PRE REGISTRATION ENTRANCE EXAMINATION FOR QUALIFYING Ph.D. DEGREE PROGRAMME: SYLLABUS (2019 ONWARDS) – SUBJECT: GEOLOGY

Dynamic Geology: Solar system – outer and inner planets. – Hypotheses related to origin of the Earth; their merits and demerits. Relief features and their types - Ocean basins and Continents. Dating of rocks - Age of the Earth. Types, products and causes of Volcanoes.

Geomorphology & Geo-tectonics: Fundamental concepts - Geomorphic features of India- Characteristic features of various kinds of landforms developed by Wind, Ground water, Glacier, Running water, Seas and Oceans - Application of Geomorphology in groundwater, mineral and oil exploration and engineering projects - Theories of plate tectonics, continental drift and sea floor spreading. Orogeny and orogenic cycles – Epiorogeny and evolution of plateaus. Structural and tectonic features of India. Quaternary tectonics.

Marine Geology: Topography, characteristics and various features of ocean basin and origin of continental shelf, slope and sub marine canyons. Waves and currents-long shore, rip and turbidity currents. Echo sounding, seismic shooting, seismic refraction and reflection. Physical and chemical properties of ocean water. Oceanographic instruments pertaining to geological operations. Sediment and water samplers. Classification of coral reefs and their characteristics. Theories of atoll formation. Eustatic sea level changes. Tsunami : origin and prediction. Ocean pollution. Natural mineral resources of the ocean. Plate tectonics and origin of ocean basins. Law of the sea and its implications.

Structural Geology: Mechanical principles – Description, Classification, Recognition, Mechanics and Causes of Folds, Faults, Joints & Unconformities –Distinction of Unconformities from faults and their use in dating structural events. Deformation Structures - Modes of representation of joints – Histogram, rose diagram and preparation of stereogram. Cleavage, Schistosity and Lineation – their description, origin and relation to major structures. Petrofabric analysis – Field and laboratory techniques. Petrofabric diagrams and their interpretation. Classification and characteristics of Tectonites, Diapirs and related structural features. Topographic maps, Field equipments, preparation of Geologic maps and report.

Stratigraphy: Principles – Standard Geological Timescale - Nomenclature and classification: Lithostratigraphy, Biostratigraphy, Chronostratigraphy and Stratotypes. Pre Cambrian formations in India – Cuddapah and Vindhyan super groups – Cambrian of Salt Range – Permo– Carboniferous of Salt Range – Gondwana formations – selected studies pertaining to Triassic of Spiti, Jurassic of Kutch, Cretaceous of Tiruchirapalli and Narmada. Deccan traps – inter and infra traps – Siwaliks – Tertiary and Quaternary formations – Age problems in India pertaining to Saline series and Deccan traps. Boundary problems in India with reference Precambrian – Cambrian, Permian – Triassic and Cretaceous – Tertiary. Sequence stratigraphy and basin analysis.

Palaeontology: Definition of fossil – Nature and modes of preservation of fossils – uses of fossils, index fossils, trace fossils. Organic Evolution - History of the concept of evolution – Darwin principles - Orthogenesis. Detailed morphology, evolution and stratigraphic importance of the following groups. Corals, Graptolites, Trilobites, Pelecypods, Gastropods, Echinoids, Brachiopods and Ammonites. Evolution of plants through ages – Gondwana flora and their stratigraphic significance. Principal groups of vertebrates through geologic time – Devonian fishes and Mesozoic reptiles. Evolutionary history of Horse, Elephant and Man. Micropalaeontological techniques – Sampling methods, separation of

microfossils from matrix, thin sectioning. Types of microfossils – General morphology, stratigraphic importance and ecological and palaeoecological significance of Foraminifera, Ostracoda and Spores and Pollens. Applications of micropalaeontoligcal studies in environmental interpretation, petroleum exploration, and marine geological studies.

