

A. W. S. (12)

KUVEMPU UNIVERSITY

DEPT. OF PG STUDIES & RESEARCH IN APPLIED GEOLOGY

PROCEEDINGS OF THE BOS (PG) ESRM & GEOINFORMATICS

Meeting of the Members of BOs (PG) in Earth Science and Resource Management (ESRM) and Geoinformatics held on 18th January 2020 in the Department of Applied Geology, Kuvempu University, Shankaraghatta – 577451.

Members Present:

1. Prof. M. S. Sethumadhav, Dept. of Earth Science, University of Mysore, Mysore
2. Prof. H Gangadhara Bhat, Dept. of Marine Geology, Mangalore University, Mangalore.
3. Prof. Syed Ashfaq Ahmed, Dept. of Applied Geology, KUS
4. Dr. Govindaraju, Dept. of Applied Geology, KUS
5. Dr. G.Chandrankantha, Chairman (BOS), Dept. of Applied Geology, KUS

Members Absent:

Prof. H.C. Vajrappa, Dept. of Geology, Bangalore University

Proceedings of the Meeting:

The Chairman (BOS) welcomed the members of the BOS and requested them to approve the following agenda, which was circulated through mail.

Agenda 1: Approval of list of Examiners for the academic year 2020-21

List of examiners for PG Examination in ESRM and Geoinformatics for the academic year 2020-21 has been approved.

Agenda 2: Review and updating of PG (ESRM) syllabus

The Board thoroughly went through the syllabus of M.Sc. in Earth Science and Resource Management and revised the syllabus keeping in view of recent developments and CSIR-NET syllabus and approved.

Any other matter with the permission of the Chair:

In between today's and the previous BOS meetings, approval has been taken by the members of BOS through mail pertaining to approval of panel of examiners for adjudication of PhD Thesis. Also, synopsis for PhD Registration has been brought to the notice of the members and passed in today's meeting.

Approval of panel of examiners for adjudication of PhD Thesis

ESRM

Sl.No.	Name of the Candidate	Guide	Remarks
1	Somesha G S	Dr. Govindaraju	Approved
2	Manohara T H	Prof K.N.Chandrashekarappa Prof. P.C.Nagesh	Approved

Geoinformatics

Sl. No	Name of the Candidates	Guide	Remarks
1	Mr. Ravikumar D	Dr. Govindaraju	Approved

(51) Approval of Synopsis for PhD Registration

Sl.No	Research Topic Title	Candidate Name
1	"Development of Model for the Crop - Drought Impacts Vulnerability Assesment for Kolar and Chikkaballapur Districts in Karnataka, India"	Mr. Harish Naik N
1	"Predictive Model for Drought and Crop Yield Assessment of Tumakuru District, Karnataka State, India Using Geospatial Technology"	Mr. Sanjay Kumar
2	"Impact of Climate Change on Water Resources of Chikkamagaluru District, Karnataka State, India Using Geospatial Approach"	Mr. Skanda Kumar

The Chairman thanked all the members of BOS for actively participating in the discussions and approving the agenda.

Prof. M. S. Sethumadhav

Prof. H Gangadhara Bhat.

Prof. Syed Ashfaq Ahmed

Dr. Govindaraju

M. S. Sethumadhav
H. Gangadhara Bhat
Syed Ashfaq Ahmed
Dr. Govindaraju
15/01/2020

Chairman (BOS),
Dr. G. Chandrakantha,
Dept. of Applied Geology,
KUS



KUVEMPU UNIVERSITY

M.Sc. in EARTH SCIENCE AND RESOURCE MANAGEMENT
(Choice Based Credit System) Syllabus – Revised, January 2020

DEPARTMENT OF PG STUDIES AND RESEARCH IN APPLIED GEOLOGY
JNANASAHYADRI,
SHANKARAGHATTA – 577 451

Preamble:

