

Kuvempu University, Department of Applied Geology, Syllabus (Scheme: CBCS)
M.Sc., in Earth Science and Resource Management (UGC innovative program)

Course Structure - Syllabus Revised on 2022-23 Academic Year

Paper Code	Title of the Paper	Credit	Theory/Practical		Total
			Internal Assessment	Main Exam	
I Semester: HardCore Papers (Theory)					
ESH 101	Crystallography, Mineralogy and Thermodynamics	4	25	75	100
ESH 102	Physical Geology and Oceanography	4	25	75	100
ESH 103	Geoinformatics	4	25	75	100
SoftCore Paper (Theory)					
ESS 101	Earth and atmospheric science	4	25	75	100
HardCore Papers (Practical)					
ESHP101	Crystallography, Mineralogy and Geochemistry	2	-	50	50
ESHP102	Physical Geology and Oceanography	2	-	50	50
ESHP103	Geoinformatics	2	-	50	50
SoftCore Paper (Practical)					
ESSP101	Earth and atmospheric science	2	-	50	50
Total		24	100	500	600
II Semester: HardCore Papers (Theory)					
ESH 201	Petrology and Geochemistry	4	25	75	100
ESH 202	Hydrogeology and Structural geology	4	25	75	100
ESH 203	Paleontology, Indian Stratigraphy, Geology of Karnataka	4	25	75	100
SoftCore Paper (Theory)					
ESS 201	Digital image processing and GIS Data Analysis	4	25	75	100
HardCore Papers (Practical)					
ESHP202	Petrology and Geochemistry	2	-	50	50
ESHP203	Hydrogeology and Structural geology	2	-	50	50
ESHP201	Paleontology and Surveying	2	-	50	50
SoftCore Paper (Practical)					
ESSP201	Digital image processing and GIS Data Analysis	2	-	50	50
	InterDepartmental Elective Paper	2	10	40	50
	Internship (Student's Undergone Internship Training At Industries/ Institutions/ Laboratories of Geological Importance)	-	-	-	-
Total		26	110	540	650
III Semester: HardCore Papers (Theory)					
ESH 301	Economic and Engineering Geology	4	25	75	100
ESH 302	Exploration Geology - Geological, Geochemical and Geophysical	4	25	75	100
ESH 303	Fuel Geology and Disaster Management	4	25	75	100
SoftCore Paper (Theory)					
ESS 301	Mineral and Water Resources Management	4	25	75	100
HardCore Papers (Practical)					
ESHP301	Ore reserve estimation and Engineering Geology	2	-	50	50
ESHP302	Exploration Geology - Geological, Geochemical and Geophysical	2	-	50	50
ESHP303	Disaster Management	2	-	50	50
SoftCore Paper (Practical)					
ESSP301	Hydro Geochemistry and Geochemical Data Interpretation	2	-	-	50
ESFW 101	Field Camp	2	-	50	50
	InterDepartmental Elective Paper	2	10	40	50
Total		28	110	540	700
IV Semester					
ESPW 401	Project Work	6	-	-	200
ESPV 402	Project Viva	2	-	-	50
Total		08	-	-	250
GrandTotal		86	320		2200
InterDepartmental Elective I Semester					
AGE 201	Water Resources	2	10	40	50
AGE 202	Geoinformatics	2	10	40	50
InterDepartmental Elective II Semester					
AGE 301	Natural Disaster Management	2	10	40	50
AGE 302	The World of Rocks and Minerals	2	10	40	50

ESH 101: CRYSTALLOGRAPHY, MINERALOGY AND THERMODYNAMICS

Unit – I: Crystallography

16 hours

Crystals, crystalline solids, and their formation. Development and importance of Crystallography. Regular arrangement of Points in Space. Symmetry in Translation Rows, Nets, and Lattices. Relation of the Crystal Lattice to the Crystal. Crystallographic Notation for planes and Axes. Study and Measurement of Crystals. Crystal projections and Stereographic projection. Crystal Classes. Space group terminology. Imperfections of Crystals. Aggregates of Crystals and Crystalline Grains. Twinning.

