PH.D ENTRANCE SYLLABUS (GEOLOGY) Binod Bihari Koylanchal University, Dhanbad

PAPER II: ADVANCED GEOLOGY

Objective: This paper helps the students to understand the recent advancements in the research fields through the respective theory and experiments.

Unit-I: STRUCTURAL GEOLOGY & GEOTECTONICS:

Concept of Stress and Strain: 2-D stress and strain analysis; Strain ellipses of different types and their geological significance; Mohr diagrams and their use; concept of stress-strain compatibility. Behaviour of rocks under stress: elastic, plastic, viscous and visco-elastic responses and their geological significance. Fold: Morphological classification of folds. Mechanical aspects of folding. Ptygmatic fold, cuspate-lobate fold, disharmonic and polyharmonic folds, kink fold. Fold interference and superposed folds. Fault and Joint: Mechanics of faulting: Anderson's theory and its limitations. Complex geometry of normal, strike-slip and thrust faults with natural examples. Concept of fault zone weakening; fault reactivation and its significance. Shear zonesgeometry and kinematics: Analysis of strain in shear zones; Kinematic significance of different shear zone structures; Shear sense indicators. Basic concept of palaeomagnetism Major tectonic features of the earth-shield areas, mobile belts, rift valleys, mid oceanic ridges, continental shelves and slopes, submarine canyons. Plate Tectonics: concept, geological and tectonic environment of Plate boundaries, Sca Floor Spreading, Island arcs, Hydrothermal vents; Orogeny and orogenic cycles - Epcirogeny and evolution of plateaus, Structural and tectonic features of India.

Unit-II: MINERALOGY & GEOCHEMISTRY:

Periodicity and symmetry-concept of space lattice. Introduction to crystal chemistry, Crystal structure of minerals-Bonding in Crystal structures, Close-packed structures- Hexagonal closepacking, cubic close-packing and body centered structure, Single chain silicates, Double chain silicates, the layer silicates, the framework silicates. Olivine group, Garnet Group, Epidote group, Pyroxene group, Amphibole group, Concept of Optical indicatrix, Pleochroism, Extinction angle and sign of elongation, Interference figures.

GEOCHEMISTRY: Distribution of elements in core, mantle, hydrosphere and atmosphere. Geochemistry of igneous rocks, Eh-pH diagram; Principal of chemical mass balance and rockcycle; Chemical weathering of minerals and rocks. Radiogenic isotopes in geochronology and petrognesis: Rb-Sr, Sm-Nd, U-Pb isotopic system.

Unit-III: PETROLOGY



Igneous Petrology: Classification of magmatic rocks - based on fabric, field relations, mineralogical and modal, and whole rock compositions. IUGS classification of plutonic, hypabyssal and volcanic rocks, Irvine-Baragar classification of volcanic rocks, classification of basalt, Phase relations in binary systems, feldspar-melt equilibria, anhydrous olivine and pyroxene crystal-melt equilibria, crystal-melt equilibria in basalt magma systems, haplo-granite system, geobarometers and geothermometers.

SEDIMENTARY PETROLOGY:

Sedimentary texture: Grain size scale, particle size distribution, statistical treatment of particle size data, particle shape and fabric Sedimentary structures: Primary (Depositional, Erosional, Penecontemporaneous deformational) and secondary Paleocurrent analysis (Sealar and Vector attributes) Siliciclastic rocks: Conglomerates, sandstones, mudrocks (texture, composition, classification and origin and occurrence), Paleo environment analysis: Concept of facies and facies association. Sedimentary Environment: Continental (Glacial, Fluvial, Eolian, Lacustrine), marginal marine (Delta, Estuary, tidal, Chenicr) and marine (shelf, slope, deep marine) Llithification and diagenesis of siliciclastic rocks Application of radioactive and stable isotopes in reconstruction of paleoenvironment

METAMORPHIC PETROLOGY:

Metamorphic facies, Schreinemakers rules, Mineral formula calculation, geothermobarometry, Petrogenetic grid and pseudosections, Time scales of metamorphism, metasomatism, migmatites, Metamorphic field gradient and P-T-t paths, Zones and isograds, Rocks as chemical system, intensive and extensive variables, closed and open systems, Gibbs phase rule and Goldschimdt's mineralogical phase rule, composition-space, Cartesian and Barycentric projections, Phase diagrams including pseudocomponent diagrams (ACF, AKF, AFM etc.), Tie-line flip and rotations, continuous and discontinuous reactions, exchange vectors, Clausius-Clayperon equation