The Department of PG Studies and Research in Applied Geology, a nodal centre for Earth Science and Resource Management Studies (recognized by UGC under Innovative Programme), offering innovative and multidisciplinary PG and Research programs leading to M.Sc. and PhD degrees. The Department is assisted by UGC (Innovative and SAP(DRS) I, II and III) and Department of Science and Technology (FIST) programs. The Department has established well-equipped mineralogy lab with polarizing microscopes, geochemical laboratory with sophisticated Atomic Absorption Spectrophotometer, Remote Sensing and GIS laboratories with High-end computers and licensed image processing and GIS software like ArcGIS, ERDAS, PCI Geomatica, ITTWISENVI, MapInfo along with many open-source software. The department also has many digital, analog satellite images and aerial photographs needed for its academics and research. The Department has ICT enabled classrooms with multimedia facilities and a library with more than 380 textbooks.

As a nodal center, the department strives to develop the knowledge, talent and leadership to understand the dynamic Earth and to manage its enormous resources and challenges facing the world in proper utilization of its resources.

Mission

We prepare students to understand and manage our Earth and its resources for the sustainable future.

Vision

As a nodal center recognised by UGC, the department intends to be nationally recognized through its education and research programs in Earth Science and Resource Management. The program emphasizes to produce well trained competent, academic and professional geoscientists capable of the developing new innovative technology in understanding and sustainable management of Earth and its resources.

Values

- Research at the highest international level
- Smart and attractive courses and facilities are leading to appropriate competencies.
- Qualifying students for attractive positions in the public and private sectors.

Eligibility

Bachelor's Degree in Science, Bachelor's degree with Geography at UG level, Engineering (Civil, Environmental, Mining, Geotechnical, Geoinformatics), B.Sc (Agriculture, Forestry, Horticulture, Soil Science) from any Indian university or equivalent qualification recognized by Kuvempu University. Eligibility for Foreign students will be in accordance with the university regulations. The general admission criteria are based on Kuvempu University guidelines.

Intake

As per university rules

Course Credits

One credit means 1 hour teaching for theory and Two-hours teaching for practicum

Duration

A two-year master's degree offered under choice-based credit system with an integrated-multidisciplinary approach. The curriculum focuses on the application based geological studies.

Attendance

A minimum of 75% attendance is required and the guidelines are as per Kuvempu University rules

Field Work

The students have to undergo a compulsory field training program up to a minimum of 7 days for which 2 credits are awarded. The students have to submit an individual field report for evaluation. The evaluation of the field report will be through viva examination.

Internship:

15 to 30 days Internship in reputed organizations/institutions based on student's choice and interest after the 2nd Semester.

Project report and Viva:

Students will have to submit an individual Project Report/dissertation at the end of the IV semester which will be evaluated by internal/supervisor and external examiners. There is no financial commitment on the part of the department/University for the project work. However, the Candidates belonging to SC/ST/OBC, the provisions made by the university is applicable. The Department/University may assist the candidate in locating him/her an appropriate place to carry out the project work in reputed institutions.

The duration of the project will be for 4 months/one semester. The dissertation will be evaluated by two examiners consisting of supervisor and one external, outside the University for 4 Credits consisting of 200 marks. The candidate will have to defend his/her dissertation in an open viva examination for 2 credits and for 50 marks.

Internal Assessment

There will be internal assessment for 25 marks for every theory paper, the assessment is based on the student's continuous evaluation consisting of Assignments, seminars, two internal tests and attendance. The internal assessment marks will be brought to the notice of students at regular interval during the course of the semester. There will be no internal assessment for practical examinations and project work.

Examination

At the end of the semester theory and practical examinations are conducted strictly as per the university guidelines. The practical examination is for 3 hours duration will have a viva for each paper.