Unit – II: Rock-forming Minerals

16 hours

Introduction to mineralogy: Definition and classification of minerals. Structural and chemical principles of minerals, chemical bonds, ionic radii, coordination number (CN), polyhedron, and Pauling's rule. Structure, chemistry, physical and optical characters and paragenesis of mineral groups: Olivine, pyroxene, amphibole, mica and spinel groups, quartz, Feldspar, feldspathoid, aluminum silicate, epidote and garnet groups.

Accessory minerals: Apatite, calcite, corundum, scapolite, sphene and zircon.

Unit – III: Ore-forming Minerals

16 hours

Classification of ore minerals. Physical, Chemical and Optical properties of the following common ore forming minerals Iron, Manganese, Aluminium, Chromium, Copper, Lead, Zinc, Gold, Silver, Platinum. Halides, Sulphides, Oxides, Carbonates, Nitrates, Borates, Sulphates, Chromates, Phosphates Arsenates, Molybdates, Tungstates, Native metals.

Unit – IV: Thermodynamics

16 hours

Fundamental relationships: Definition and conventions, standard states; Principles of Geothermobarometry, Fundamental Thermodynamic Concepts, Laws of Thermodynamics - Enthalpy, Entropy, Heat capacity and free energy concept of equilibrium and equilibrium constant. Gibbs phase rule, application to mineralogical system. Forsterite-Fayalite; Albite-Anorthite; Albite-Orthoclase. Forsterite-Quartz and Diopside-Anorthite.

Aquatic Chemistry- Carbonates, Surface water and Groundwater Chemistry, Alkalinity.

Trace Elements in Igneous Processes: Behavior of the Elements, Goldschmidt's Classification Trace Element Distribution during Partial Melting, Trace Element Distribution during Crystallization.

Radiogenic Isotope Geochemistry: Basics of Radiogenic Isotope Geochemistry, Decay Systems and Their Applications- Rb-Sr, Sm-Nd, Lu-Hf, Re-Os, U-Th-Pb, C.

Stable Isotope Geochemistry- C, S, and O isotope geochemistry

References:

1. Berry, Mason, Dietrich, Mineralogy- concepts, descriptions, determinations; 2nd edition, CBS Publishers.
2. Rutley's elements of mineralogy; 27th edition, revised by C.D Gribble, CBS Publishers.
3. Perkins Dexter; Mineralogy; 3rd edition, Pearson Publications
4. William E. Ford, Dana's textbook of Mineralogy; 4th edition, CBS Publishers.
5. William M. White, Geochemistry, 2013, Wiley-Blackwell
6. Krauskopf, K. B. and D. K. Bird. 1995. Introduction to Geochemistry. New York: McGraw-Hill.
7. Klein, C and Hurlbut, Jr., C.S. 1993; Manual of Mineralogy. John Wiley
8. Introduction to the Rock-forming Minerals Paperback –2013 W. A. Deer (Editor), R. A. Howie (Editor), J. Zussman (Editor)
9. Maureen M. Julian, Foundations of Crystallography, Taylor & Francis Group (2008)
10. C. Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2009

ESH 102: PHYSICAL GEOLOGY AND OCEANOGRAPHY

Unit – I: Physical geology

16 hours

The Solar system: Sun and planets, introduction to components of the earth, origin of the earth, age of the earth, interior of the earth. Plate Tectonics, Sea floor Spreading and Continental drift theory, Mountain building activity-types and formation. Neotectonics.

Unit – II: Geomorphology

16 hours

Introduction: Fundamental concepts of geomorphology. **Geomorphic processes:** Weathering, Types of weathering, Zone of weathering and Erosion, transportation, deposition **Geomorphic controls:** Geology and structure, climate and biogenic **Landforms of exogenetic origin:** Fluvial Process and landforms Wind action and Aeolian landforms, Glaciers and Glacial landforms, Marine erosion and Coastal landforms. **Landforms of endogenetic origin-** Volcanic and Tectonic landforms. Landforms of biogenetic and extraterrestrial activity origin; Termites Man made structure like quarries, road cuts and fills.

