VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI. 590016
Syllabus for the (VTU-ETR) qualifying examination for the admission to Ph.D programme 2020 in Geology.

MODULE 1. PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Introduction Geology and it's perspectives. Pure and applied branches of geology: scopes and applications. The solar system. Theories of planetary evolution. The earth. Components of Earth System: atmosphere, lithosphere, hydrosphere, biosphere. Origin of Earth. Age of the Earth. Structure of the earth and its composition. Radiometric methods (Rb-Sr, U-Pb, Sm-Nd, Pb-Pb) of age determination.

Geomorphic agents, Geomorphic processes; endogenetic and exogenetic. Land forms.

Weathering - physical, chemical, biological. Soil- Definition, Formation, Types of soils. Soil Profile. Physical and chemical properties of soils. Classification of soil particle size.

Geological work of rivers and fluvial landforms. Geological work of wind and Aeolian landforms. Geological work of glaciers and Glacial landforms. Geological work of groundwater and Karst topography. Geological work of Oceans and Coastal landforms.

Geological Field Report: Aims and Objectives, Introduction, Study Area, Accessibility, Climate, Geology of the area, Methodology, Results, Discussions, Conclusion, Bibliography and Appendix.

References:

1. Principles of Physical Geology — A. Holmes
2. Geomorphology — V.K. Sharma
3. Aspects of tectonics — K.S. Valdiya
4. General Geology — Radhakrishanan. V
5. A text book of Geology — Mahapatra, G.B
6. Text book of Geology — P.K.Mukherjee
7. Engineering Geology — Parbin Singh
8. Principles of Engineering Geology — K.M.Bangar
9. Introduction to Geomorphology — V.S. Kale & Avijit Gupta
10. Field Geology — F.H.Lahee

MODULE 2. GEODYNAMICS

Plate-tectonics: Introduction to Geodynamics. Origin of oceans, continents and mountains. Concepts and theories of isostasy. Palaeomagnetism, Continental drift, Sea floor spreading. Concept of plate tectonics. Nature and types of plate margins, Midoceanic ridges and trenches. Origin and distribution of Island arcs. Gross tectonic features of continents - orogenic belts, continental margin types, Shield areas and cratons, Rift valleys.

Earthquakes: Earthquake waves, intensity and magnitude, seismographs and seismometers, causes and effects of earthquake, Seismic zones of India.

Volcanoes:- volcanic activity, types of volcanoes, lava. Volcanic landforms; depressed landforms: Landforms due to the accumulation of lava.

Landslides: Investigation of Landslides, Types. Protective measures from falls and landslides. Solifluction forms. Types of slopes, their formation and steadines. Classification of slopes.

Stages in development. Forecast for sloping processes and evaluation of slope steadiness. Measures for stabilization of slopes. Engineering consideration of landslides.

References:

1. Principles of Physical Geology — A. Holmes
2. Aspects of tectonics — K.S. Valdiya
3. General Geology — Radhakrishanan. V
4. A text book of Geology — Mahapatra, G.B
5. Text book of Geology — P.K.Mukherjee
6. Engineering Geology — Parbin Singh
7. Principles of Engineering Geology — K.M.Bangar

MODULE 3. CRYSTALLOGRAPHY AND MINERALOGY

Crystallography:

Definition of crystal, morphological characters of crystal – face, form, edge, solid angles, Euler's law.

Interfacial angle, Contact Goniometer and its use.

Symmetry characters– Plane, axes and centre. Crystallographic axes, axial ratio and notation. Parameters- Weiss parameter, Miller indices.

Study of crystal forms of normal classes of all six crystal systems- 1) Isometric, 2) Tetragonal, 3) Trigonal, 4) Hexagonal, 5) Orthorhombic, 6) Monoclinic and 7) Triclinic.

Mineralogy:

Definition of mineral. Formation of minerals. Classification of minerals. Physical properties of mineral, Characters depending upon the state of aggregation; habit, form. Characters depending upon cohesion and elasticity; cleavage, fracture, hardness, tenacity. Characters depending upon light; colour, streak, luster, diaphaneity, iridescence, Opalescence, Luminescence, Fluorescence, Tarnish. Characters depending upon electricity and magnetism; conductivity, pyro, piezo, para and diamagnetism.

Classification of minerals based on chemical composition. Silicates: abundance in the crust, classification of silicates, based on structures – Neso, Soro, Cyclo, Ino, Phyllo, Tectosilicates.