Course Structure

Paper Code	Title of the Paper	Credits	Theory/ Practicals		Total
			IA	Main Exam	
I Semester: Hard Core Papers (Theory)					
ESH 101	Crystallography, Mineralogy and Geochemistry	4	25	75	100
ESH 102	Physical Geology, Meteorology and Oceanography	4	25	75	100
ESH 103	Geomorphology and Structural Geology	4	25	75	100
Soft Core Paper (Theory)					
ESS 101	Remote Sensing and GIS	4	25	75	100
Hard Core Papers (Practical)					
ESHP101	Crystallography, Mineralogy and Geochemistry	2	-	50	50
ESHP 102	Meteorology and Oceanography	2	-	50	50
ESHP 103	Geomorphology and Structural Geology	2	-	50	50
Soft Core Paper (Practical)					
ESSP 104	Remote Sensing and GIS	2	-	50	50
	Total	24	100	500	600
II Semester: Hard Core Papers (Theory)					
ESH 201	Igneous, Sedimentary and Metamorphic Petrology	4	25	75	100
ESH 202	Paleontology and Indian Stratigraphy	4	25	75	100
ESH 203	Hydrogeology and Water Resources Management	4	25	75	100
Soft Core Paper (Theory)					
ESS 201	Digital Image Processing and Remote Sensing Applications	4	25	75	100
Hard Core Papers (Practical)					
ESHP 202	Igneous, Sedimentary and Metamorphic Petrology	2	-	50	50
ESHP 203	Palaeontology and Geostatistics	2	-	50	50
ESHP 201	Hydrogeology and Hydrogeochemistry	2	-	50	50
Soft Core Paper (Practical)					
ESSP 201	Digital Image Processing and Remote Sensing Applications	2	-	50	50
	Interdepartmental Elective Paper	2	10	40	50
	Total	26	110	540	650
III Semester: Hard Core Papers (Theory)					
ESH 301	Ore Geology and Indian Mineral Deposits	4	25	75	100
ESH 302	GIS Data Processing and Disaster Management	4	25	75	100
ESH 303	Exploration Geology - Geological, Geochemical and Geophysical methods	4	25	75	100
Soft Core Paper (Theory)					
ESS 301	Mining Geology, Engineering Geology and Fuel Geology	4	25	75	100
Hard Core Papers (Practical)					
ESHP 301	Ore geology and Ore reserve estimation	2	-	50	50
ESHP 302	GIS Data Processing and Disaster Management	2	-	50	50
ESHP 303	Exploration Geology	2	-	50	50
Soft Core Paper (Practical)					
ESFW 301	Field work	2	-	50	50
	Inter Departmental Elective Paper	2	10	40	50
	Total	26	110	540	650
IV Semester					
ESPW 401	Project Work	6	-	-	200
ESPV 402	Project Viva	2	-	-	50
	Total	08	-	-	250
	Grand Total	86	320		2150
II Semester – Inter Departmental Elective Paper					
AGE 201	Water Resources	2	10	40	50
III Semester – Inter Departmental Elective Paper					
AGE 301	Natural Disaster Management	2	10	40	50

SYLLABUS
M.Sc. in Earth Science and Resource Management

I Semester

I Semester					
Paper Code	Title of the Paper	Credits	Theory/ Practicals		Total
			IA	Main Exam	
I Semester: Hard Core Papers (Theory)					
ESH 101	Crystallography, Mineralogy and Geochemistry	4	25	75	100
ESH 102	Physical Geology, Meteorology and Oceanography	4	25	75	100
ESH 103	Geomorphology and Structural Geology	4	25	75	100
Soft Core Paper (Theory)					
ESS 101	Remote Sensing and GIS	4	25	75	100
Hard Core Papers (Practical)					
ESH P101	Crystallography, Mineralogy and Geochemistry	2	-	50	50
ESH P102	Meteorology and Oceanography	2	-	50	50
ESH P103	Geomorphology, Structural Geology	2	-	50	50
Soft Core Paper (Practical)					
ESS P104	Remote Sensing and GIS	2	-	50	50
	Total	24	100	500	600

ESH 101: CRYSTALLOGRAPHY, MINERALOGY AND GEOCHEMISTRY

16 hours

Unit – I: Crystallography

Crystallography -Elements of crystal structure. Symmetry elements.