Unit – III: Geomorphology

16 hours

Mass wasting: Classifications, Causes geomorphic significance and conservation of mass wasting, Morphology of Indian sub-continent Morphology of the ocean floor. **Soil as a resource:** Soil uses, component and profiles. Soil formation processes. Physico - chemical parameters of soil, Classification of soils. Soils erosion, conservation practices, preventive measures.

Unit – IV: Oceanography

16 hours

Introduction to Oceanography, Plate Tectonics, The Ocean Floor, The Atmosphere and the Oceans, Circulation Patterns and Ocean Currents , Waves and Tides, Beaches, and Coasts, Estuaries, and Environmental Issues, Oceanic Environment and Production, Marine Resources and Pollution.

Books for References:

1. Physical Geology by Montgomery
2. Bob F Mallory, David N Cargo- Physical Geology McGraw Hill Book Company
3. Principles of Geomorphology by Dayal
4. Principles of Geomorphology, Thornburry
5. K Siddhartha, Oceanography- A Brief Introduction
6. Alan P. Trujillo and Harold V. Thurman 2016 Essentials of Oceanography, Pearson Publ.

ESH 103: GEOINFORMATICS

Unit I - Aerial Remote Sensing

16 hours

Introduction Remote Sensing: Types of Remote Sensing, Aerial Remote Sensing-Horizontal, Oblique-High oblique, low oblique. Advantages of Aerial Photography, Application of Aerial Photography

Tools in Aerial Photography: Introduction: Stereo pair, Stereoscope, Pocket Stereoscope, Mirror Stereoscope, Parallax bar, Determination of area using Planimeter, Determination of Length using Rotameter

Stereoscopic Vision Test: Determination of Relative Position of the object Carl zees stereo plate
Annotations: Introduction: Fiducial Marks, Principal Point, Conjugate Principal Point, Nadir Point, Focal Length, Vertical level, Altimeter, Date, Time, Serial photo number, Compass, Flight Altitude, Scale. **Determination of flight direction:** x-y co-ordinates, principle point, Conjugate Principal Point, Perspective center, Nadir point, flight line and direction Determination of Scale Average Scale

Unit II- Photogrammetry

16 hours

Computing flying height from vertical photograph, computing relief displacement from vertical photograph, computing height of the object from vertical photograph, computing air base from vertical photograph, computing ground control point from the aerial Photograph

Principle keys for interpretation of aerial Photograph: Tone, Texture, Shape, Size, Scale, Pattern, Shadow, and Association

Application of Aerial Photograph: Fluvial landform, Coastal landform, glacial landform Structural landform, volcanic landform, Aeolian landform, Land use/ Land cover mapping.

Unit III: GIS

16 hours

Introduction, fundamentals and functions of GIS, Components of GIS. Data and information: Types of geological and natural resources data, spatial and time variant, oriented information. Map Projection: Earth's size and shape in time and space. Spherical coordinates, Properties of map projections, Types of basic projections classification - Cylindrical, Conical and Azimuthal projections. Overview of map projection. Data models: Raster and Vector models. Advantages and Disadvantages of Raster and Vector Models and GIS data processing. Data quality and errors: Importance of Errors, Accuracy and Precision, Types of Errors, Sources of Inaccuracy and Impression, Problems of Propagation and Cascading, False precision and false accuracy, and dangers of undocumented data.

Unit IV GPS

16 hours

GPS: GPS Overview, Global Navigation Satellite system, Fundamentals of Satellite Navigation. GPS system segments. GPS signal characteristics. GPS signal acquisition and tracking. GPS-Error sources, Measurements, Accuracy and estimates of user position and time.