Chemical composition, physical, optical properties, mode of occurrence and uses of the following group of minerals: - Olivine group, Amphibole group, Pyroxene group, Mica group, Quartz group, Garnet group and Feldspar group.

Ore Minerals: Definition of ore mineral, ore, gangue, tenor. Introduction to metallic and non metallic ore minerals. Uses and distribution of following ore minerals in India: Iron, Manganese, Copper, Aluminium (Bauxite), Gold, Coal and Petroleum.

References:

1. Rutley's Elements of Mineralogy — H.H. Read
2. Mineralogy for students — M.I. Batty
3. Mineralogy — Berry & Mason
4. Dana's Text book of Mineralogy — W.E. Ford
5. Engineering Geology — Parbin Singh
6. Principles of Engineering Geology — K.M.Bangar

7. Economic Mineral Deposits - Bateman Allan .M.
8. Economic Geology – Charles Richardson
9. Ore Geology and Industrial Minerals – Anthony M Evans
10. Indian Mineral Resources - S.Krishnaswamy
11. Minerals of Karnataka - B.P.Radhakrishna
12. Treatise of Minerals of India - R.K.Sinha

MODULE 4. PETROLOGY

Magma- Definition, Assimilation, Differentiation and Crystallizatioin. Composition- acidic and basic magma. Mode of occurrence of igneous rocks: Intrusive and extrusive igneous rocks**_Classification of igneous rocks**: Chemical classification- CIPW, Shand and Holmes, based on silica content (acidic, basic, intermediate and ultrabasic). Mineralogical classification- color index (leucocratic/felsic and melenocratic/mafic); Mineral content in rock: essential, accessory and secondary minerals.

Bowens Reaction Series – Discontinuous and Continuous

Description, textures, occurrence, engineering properties, Indian distribution and uses of the following rocks: Granite, Dolerite, Basalt, Diorite and their porphyries, Rhyolite, Gabbro,

Classification of sedimentary rocks: Based on origin: Clastic/mechanical deposits and Non clastic deposits - residual, evaporites and non-evaporates/chemical and organic deposits; based on grain size- Rudaceous, arenaceous and argillaceous.

Structures of sedimentary rocks: stratification, lamination, graded bedding, cross/ current bedding, ripple marks, mud cracks/sun cracks, rain prints and oolitic. **Textures of sedimentary rocks**: Clastic and non clastic. Wentworth grain size classification. Sphericity and roundness.

Description, textures, occurrence, engineering properties, Indian distribution and uses of the following rocks: Sandstone, Limestone, Laterite, Shale,

Types of metamorphism with brief descriptions: Cataclastic, thermal, dynamothermal, plutonic metamorphism. **Metasomatism**- Neosome and Metasomes, Migmatites. **Textures and Structures in Metamorphic rocks:** Crystalloblastic, palimpset. Cataclastic, granulose, gneissose and schistose. **Metamorphic Facies:** Facies Concept and zones. Eskola's facies

Description, textures, occurrence, engineering properties, Indian distribution and uses of the following rocks: Quartzite, Marble, Slate, Gneiss and Schist

References:

1. Principles of Petrology - By G. W. Tyrrell, B.I.Publications Pvt. Ltd. Mumbai.
2. Igneous and Metamorphic Petrology - By Turner and Verhoogen
3. Sedimentary Rocks - By Pettijohn, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Introduction to Sedimentology - By Sengupta, S
5. Sedimentary Petrology : an Introduction to the Origin Sedimentary Rocks by M.E.Tucker
6. Principles of Sedimentology & Stratigraphy by S.J.Boggs (2006)
7. Practical Approach to Sedimentology by Roy Lindholm (1987)

8. Igneous and Metamorphic Petrology - By Best M.G., CBS Publishers, Delhi

MODULE 5. STRUCTURAL GEOLOGY

Attitude (Dip and Strike). Primary Structural Forms & Secondary Structural Forms. Concept of deformation. Forces of deformation.

Joints: Classification – Geometrical joints and Genetic. Significance of joints.

Faults: Definition - Elements of fault, Classification - Geometrical and Genetic. Criteria for recognition of faults in the field and their importance.

Folds: Definitions - parts of folds, Types of folds. Denudational structures. Criteria for recognition of folds in the field and their importance.

Unconformity- Definition, Types and significance.