Crystallography and Optical Mineralogy: Morphological characters of a crystal. Elements of crystal symmetry – Crystallographic axis – Axial Ratios, Parameters Indices and Symbol. Weiss and Millerian systems of crystal notation – zones – crystal forms – interfacial angles and their measurements – Contact and Reflecting Goniometers. Classification of crystals into systems and classes. Study of the symmetry elements and forms present in 32 classes in the Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems. Derivation of 32 Crystal classes and their symmetry projections – Spherical, Stereographic and Gnomonic projections of crystals belonging to normal classes - Twinning in crystals – Irregularities of crystals – Bragg's law and its application. 14 Bravais space lattices. Powder diffraction method – Optical properties of isometric, uniaxial and biaxial crystals. – Applications of optical accessories.

Mineralogy: Structural classification of silicate minerals – Isomorphism – Exsolution – Order, disorder relations – Polymorphism - Pseudomorphism- Fluorescence in minerals – Description, chemistry, physical and optical properties and paragenesis of ortho and ring silicates, aluminosilicates, chain silicates, sheet silicates, tekto silicates.

Petrology: Magma: types and their evolution - Crystallisation of Magma - Forms and structures of intrusive and extrusive igneous rocks - Textures and micro structures of igneous rocks - Classification of igneous rocks - Petrography and Petrogenesis of Granite – Rhyolite Clan, Syenite – Trachyte Clan, Gabbro – Basalt Clan, Alkaline rocks, Anorthosites, Lamprophyres, Kimberlites, Komatiites, Carbonatites and Charnockite. Sedimentation - Textures and structures of sedimentary rocks – Composition, Classification and Petrography of sedimentary rocks, Sedimentary environments - Tectonics and sedimentation - Techniques in Sedimentology. Metamorphism and its agents. Metamorphic textures and structures - Grades, Zones and facies of metamorphism. Contact, Dynamic, Dynamothermal and Plutonic metamorphism and their products. Metasomatism. Petrography of important foliated and non-foliated metamorphic rocks.

Hydrogeology: Hydrgeological cycle-Occurrence and vertical distribution of Ground water in geological formations-Groundwater movement-Darcy's law and its applications-Porosity and Permeability-determination of permeability in laboratory and in the field. Surface and subsurface methods of ground water detection-Types of wells and well development techniques-Methods of pump tests and evaluation of aquifer parameters. Water quality parameters and their standards for domestic, industrial and irrigation purposes. Recharge methods and practices-Basin investigation and water balance studies. Conjunctive use of surface and ground water resources in India. Sea water intrusion in coastal areas and its prevention. Ground water provinces of India.

Petroleum & Coal Geology, Economic Geology, Geophysics & Geochemistry: Fundamental concepts of organic and inorganic theories of hydrocarbon. Sedimentary processes and accumulation of organic matter - occurrence and distribution of hydrocarbons in sedimentary basins of India - Types of coal – origin and mode of occurrence - physical and chemical characteristics of coal. Processes of formation and classification of mineral deposits, Plate tectonics and Ore genesis – mode of occurrence, origin,

distribution and uses of metalliferrous and industrial mineral deposits in India. Physical, optical and rotation properties of ore minerals - A concise account of principles, field equipments and techniques, data interpretation, applications and limitations of various geophysical exploration methods - Origin and abundance of elements in the earth's crust - geochemical anomaly - Application of geochemistry in Mineral exploration, Oil prospecting, Ground water targeting, Soil studies. - Brief outline of analytical methods of igneous rocks.

Engineering Geology: Engineering properties of rocks. Properties of building stones, concrete aggregates and rail road ballast. Earth movements and preventive measures. Geological investigations pertaining to foundation of bridges, buildings, highways and airfields. Geological investigations of sites for various types of dams-Dam construction - problems – remedial measures. Spillways, reservoir problems. Geological investigations for tunneling through hard and soft grounds and associated problems. Geological investigations for harbours, docks, coastal erosion and protection.

Mining Geology: Mining terms and their descriptions. Sampling techniques and principles. Types and methods of drilling and geological logging. Factors controlling the choice of various mining methods. Alluvial, open cast and sub surface mining methods and mine machineries. Explosives used for mining. Assaying and evaluation of ore bodies and their extensions. Ore reserve estimation. Mining hazards and preventive measures.