Books for Reference

1. Photogrammetry- Moffit, H.F., and Edward, M.M., (1980). Harper and Row Publishers
2. Fundamentals of Remote Sensing and Air Photo Interpretation, Avery T.E. and G.L.Berlin, Prentice Hall (1992)
3. Manual of Photogrammetry, 3rd Edition, 1966, American Society of Photogrammetry
4. Aerial Photographs in Geologic Interpretation and Mapping By RICHARD G. RAY
5. Photogrammetry by Richard Burns, PLS Caltrans Geometronics.
6. Geographic Information Systems and Science 3rd Edition by Paul A. Longley, Mike Goodchild, David J. Maguire, David W. Rhind, John Wiley and Sons
7. Concepts and Techniques of Geographic Information Systems, 2nd Edition Chor Pang Lo, Albert K.W. Yeung, Prentice Hall Publ.

ESS 101: EARTH AND ATMOSPHERIC SCIENCE

Unit – I:

16 hours

Fundamental principles of climatology, Koppen's and Thornthwaite's scheme of climate classification. Climate change.

Earth- Sun relationship: Sunlight, The atmosphere's ultimate energy source, solar fluxes in atmosphere and at the Earth's surface, Radiation model, Infrared Radiation, conductive and convective fluxes, Earth's energy budget and radioactive forcing.

Earth's Atmosphere: composition of the atmosphere, early atmosphere, vertical structure of atmosphere, layers of atmosphere.

Climate and Weather: Weather Forecasting, Acquisition of Weather information, forecasting techniques, satellites and weather forecasting, weather forecasting using weather charts, weather plotting symbols, national weather service's forecasts and services, commercial weather forecasting services.

Unit – II:

16 hours

Temperature: temperature and Heat transfer, temperature scales, latent heat, conduction, convection.

Air temperature: Daily temperature variations: Daytime warming, nighttime cooling, cold air near the surface, controls of temperature, Air temperature data, and uses of temperature data.

Humidity: Humidity variables and measuring Instruments, Humidity variations and their effect on human comfort, formation of dew and frost.

Clouds: Basic cloud genera (classification of clouds), clouds with vertical development, mechanism of clouds formation.

Precipitation: Precipitation process. Collision and coalescence process, the Bergeron process, precipitation types, precipitation modification, measuring precipitation, instruments, Doppler radar and precipitation.

Global warming and greenhouse effect: Key to global warming changes in radioactive forcing, feedbacks to radiative forcing, computer models of global warming, the temperature record, global warming and the future.

Unit – III:

16 hours

Air pressure: air pressure. Atmospheric pressure, measuring air pressure, surface and upper air charts, forces and motions (Newton's law), forces acting on the atmosphere, vertical motions

and the movement of pressure centers, pressure, temperature, and thickness relationships.

Winds: Hydrostatic equilibrium, geostrophic wind, gradient wind, surface winds, winds and vertical air motions, wind pressure, wind measurement.

Atmospheric circulations: Forms and scales of atmospheric motion, the molecular scale, micro scale circulation, meso scale circulation, synoptic- scale circulations and local winds, global- scale structures and general circulation, ocean-atmosphere interactions.

Air masses: Air masses source regions, continental polar air masses, maritime polar air masses, continental tropical air masses, maritime tropical air masses.

Unit – IV:

16 hours

Latitude cyclones: Polar front theory, causes for development of cyclone, where do mid-latitude cyclones tend to form? Developing-middle-latitude cyclones and anticyclones, jet streams and developing mid-latitude cyclones.

Thunderstorms: types, distribution, lighting and thunder, thunderstorms and flooding.

Tornadoes: Tornado occurrence, tornado winds, tornado formation, observing tornadoes, waterspouts, tornado forecasting and safety

Hurricanes: hurricane and tropical weather, tropical cyclone categories, anatomy of a hurricane, hurricane formation and dissipation: Hurricane stages of development, hurricane movement, destruction and warning.

Indian Monsoon: components of Monsoon, synoptic systems of Monsoon, Indian Monsoon, rainfall and its variability.

Reference:

1. Meteorology by Eric W. Danielson, James Levin, Elliot Abrams
2. Essentials of Meteorology: An invitation to the Atmosphere by C. Donald Ahrens
3. Meteorology – Moran and Morgan.
4. Principles of Physical Geography by A. Das Gupta, A.N.Kapoor : S. Chand and company ltd.