References:

1. Structural Geology - By M. P. Billings,
2. Fundamentals of Structural Geology - By N. W. Gokhale
3. Principles of structural Geology - C.M. Novin
4. Structural geology - De Sitter
5. Theory of Structural Geology- Gokhale, N.W.
6. Structural Geology – Fundamentals and Modern developments. – Ghosh. S.K
7. Structural and Tectonic, Principles- P.C. Bedgley
8. An Introduction to structural Geology - E.W. Spencer
9. Fundamentals of structural Geology- Park, P.G.

MODULE 6. PRINCIPLES OF STRATIGRAPHY AND INDIAN STRATIGRAPHY

Correlation and correlation methods- Petrological and paleontological.
Geological Time Scale: Important Geological events (climate, life and mountain building) in brief during- Paleozoic, Mesozoic and Cenozoic era.

Brief account of physiographic divisions of India- Peninsular, extra peninsular and indo-Gangetic alluvial plains.
Petrology, classification and economic importance of-
Archaeans of Karnataka; Cuddappah system of Andhra Pradesh and its equivalents in Karnataka-Kaladgi series; Vindhyans system; Gondwana system with flora and fauna; Deccan traps- Inter trappeans, infra trappeans, bagh and lameta beds; Jurassic of Kutch, Triassic of Kashmir and Cretaceous of Trichinapoly.

References:
1. Geology of India and Burma - Krishnan M.S

2. Geology of India - Wadia D.N
3. Stratigraphy of India- Ravindrakumar K.R.
4. Principles of Stratigraphy - Lemon R.Y
5. General Stratigraphy - J.W. and Barret B.H
6. Geology of India – M Ramakrishnan & R Vaidynadhan

MODULE 7. HYDROGEOLOGY

Hydrologic cycle. Ground Water – Introduction, origin, types, occurrence, movement of ground water, Hydrologic properties of rocks. Water bearing geologic formations.

Well hydraulics, Darcy's Law and Its' applications. Water table and its fluctuations; Hydrographs, water table contour maps, hydro-stratigraphic units.

Groundwater chemistry - Physical, chemical and biological properties of groundwater. Water quality, drinking water standards, groundwater quality map of India.

Recharge structures, Types of recharge structures, Artificial recharge of groundwater- roof/rain water harvesting system, Problem of over exploitation of groundwater and remedial measures; sea water intrusion in coastal aquifers and remedial measures.

Interpretation of hydrogeomorphic units using satellite imageries. Water budget equation and Groundwater management

References:

1. Groundwater - By Todd D. K., John Wiley and Sons.
2. Groundwater - By K. V. Karanth,
3. Groundwater and Tube wells - By S.P. Garg, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Hydrogeology - By Stanley N. Davis, Roger J. M. De Wiest, John Wiley and Sons.
5. Ground water McGraw Hill. New York. Tolman., G.F. 1937
6. Ground water Hydrology. John wiley & Sons. Todd, D.K. 1959
7. Ground water, Wiley Eastern. Raghunath, H.M. 1983
8. Ground water Resources evaluation, McGraw Hill. Walton, W.C. 1970.
9. Ground water Assessment Development & management Tata McGraw Hill. Karanath, K.R. 1987.

MODULE 8. GEOPHYSICAL EXPLORATION

Introduction – Methods of Exploration

Gravity Method: Introduction, Basic principle, Gravity of the Earth, Gravity reductions, Densities of rocks and minerals, Density estimates from field results, Gravimeters-Stable type, Field operations, results and interpretation.

Magnetic Method: Introduction, Basic principle, Magnetism of the Earth, Magnetism and magnetic susceptibilities of rocks and minerals, Field instruments, Field operations. results and interpretation.

Seismic Methods: Introduction, Principles of Reflection and Refraction Methods, Field Equipment – Geophones, results and interpretation.

Electrical Methods: Introduction, Electical properties of rocks and minerals.

Resistivity Method: Elemental theory, Resistivity Meters, Electrode layouts – Wenner and Schlumberger spreads, Field procedure, Application of resisitivity method in ground water search.

References:

1. Geochemistry in mineral exploration Hawkes. H & Wobb J.S. Harper & Row New York.
2. Principles of Geochemical prospecting. Ginzburg. I.I. Petgaon Press, N.Y. London.
3. Biochemical methods of Prospecting - Malyuga, D.P.
4. Introduction to geophysical prospecting - Milton B, Dobrin Mc Graw Hill Book
5. Outlines of geophysical prospecting - A manual for Geologists. M.B.R. Rao. Prasaranga, Mysore University.
6. Geophsical Methods in Geology - P.V. Sharma.
7. Geophysical Exploration - Heilava. C.H.
8. Exploration Geophysics for Geologists and Engineers - Edited by Bhimasanakaran, V.L.S. Gour. V.K. - The Association of Exploration Geophysists - Hyderabad
9. Applied Geophysics – W.M.Telford,L.P.Geldart,R.E.Sheriff,D.A.Keys. Cambridge univ., Press,1976, pp 860

MODULE 9. SURVEYING AND GEOENGINEERING STUDIES

Surveying:

Introduction: Definition, objectives, uses, classification of survey, principles of surveying, introduction to map and map projection, scales and types of scale, error and types of error.