Unit-IV: STRATIGRAPHY, PALAEONTOLOGY, HYDRO GEOLOGY, ENGINEERING GEOLOGY

International Stratigraphic Code and development of a standardised stratigraphic nomenclature. Concepts of Stratotypes, Global Stratotype Section and Point (GSSP). Principles of stratigraphy and correlation, Facies Concept in Stratigraphy, Walther's Law. Basic concepts of sequence stratigraphy, magneto-, seismic and chemo-stratigraphy. Methods of measurements of geological timeTectonostratigraphic framework of Dharwar craton, an overview of Bastar, Singhbhum, Bundelkhand and Aravalli cratons, Eastern Ghat mobile belt, Central Indian Tectonic Zone; Cretaceous-Palaeogene boundary sections of India. Stratigraphic boundary problems –Pre CambrianCambrian (P/C),Permian-Triassic(P/Tr) and Cretaceous –Tertiary (K/T)boundaries. Palaeogene stratigraphy of Kachchh. Stratigraphy of the Himalaya.

Study of Ichno fossils; Taphonomy and preservation. MorpholGeology, classification, biostratigraphy and evolutionary trends of Trilobites, Brachiopods, Bivalves, Cephalopoda, Gastropods and Echinoids. Foraminifera, diamorphism, morpholGeology and biostratigraphy;



Gondwana flora and their significance, Palynogeology, types of Gondwana palynomorphs and its importance

Role of groundwater in the hydrological cycle; Controls of Geology on groundwater occurrence and distribution; Classification of aquifers and aquifer systems; Darcy's law; Hydraulic conductivity, Engineering Properties of rocks, and Soils; Properties and selection of Construction Materials; Landslides and stability of Hill slopes; geological investigation for Engineering Projects.: geological investigations and criteria for sites selection of Dam sites, Reservoirs Tunnels and Bridges;

Unit-V: ECONOMIC GEOLOGY & EXPLORATION GEOLOGY

Concepts of Ore Genesis; Distribution of Ore deposits-Global Perspective; Mode of occurrences and morphology of ore bodies, Controls of Ore localization; Classification of Ore deposits; Processes of Ore formation – Magmatic, Sedimentary, Metamorphic associations and Weathering processes; Ore deposits and Plate Tectonics. Coal: Origin, mode of occurrence and types of coal; Proximate and Ultimate analysis; Concept of Macerals and Microlithotypes: Classification, rank, and grade of coal; Petroleum: Origin and migration of Petroleum. Properties of source and reservoir rocks, Petroleum Traps; geological and geophysical methods of petroleum exploration; Petroliferous basins of India;

Geological Mapping techniques; Geological criteria for mineral prospecting: Basic principles of Geochemical Exploration ;Principles and application of surface geophysical exploration techniques; Brief outline of various well logging techniques; Strategic, critical and essential minerals. India's status in mineral production vis a vis world scenario; National Mineral Policy

Suggested Books:

- > Condie, Kent. C. (1982): Plate Tectonics and Crustal Evolution, Pergamon Press Inc.
- > Rumsay, J.G. (1967): Folding and fracturing of rocks, McGraw Hill.
- Kerr P. F. Optical Mineralogy, 1959. McGraw-Hill.
- > Mason, B (1986). Principles of Geochemistry. 3rd Edition, Wiley New York.
- > Wilson, M. 1989 Igneous Petrogenesis. London Unwin Hyman.
- Sam Boggs, 1995. Principles of Sedimentology and Stratigraphy, Print iceHall, New Jersey. Tucker, M.E., 2006. Sedimentary Petrology. Blackwell Publishing.
- > Best, M.G., 2003. Igneous and Metamorphic Petrology, Blackwell Science.
- > Raup, D.M. and Stanley, S.M. (1985): Principles of PaleontolGeology, CBS Publ.
- Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley & Sons. Krishnan, M.S., 1982. Geology of India and Burma, C.B.S.Publishers, Delhi
- Singh, P. (1994): Engineering and General Geology, S.K. Kataria and Sons, Delhi.
- K. R. Karanth (1989): HydroGeology, Tata McGraw Hill Publ..
- S.N. Davies and R.J.N. De Wiest (1966): HydroGeology, John Wiley and Sons, New York.

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- Bagchi, T.C., Sengupta, D.K., Rao, S.V.L.N. (1979): Elements of Prospecting and Exploration, Kalyani Publ.
- Banerjee , P.K. and Ghosh, S. (1997): Elements of Prospecting for Non-fuel Mineral deposits, Allied Publ.

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