ESH 201: PETROLOGY AND GEOCHEMISTRY

Unit – I

16 hours

Igneous Petrology-Introduction: Definition and classification of rocks based on mode of formation, Classification of igneous rocks: Mode, CIPW norm, IUGS and Irvine-Barger classifications; Crystallization of binary systems. Igneous Rocks: Magmatic evolution: Differentiation; Forms, Textures, and structures of igneous rocks. Structures and textures: Magmatism and tectonics.

Origin, distribution and significance of Igneous rocks –Acid Igneous rocks- Granites, Adamellites and Granodiorites, Syenites and related Alkali-rich rocks, Intermediate rocks- Diorites, Micro diorites and Andesites, Monzonite, Basic Igneous rocks- Gabbros, Norite, Dolerites and Basalts. Feldspathoidal rocks and related rocks, Carbonatites, Lamprophyres, Ultramafites, Anorthosites, Pyroclastic rocks. Ophiolite suite.

Unit – II

16 hours

Sedimentary Petrology: Sedimentary processes and their products. Classification of sediments. Diagenesis & Lithification. Sedimentary structures. Classification of sedimentary rocks. Mineral composition, structure and textures of Clastic and non-Clastic sediments and Residual deposits. Origin, occurrence, and characteristics of common sedimentary rocks – Rudaceous, arenaceous, Argillaceous and carbonates.

Unit–III

16 hours

Metamorphic Petrology: Types and factors of metamorphism. Zones, grades and facies of metamorphism. Facies of Regional and contact metamorphism. Textures and structures of metamorphic rocks. Metamorphism of argillaceous, arenaceous, calcareous and acidic and basic igneous rocks. Metasomatism. Composition, origin and mode of occurrence of Gneisses, Amphibolites, Granulites, Schists and Eclogites.

Unit-IV

Geochemistry-

Introduction to Geochemistry- Elements, Atoms, and Chemical Bonds, a Brief Look at the Earth Principles of Geothermobarometry, Aquatic Chemistry- Carbonates, Surface water and Groundwater Chemistry, Alkalinity, Trace Elements in Igneous Processes: Behavior of the Elements, Goldschmidt's Classification Trace Element Distribution during Partial Melting, Trace Element Distribution during Crystallization, Trace Element Distribution during Crystallization Radiogenic Isotope Geochemistry: Basics of Radiogenic Isotope Geochemistry, Decay Systems and Their Applications- Rb-Sr, Sm-Nd, Lu-Hf, Re-Os, U-Th-Pb, C, Stable Isotope Geochemistry- C, S, and O isotope geochemistry.

Books for Reference

1. Petrology of the Igneous rocks, 13th edition, F.H. Hatch, A.K. Wells and M.K. Wells
2. Igneous And Metamorphic Petrology – Turner and Verhoogan
3. Text book of Petrology – G W Tyrrell
4. Petrology – Hyndman
5. Igneous and Metamorphic Petrology – Myren G Best
6. Petrology (Igneous, Sedimentary and Metamorphic) – Eeneest G Ehlers/Harvey Blatt
7. Igneous Petrology- McBirney
8. Principles of Igneous and Metamorphic Petrology- Anthony R Phillips
9. Igneous Petrology – M K Bose
10. Petrology of Igneous rocks – Alok K Gupta
11. Metamorphism and Metamorphic rocks – Miyashiro
12. Metamorphic Petrology – B Bhaskar Rao
13. Sedimentary Petrology – Pettijohn
14. Igneous and Metamorphic Petrology – W D Winter
15. Petrology (Igneous, Sedimentary and Metamorphic) – Loren A Raymond
16. Krauskopf, K. B. and D. K. Bird. 1995. Introduction to Geochemistry. New York: McGraw-Hill.
17. William M. White, Geochemistry, 2013, Wiley-Blackwell

ESH 202: HYDROGEOLOGY AND STRUCTURAL GEOLOGY

Unit – I:

16 hours

Surface Water Hydrology: Global distribution of water. Hydrological Cycle - Precipitation, Interception, Infiltration, Soil Moisture, Evaporation, Evapotranspiration: Potential and actual evapotranspiration and Runoff. Measurement of runoff, factors controlling runoff.