Photo Geology, Remote Sensing and GIS: Types of aerial photographs. Photographic scale – causes for variation. Flight planning. Parallax. Vertical Exaggeration. Stereoscopy and stereoscopes. Study of aerial photos using stereoscopes. Mosaics : Types and construction. Remote sensing: definition. Energy sources and radiation principles–Electromagnetic spectrum – Remote sensing platforms- Energy interaction with atmosphere and earth's surface features. Types of satellites. Sensors and their resolutions. Data acquisition, receiving and recording. Photographic and digital characteristics of Landsat, SPOT, IRS series of satellites and other high resolution satellites. Indian space programme: past, present and future. Elements of photo and image interpretation, interpretation strategies and keys.

Environmental Geology: internal and external sources – Mass extinction through geologic time – Major climatic changes through Geologic time – Natural hazards due to river flooding, soil erosion, mass movements, earth quake, volcano, sea water intrusion, coastal flooding and tsunami : their causes and governing/influencing factors, role of Geology in strategies for reduction/prevention/mitigation.

BOOKS FOR REFERENCE

1. Tom Garrison,2008 - Essentials of Oceanography, Cengage Learning
2. Billing, M.P. (1974) - Structural Geology, prentice Hall
3. Lahee, H. 1959 - Field Geology, McGraw Hill.
4. Gary Nichols, 2009 - Sedimentology and Stratigraphy, John Wiley and Sons
5. Krishnan, M.S. 1956 – Geology of India and Burma, Higgin bothams.
6. Shrock. R.R. and Twenhofel , W.H – 1953 – Principles of invertebrate Palaeontology, Amold publication
7. Moore, R.C. Lalieker, C.D. and Fischer, A.G – 1952 – Invertebrate Fossils Mc Graw Hill.
8. Dexter Perkins, 2003 - Mineralogy, Pearson education private ltd.
9. Dana, E.S. – 1955 – Text Book of mineralogy, wiley
10. Myron G. Best, 2003 - Igneous and metamorphic petrology, Wiley-Blackwell

11. Tyrrell. G.W.(1963)- Principles of Petrology – Asia Publishing House.
12. Turner.F.J and Verhoogen.J –1960.- Igneous and Metamorphic petrology – McGraw Hill.
13. Winter. J.D.- (2001) – Igneous and Metamorphic Petrology –Prentice Hall.
14. Pettijohn, F.J.- 1967 – Sedimentary Rocks, Harpers and Bros
15. Larry Thomas, 2002 - Coal geology, John Wiley and Sons
16. A.T. Levorsen Geology of Petroleum CBS publishers and distributors, Delhi 1985, II Edition 1999.
17. Bateman, A.M. – 1995 – Economic Mineral Deposits, Willey.
18. Arogyaswamy, R.N.P. 1973 Courses in Mining Geeology, Oxford &IBH, New Delhi.
19. Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd., New Delhi
20. Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
21. Tim Davie, 2008 - Fundamentals of hydrology, Routledge
22. Todd, D.K. 1959- Ground water Hydrology, Wiley
23. Raghunath, H.M. - 1983 - Groundwater, Wiley Eastern
24. Paul R.pinet – 2012 -,Essential invitation to oceanography,
25. Hamid Rizvi,SM – 2009 - Geomorphology & Hydrology; A Hand book
26. Hota,Rabindranath – 2012 - Practical approach to crystallography and mineralogy
27. Anthny M Evans, - 2012 - Ore geology and Industrial minerals Introduction
28. Guilbert, K M – 2007 - The geology of ore deposits
29. Parthasarathy A - 2013- Engineering geology
30. Bell, F G – 2016- Engineering geology
31. Lillisand, Thomas M Remote sensing and image interpretation
32. Panda, B C - Remote sensing; principles and application
33. Dobrin, Milten B - Introduction to geophysical prospecting
34. C. Misra – 2012- Introduction to geochemistry
35. Vaidyanathan,S – 2011- An Introduction to Disaster management
36. Telford, WM – 2018 - Applied Geophysics
37. Dwivedi S – 2017 – Geochemistry
38. Bernard W – 2014 - Geology and the Environment