Linear Measurement: Distance measurement devices: Chain, tape, GPS, Electronic Distance Measurement (EDM) etc., corrections

Direction and Angular measurement: Prismatic Compass, uses, types, meridians, bearings, local attraction, declination. Theodolite: Types, Temporary adjustment, Measurements of horizontal and vertical Angles

Traverse Survey: Types of traverses, Theodolite traverse – Field work, Latitude, departure, Coordinate system of traverse, Adjustment of close traverse, other uses of theodolite.

Levelling & Contouring: Definitions, Types of levels, methods of levelling, R.L. computations, various types of levelling, contour, characteristics, methods of plotting contour.

Geoengineering studies:
The role of geology in civil and environmental engineering. Mechanical properties of rocks and soils. Rock strength. Rocks as engineering materials.

Bridge sites: Bridge structure, types, bridge problems, and geological parameters. Geology of bridge sites.

Dams: Types of Dams. Location of dam. Geological considerations- topography, structure and lithology. Foundation and seepage problems in dams and their treatment. Foundation treatment.

Reservoir: Reservoir problems- seepage and silting. Reservoir induced seismicity.

Tunnels: terminology, definitions, types. Geological considerations- Lithology and structure. Ground failures in tunnels.

Geological site investigations for engineering projects. Problems of groundwater in engineering projects.

References:

1. Engineering Geology- Parbin Singh
2. Engineering Geology- F.C.Bell
3. Principles of Engineering Geology - Bangar
4. Surveying – Duggal
5. Surveying & Leveling – Kanetkar
6. B S Sathyanarayana Swamy, "A Text Book of Engineering Geology" – 2000 Edition, Dhanpat Rai & Co (P) Ltd. Delhi.
7. S K Garg, "Physical and Engineering Geology" – Third Edition 1999- Khanna Publishers, Delhi 111006
8. K V G K Gokhale, "Principles of Engineering Geology" – Revised Edition 2005, B S Publications Hyderabad.
9. D S Arora, "Geology for Engineers" – Second Edition, 1982 Mahendra Capital Publishers, Chandigarh.
10. D Venkata Reddy, "Engineering Geology" - 2011 Edition, Vikas Publishing house Pvt. Ltd New Delhi.
11. Robert F Legget, "Geology and Engineers" – Third Edition McGraw Hill International edition, Civil Engineering series.

MODULE 10. REMOTE SENSING AND GIS

Aerial remote sensing: Applications of Aerial photographs, Types of aerial photography, Geometry of Aerial Photographs-Scale; Flight procedures, Mosaics, Types of Stereoscopes, Mosaics and its types, Identification and Interpretation-Approach and Criteria, Elements of aerial photo-interpretation (Geotechnical and photo elements)

Satellite remote sensing: Introduction to remote sensing. Basic principles of Electromagnetic spectrum – platforms – sensors. Energy interaction with atmosphere and earth's surfaces.

Sensors: Active and Passive sensors, Types of resolutions- spatial, temporal and radiometric, History of Indian satellites.

GIS and GPS: Global Positioning System (GPS) and its application in GIS. Coordinate systems, Projections. Functionality of GIS, Computer Fundamentals of GIS. GIS working principle. Representation of geographic information in GIS.

References:

1. Aerial photographic interpretation. Principles and applications – D.R.Leuder.
2. Photogeology – Miller.J.C
3. Manual of colour aerial photography – Ed. Smith, J.T.Jr.
4. Manual of Remote sensing – Ed Robert G Reeves.
5. Remote sensing in Geology – Parry S.Siegal & Alan. R.Gillespie.
6. Principles of Remote sensing – Patel singh; SP Publication.
7. Digital Remote Sensing – Pritivish Nag M Kudrat; concept publication.
8. Remote sensing and its applications – LRA Narayan
9. Principles and application of Photogeology by Shiv N Pandey
10. Remote sensing of environment by Joseph Lintz, jr. David S. Simonett.
11. Text book of Remote Sensing and Geographical information systems - M.Anji Reddy