase, Gibbs free energy for a reaction, The equilibrium state, Le Chatelier's principle; Thermodynamic evaluation of phase diagrams, Clapeyron equation. Thermodynamics of metamorphic reactions; Geothermobarometry. Metamorphism of Calcareous and Ultramafic rocks. Metamorphic Fluids and its role in metamorphism. Metasomatism. Migmatites

Recommended Books:

1. Metamorphic Petrology – B.W.D.Yardley; *ELBS/Longman*
2. Petrology of Igneous and Metamorphic Rocks – D.W.Hyndman (2nd Edition); *McGraw-Hill Book Company*
3. Igneous and Metamorphic Petrology – M.G.Best; *CBS Publishers and Distributors*
4. An introduction to igneous and metamorphic petrology - John, D Winter; *Prentice Hall, 2001*.
5. Petrology – W.T Huang; *McGraw-Hill book Company*
6. Metamorphism and Metamorphic Belts – A Miyashiro; *George Allen & Unwin Ltd.*
7. The Study of Rocks in Thin Section – W.W. Moorhouse; *CBS Publishers & Distributors*
8. Principles of Igneous and Metamorphic Petrology – A.R. Phillpotts; *Prentice-Hall of india Pvt. Ltd*
9. Igneous and Metamorphic Petrology – F.J. Turner and & J. Verhoogen; *McGraw-Hill book*
10. Petrogenesis of Metamorphic rocks – H.G.F.Winkler; Springer Verlag, *New York Inc.*
11. Theoretical Petrology – T.F.W.Barth; *John Wiley and Sons,Inc.*

Paper: GLG803C (Core)
Palaeontology
L+T+P=3+1+0= 4 credits

Total Number of Theory classes (*Lectures*) : 48 (48 hours)
Total Number of Tutorial classes (*Tutorials*) : 16 (16 hours)

THEORY

Palaeontology : *Number of Lectures: 48*

Phyletic gradualism and punctuated equilibrium theory; Collection, Preparation and Nomenclature of fossils; Applications of fossils in the study of Palaeoecology, Palaeobiogeography and Palaeoclimate.

Micropalaeontology: Types of microfossils, calcareous microfossils: Foraminifera - morphology, classification, geological distribution, significance and important genera; Ostracod - morphology, palaeoecology and geological history; Siliceous microfossils: Radiolaria- morphology, classification and applications; Brief account of marine diatoms and silicoflagellates; Phosphatic microfossils: Conodonts - morphology, palaeoecology, geological significance; Organic Walled microfossils: Brief account of dinoflagellates and acritarchs.

Application of micropalaeontology in hydrocarbon exploration, Environmental significance of microfossils; Ichnology: classification of Trace fossils and their application of in palaeoenvironmental reconstruction; Nano fossils and their applications in geology.

Palynology: General morphology of spores and pollens and their geological significance; Application of palynology in different branches of science and in hydrocarbon exploration. Study of Gondwana flora and their Palaeoclimatic implications.

Vertebrate Palaeontology: Major subdivision of vertebrates; Succession of vertebrate life through geologic time; Broad classification and study of some characteristics Indian vertebrate fossils.

Recommended Books:

1. Microfossils and their Applications - P.K. Kathal; *CBS Publishers and Distributors.*
2. Microfossils - Armstrong, H.A., and Brasier, M.D., *Blackwell,* 2005.
3. Micropaleontology in Petroleum Exploration- Jones, Robert Wynn. (1996); *Clarendon Press.*
4. Fossils at a Glance, 2nd Edn. -Clare Milsom and Sue Rigby; *Wiley-Blackwell*.
5. Principles of Palaeontology - Raup, D. M. & Stanley, S. M., *W. H. Freeman; CBS Publishers and Distributors.*
6. Principles of Invertebrate Palaeontology- R.R. Shrock and W. H. Towenhofel; *CBS Publishers and Distributors.*
7. Evolution of Vertebrates - E. H. Colbert; *Willey Eastern Limited*

Paper: GLG804C (Core)
Stratigraphy
L+T+P=3+1+0= 4 credits

Total Number of Theory classes (*Lectures*) : 48 (48 hours)
Total Number of Tutorial classes (*Tutorials*) : 16 (16 hours)

THEORY

Principles of Stratigraphy : *Number of Lectures: 24*

Stratigraphic Relations - Contacts, Unconformities; Vertical and Lateral Successions of Strata; Cyclic Successions; Stratigraphic Cycles and their postulated causes; Sedimentary Facies; Walther's Law of Succession of Facies; Transgressions and Regressions.