X-Ray Crystallography – Principles and applications of powder X-Ray crystallography. Crystalline and Amorphous forms - Symmetry and Classification of Crystals - System of Crystal Notation - (Weiss and Millerian) - Forms and Habits. Crystal Systems (Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic, and Triclinic), Twinning-crystalline Aggregates – Columnar, Fibrous, Lamellar, and Granular - Imitative shapes and Pseudomorphism. Derivation of 32 Crystal classes based on Schoenflies notation - Bravies lattices and their Derivation - An outline of Space Groups

Unit –II Mineralogy

16 Hours

Physical Properties: (Colour – Structure – Form – Luster - Transparency – Streak – Hardness – Specific Gravity – Tenacity – Feel – Taste – Odour) - Electrical, Magnetic and Thermal properties. Empirical and Structural formula of minerals – Isomorphism, Polymorphism and Pseudomorphism. Optical Properties (Colour – Form – Cleavage - Refractive Index - Relief – Alteration – Inclusions – Zoning – Pleochroism – Extinction - Polarization colours – Birefringence) – Twinning.

Unit –III Mineralogy

16 Hours

Structure of Silicates, Physical, chemical and optical properties of following rock forming minerals: quartz group, feldspar group, mica group, pyroxene group, amphibole group, olivine group, garnet group, chlorite group, oxide group, carbonate group and alumino silicates

Unit - IV: Geochemistry

16 Hours

Introduction to Geochemistry- Elements, Atoms, and Chemical Bonds, a Brief Look at the Earth Principles of Geothermobarometry, Energy, Entropy and Fundamental Thermodynamic Concepts, Laws of Thermodynamics, 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.

Carbonates, Surface water and Groundwater Chemistry, Alkalinity, Behavior of the Elements, Goldschmidt's Classification Trace Element Distribution during Partial Melting, Trace Element Distribution during Crystallization, Basics of Radiogenic Isotope Geochemistry,

Books for References:

1. C. Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2009
2. Maureen M. Julian, Foundations of Crystallography, Taylor & Francis Group (2008)

3. Introduction to the Rock-forming Minerals Paperback –2013 **W. A. Deer** (Editor), **R. A. Howie** (Editor), **J. Zussman** (Editor)
4. Klein, C and Hurlbut, Jr., C.S. 1993; Manual of Mineralogy. John Wiley.
5. Krauskopf, K. B. and D. K. Bird. 1995. *Introduction to Geochemistry*. New York: McGraw-Hill.
6. William M. White, *Geochemistry*, 2013, Wiley-Blackwell

ESH 102: PHYSICAL GEOLOGY, METEOROLOGY AND OCEANOGRAPHY

Unit I - Physical Geology

16 Hours

Introduction to Physical Geology, Volcanism and Extrusive Rocks, Weathering and Soil, Time and Geology, Mass Wasting, Streams and Floods

Unit II - Physical Geology

16 Hours

Ground Water, Glaciers and Glaciation, Deserts and Wind Action, the Earth's Interior, Mountain Belts and the Continental Crust, Energy and Mineral Resources

Unit III- Meteorology

16 Hours

Fundamental principles of climatology. Earth's radiation balance; latitudinal and seasonal variation of insolation, temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance. Air masses, monsoon, Jet streams, tropical cyclones, and ENSO. Classification of climates – Koppen's and Thornthwaite's scheme of classification. Climate change.

Unit IV –Oceanography

16 Hours

Introduction to Oceanography, Plate Tectonics, The Sea 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

Books for Reference:

1. Charles C. Plummer, *Physical Geology Companion Site*, 14/e, McGraw Hill, 2013
2. Charles E. Jones, Norris W. Jones, *Lab Manual for Physical Geology*, 8/e McGraw Hill,
3. Eric W. Danielson, James Levin, Elliot Abrams, *Meteorology*, Wm C Brown Publ.
4. Diane H. Carlson, Carlos C. Plummer, David McGeary. *Physical Geology: Earth Revealed*, 6/e McGraw Hill,
5. Alan P. Trujillo and Harold V. Thurman 2016 *Essentials of Oceanography*, Pearson Publ.

ESH 103: GEOMORPHOLOGY AND STRUCTURAL GEOLOGY

UNIT – I

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 – II

16 Hours

Morphology of Indian sub-continent, Morphology of the ocean floor. Applied Geomorphology: Dams and Reservoirs, tunnels, and High way construction, 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 – III: ROCK DEFORMATION

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, Lamination, foliations, dykes and lineaments. Unconformity.