Groundwater Hydrology: Introduction and definition, occurrence origin and classification.

Vertical distribution of water in the crust: Zones of Aeration - Soil moisture zone, vadose zone, Capillary fringe. Zone of saturation - water table, fluctuation of groundwater level, water level measurements and interpretation.

Water bearing characteristic of rocks: Porosity, Effective Porosity, Permeability, Transmissivity, Storage Coefficient, Specific Yield, Specific Retention.

Definitions and hydrologic properties: Groundwater reservoirs - Aquifers - Confined, Unconfined and Perched aquifers, Aquiclude, Aquifuge, Aquitard, Coastal Aquifers, Fresh and salt-water relationships in coastal and island areas.

Unit – II:

16 hours

Groundwater flow: Laminar flow and Turbulent flow, Darcy's Law, Experimental verification, range of validity, Reynold's number. Flow lines and equi-potential lines, Preparation of groundwater contour maps and Flow nets. Basic Groundwater flow equations: Steady and Unsteady state of flow.

Well Hydraulics: Steady radial flow to a well, Confined aquifer, unconfined aquifer, Dupit's approximation. Unsteady radial flow to a well: Confined aquifer. Unconfined aquifer. Theis's non-equilibrium equation, Jacob's solution.

Pumping Test: Aquifer test and well test for determination of the formation and well loss coefficients. Multiple drawdown tests, well efficiency, selection of test sites

Unit – III:

16 hours

Introduction, Rock deformation, Mechanical principles and properties of rocks and their controlling factors. (Confining pressure, temperature, time, pore fluid pressure etc). Stress and Strain in Solids. Two dimensional stress analyses. Concept of strain. Homogeneous and inhomogeneous strain. The fundamental strain equation. Two dimensional strain analysis. Types of strain ellipses and ellipsoids, their properties and geological significance. Dip and strike, Compass Clinometers, Lineation, foliations, dykes and lineaments. Unconformity.

Unit – IV:

16 hours

Definition and importance of structural Geology.

Primary Structures: Ripple marks, Sun cracks, Rain prints, Stratification, Current bedding and Graded bedding. Their importance in identifying secondary structures.

Secondary structures: **Folds** – types of folds and their classification – Ramasay's classification of folds and their recognition of folds in the field. **Joints** - Description, morphology, genetic and geometric classification. **Faults** – Causes, mechanism and dynamics of faulting. Fault types, their genetic and geometric classifications. Faults recognition in the field.

Reference:

1. Groundwater Hydrology (2nd Ed.) – D.K.Todd – John Wiley and Sons Inc. New York.
2. Hydrogeology (2nd ed.) – C.W.Fetter – Merrill Publishing Co. U.S.A.
3. Hydrogeology - K.R.Karanth – Tata McGraw Hill Publishing Co. Ltd.
4. Ground Water Assessment, Development and Management – K.R.Karanth– Tata McGraw Hill Publishing Co. Ltd.
5. Groundwater – H.M.Raghunath – Wiley Eastern Limited
6. Hydrology – H.M.Raghunath– Wiley Eastern Limited
7. Elements of Hydrology – V.P.Singh
8. Engineering Hydrology – K.Subramaniam - Tata McGraw Hill Publishing Co Ltd.
9. Applied Hydrology – Mutreja, K.N. - Tata McGraw Hill Publishing Co. Ltd.
10. Marland P Billings – Structural Geology 3rd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey

11. Haakon Fossen- Structural Geology, 2nd edition, Cambridge University Press
12. George H. Davis, Stephen J. Reynolds, Charles F. Kluth : Structural Geology of Rocks and Regions: John Wiley & Sons, INC.

ESH 203 : PALEONTOLOGY, INDIAN STRATIGRAPHY & GEOLOGY OF KARNATAKA

Unit – I: Paleontology

16 hours

Introduction: Classification of life -plant kingdom and Animal kingdom-vertebrate and invertebrate –phylum, class, order, general and species.