Sequence Stratigraphy; Exxon-Vail Curve; Methods and Applications of Sequence Stratigraphy; Seismic Stratigraphy; Magnetogratigraphy; Field Reversals and Polarity Time Scale; Magnetogratigraphic Correlation.

Chemostratigraphy; Oxygen Isotopes; Carbon Isotopes; Strontium Isotopes; Sulphur Isotopes.

Indian Stratigraphy : *Number of Lectures: 24*

Stratigraphic Boundary Status in India : Precambrian-Cambrian, Permo-Triassic, Cretaceous-Palaeogene (K-Pg), Neogene-Quaternary.

Precambrian Stratigraphy :
Precambrian belts of India (Dharwar Craton, Bastar Craton, Singhbhum Craton, Aravalli Craton, Bundelkhand Craton, Eastern Ghat Mobile Belt, Satpura Mobile Belt or CITZ, Assam-Meghalaya Plateau (*Shillong Plateau*), Southern Granulite Terrain): Age correlations, metamorphism, tectonics and evolution. Archean-Proterozoic boundary problem in India.
Concept of Precambrian supercontinents. Important Proterozoic basins of Peninsular India: Sedimentation, correlation and evolution.

Phanerozoic Stratigraphy :
Stratigraphy, tectonics, and basin evolution of Gondwana sedimentary units; correlations between different Gondwana successions in India.
Evolution and stratigraphy of Indian Coastlines: Marine Mesozoics of India viz. Jurassic of Kutch; Cretaceous of South India, Central-Western India and North-Eastern India.
Traps: Deccan, Rajmahal, Sylhet and Rajahmundry Traps and their correlations.
Phanerozoics of Extra Peninsula**:** Spiti, Kashmir and Salt Range.
Lithostratigraphy of different sedimentary cycles vis-à-vis major geologic and tectonic events of the Himalayas.
Palaeogene-Neogene (Tertiary) formations of Kutch and North-Eastern India.
Lithostratigraphy of Siwalik Sediments.

Recommended Books:

1. Precambrian Geology of India – S.M.Naqvi and J.J.W.Rogers; *Oxford University Press.*
2. Indian Precambrian – B.S.Paliwal (Ed.); *Scientific Publications* (*India*), *Jodhpur*.
3. Cratons and Fold Belts of India – R.S.Sharma; *Springer-Verlag.*

4. Geology of India, Vol. 1 & 2 – M. Ramakrishnan and R. Vaidyanathan; *Geological Society of India, Bangalore*.
5. Geological Survey of India Reports and other recent Scientific publications on Indian Stratigraphy.

Paper: GLG805L (Lab)

Igneous Petrology Practical; Metamorphic Petrology Practical; Palaeontology Practical; Stratigraphy Practicals; Geological Field Work – I (*1 credit*)

L+T+P=0+0+(3+1)= 4 credits

Total Number of Practical classes (*Lectures*) : 48 (96 hours)

PRACTICAL

Igneous Petrology : *Number of Practicals: 13*
Study of hand specimen of various igneous rocks.
Microscopic study of mineralogical and textural characteristics of igneous rocks.
CIPW Norm calculation.

Metamorphic Petrology : *Number of Practicals: 13*
Identification of rock hand specimens: slate, phyllite, various types of schists, gneiss, amphibolite, granulite, calc silicate rocks, marble, quartzite, hornfels, augen gneiss, mylonite, migmatite, eclogite.
Thin section study of rocks under microscope: Schists, quartzites, amphibolites, granulites.
Thin section study of microtextures: Schistosity, porphyroblastic, granoblastic, corona and symplectite.
ACF and AKF plotting.

Palaeontology : *Number of Practicals: 13*
Microscopic study of Foraminifera, Radiolarian, Ostracods, Dinoflagellates.
Megascopic study of important plant fossils from Gondwana Flora.
Microscopic study of the morphology of Spores and Pollens.
Construction of range chart.

Stratigraphy : *Number of Practicals: 9*
Study of Indian stratigraphic rocks in hand specimens.
Construction and analysis of sea-level curve from vertical successions of strata.
Interpretation of seismic sections; Recognizing sequences in seismic sections.
Interpretation of geologic history from geologic maps.
Bore-hole problems.

Geological Field Work – I : 1 credit