Fossils: Definition, Mode of preservation of fossils, physico-chemical conditions for fossilization, types of fossils, significance of fossils, and imperfection of geological record,

Invertebrates: Morphology, classification evolutionary trends, and Geological distribution of Foraminifera, Cnidarians, Bryozoa, Brachiopods, Lamellibranch, Gastropods, Cephalopods, Echinoids Trilobites & Graptolites.

Plant fossils- Introduction, classification, Morphology and distribution of Lepidodendron, sigillaria, calamities, Glossopteris, ptilophyllum.

Unit – II: Indian Stratigraphy-I

16 hours

Principles of stratigraphy, Geological time scale, Stratigraphy classification, stratigraphic units of India, Physiographic Units of India.

Archean system-, Dharwar super group-lithology and structure, Classification – distribution of Archean rocks in Indian continent and economic importance.

Proterozoic formations-Cuddapah & equivalents, Vindhyan group & equivalents and economic importance.

Unit – III: Indian Stratigraphy-II

16 hours

Paleozoic group- Cambrian rocks, Ordovician and Silurian rocks, Devonian rocks, Permian-Carboniferous rocks. Mesozoic group-Triassic rocks, Jurassic rocks, Cretaceous rocks-Gondwana super group and economic importance. Deccan traps. Tertiary group- Siwaliks and Karewas

Unit – IV: Geology of Karnataka

16 hours

Summary of Geological history of Karnataka, Archean rocks, Ancient supra crustal rocks – Sargurs, Gneissic complex, gold bearing schist belts of eastern Karnataka, schist belts of western Karnataka, Granulite, Younger granites. Purana Basins Kaladgi and Bhima group, Gondwana group, Deccan volcanism, Dykes rocks. Tertiary rocks laterite and Black soil.

Reference:

1. Geology of Karnataka- B P Radhakrishna and R Vaidyanadhan Geol. Soc. India Publ
2. Memoire 112 Geological Survey of India Publication
3. Geology of India by DN Wadia
4. Geology of India and Burma by M S Krishnan
5. Historical Geology and Principles of Stratigraphy by Ravindra Kumar
6. Paleontology: The Record of Life COLIN W. STEARN Logan Professor of Geology McGill niversity ROBERT L. CARROLL Strathcona Professor of Biology McGill University with illustrations by Linda Angeloff Sapienza
7. Text-book of Paleontology edited by Charles r. Eastman, A.M.,
8. Palaeontology –Evolution and Animal Distribution by Dr. P C Jain and Dr. M S Anantha Raman-Vishal Publications.
9. Robert R.Shrock and William H., Twenhofel, (1953) Principles of Invertebrate

- Palaeontology Mc Graw-Hill Book Co-Invertebrate Paleontology, H.Woods, Cambridge University press, 1961
10. R.C.Moore, C.G., Lalicker and A.G. Fisher, 1952. Invertebrate Fossils Mc Graw Hill Book Co., Alfred S.Romer (1963) Vertebrate Paleontology, , University of Chicago press
 11. B.U.Haq and A.Boerma, 1978, Introduction to Marine Micropaleontology, Elsevier Publishing Company. M.D., Brasier, 1980, Microfossils, George Allen & Unwin, London.
 12. G.Bigot, 1985, Elements of Micropaleontology, Graham & Trotman, London
 13. H.H.Swinerton, (1961) Outlines of Paleontology, Edward Arnold PublisherReference Books
 14. Derek V.Ager, 1963, Principles of Paleocology, McGraw Hill Book Co.Benton, M.J. 1990, Vertebrate Paleontology, John Wiley, Unwin Hyman, , 1971, Vertebrate Paleozoology, John Wiley
 15. F.B.Phleger, Ecology and Distribution of Recent, Foraminifera, Hohn Hopkins Press.
 16. J.P.Kennet and M.S.Srinivasan; 1951, Forminifera, W.H.Freeman & Co.,

ESS 201: DIGITAL IMAGE PROCESSING AND GIS DATA ANALYSIS

Unit-I: Digital Image Processing

16 hours

Data collection, data analysis, data collection errors, Remote sensing data requirements, image processing functions, image data formats.

Image quality assessment: Image processing, Mathematical notations, Sampling theory, Histograms and its significance in digital image processing, Image Metadata, Univariate descriptive image statistics, Central tendencies in remote sensing data, measures of dispersion, measures of distribution, multivariate statistics, geostatistical analysis.

Image Rectification and Restoration: Geometric correction, geometric errors, types of geometric corrections: Image to map, Image to Image, hybrid approach, rectification logic, Mosaicking.

Image enhancement: Image reduction and magnification, contrast enhancement-linear and nonlinear enhancements, Band ratioing, spatial filtering- spatial convolution filtering, Fourier transformation, principal component analysis.

Unit-II: Digital Image Processing

16 hours

Thematic Information extraction: Supervised classification – Landuse and Landcover classification schemes. Training site selection and statistical extraction. Feature selection of classification algorithm. Unsupervised classification methods-Chain and ISODATA methods, cluster busting, Fuzzy classification. Object oriented Classification.

Thematic information Extraction-Hyperspectral Image Analysis: Hyperspectral data collection, Steps to extract information from Hyperspectral data, Hyperspectral Image quality assessment, Radiometric calibration, MNF (Minimum Noise Fraction, Pixel purity index mapping, Spectral Angle Mapper, Indices from Hyperspectral Data

Thematic map accuracy: Landuse/Landcover map accuracy assessment, sources of errors in remote sensing derived thematic products, error matrix, sampling size and design, evaluation of error matrices, geostatistical analysis to assess the accuracy of remote sensing derived information.

Unit III: Remote Sensing Applications

16 Hours

Thermal Infrared Remote Sensing: Thermal Infrared Radiation Properties, Thermal Radiation Laws, Atmospheric Windows, Thermal Infrared Data collection, Thermal Infrared Remote Sensing.

Active and Passive Microwave Remote Sensing: Active Microwave system components, RADAR environmental considerations, SAR Remote Sensing, RADAR Interferometry, and Passive Microwave Remote Sensing.

LIDAR Remote Sensing: LIDAR Principles, Accuracy of LIDAR Measurements, LIDAR derived vegetation information LIDAR derived Urban Information.

Remote Sensing of Vegetation: Spectral Characteristics of Vegetation, Temporal Characteristics of Vegetation Indices: Vegetation Indices, Remote Sensing of Vegetation change.

Remote Sensing of Urban Landscape: Urban/suburban resolution considerations, Remote Sensing Land use and Land cover, Residential Land use, Commercial Land use, Industrial land use, Transportation infrastructure, Communication and Utilities, Urban Disaster Emergency Response.

Remote Sensing in Geology: Remote Sensing of Soils, Remote Sensing of Rocks and Minerals; Imaging Spectroscopy of Rocks and Minerals. Lithology, Structure, Drainage and pattern, Remote Sensing in Geomorphology; Landforms; Igneous, sedimentary, structural, fluvial, karst, shoreline, Aeolian and Glacial.

Remote Sensing of Water: Remote Sensing of Surface water Biophysical Characteristics, Spectral Responses of Water as a function of Wavelength and organic/inorganic constituents, Water Bathymetry, Water surface temperature, Precipitation, Aerosols and clouds, Snow, Water quality modeling using Remote Sensing. Watershed analysis.

Unit IV: GIS Data Analysis

16 Hours

Overlay analysis operations, Logical Operations (Boolean Operations), Conditional operations, Buffer analysis, Site suitability Analysis, Map algebra, Neighborhood analysis, Spatial analysis, Surface analysis, Network analysis.

Reference:

1. Introductory Digital Image Processing: A Remote Sensing Perspective:By J.R.Jensen4th Edition Prentice Hall Pub (2015).
2. Remote Sensing of Environment: An Earth Resources Perspective: By J.R.Jensen 2nd Ed., Upper Saddle River, NJ: Prentice Hall, 592 pages (2012).