UNIT – IV: STRUCTURES

16 hours

Definition and importance of structural Geology. Primary and Secondary Structures, 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.

Books for Reference:

1. Physical Geology by Montgomery
2. Principles of Geomorphology by Dayal
3. Principles of Geomorphology, Thornbury
4. Structural Geology – P. Billings
5. Structural Geology – B.S.Sathyanaaraswamy

ESS 101: REMOTE SENSING AND GIS

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 Zeiss 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, principal 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 Imprecision, 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 References:

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.

PRACTICAL: I SEMESTER

ESHP 101: CRYSTALLOGRAPHY, MINERALOGY AND GEOCHEMISTRY

1. Study of models of cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems
2. Stereographic projections on the Wulff's Stereo net.
3. Megascopic study of rock forming minerals
4. Determination of relative relief (RI) of minerals by Becke-line test and sign of elongation of minerals.
5. Optical properties of Rock forming minerals
6. Microscopy of rock forming minerals
7. Determination of optic sign of uniaxial minerals, optic sign of biaxial minerals.
8. Determination of anorthite content of plagioclase by Michel Levy Method.

ESHP 102: METEOROLOGY AND OCEANOGRAPHY

1. TRMM Rainfall data Analysis- Monthly trends, Deviation from Normal Rainfall, Statistical Analysis
2. Estimation of Spatial and Temporal Variability of Rainfall
3. Interpretation of Weather maps and weather forecasting
4. Numerical Weather Prediction

ESHP 103: GEOMORPHOLOGY AND STRUCTURAL GEOLOGY

1. Preparation of Geomorphology map and Symbols used in Geomorphology map
2. Toposheet Reading
3. Preparation of drainage map, Calculation of Morphometry parameters Preparation of Spatial map of drainage density, drainage Frequency, Relative Relief, Dissection Index, Spatial map of Slope map,
4. Meandering and Sinuosity Index
5. Exercises on structural geology problems – thickness of beds on horizontal, inclined surfaces.
6. Exercises on structural geology problems – Dip and strike problems
7. Exercises on structural geology problems – Borehole problems
8. Stereographic projections of structural data.
9. Drawing and interpretation of profile section across the geological maps.
10. Site selection for construction of Dams, Tunnels, Highways, Roads, Reservoirs and Canals.
11. Completion of out crops maps
12. Field observations and measurement of primary and secondary structures
13. Use of compass clinometers

ESSP 101: REMOTE SENSING AND GIS

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, and Parallax bar,

Determination of area using Planimeter, Determination of Length using Rotameter

Stereoscopic Vision Test:

Determination of Relative Position of the object Carl zeis 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

Photogrammetry

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

Principle keys for interpretation of aerial Photograph

a. Tone, b. Texture, c. Shape, d. Size, e. Scale, f. Pattern, g. Shadow, and h. Association

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

II Semester

Paper Code	Title of the Paper	Credits	Theory/ Practicals		Total
			IA	Main Exam	
II Semester: Hard Core Papers (Theory)					
ESH 201	Igneous, Sedimentary, Metamorphic Petrology	4	25	75	100
ESH 202	Paleontology, Indian Stratigraphy	4	25	75	100
ESH 203	Hydrogeology, Water Resources Management	4	25	75	100
Soft Core Paper (Theory)					
ESS 201	Digital Image Processing, Remote Sensing Applications	4	25	75	100
Hard Core Papers (Practical)					
ESHP 202	Igneous, Sedimentary, Metamorphic Petrology	2	-	50	50
ESHP 203	Paleontology, Geostatistics	2	-	50	50
ESHP 201	Hydrogeology and Hydro geochemistry	2	-	50	50
Soft Core Paper (Practical)					
ESSP 201	Digital Image Processing, Remote Sensing Applications	2	-	50	50
	Inter Departmental Elective Paper	2	10	40	50
	Total	26	110	540	650

ESH 201: IGNEOUS, SEDIMENTARY, AND METAMORPHIC PETROLOGY

Unit – I

16 hours

Introduction: Definition and classification of rocks based on mode of formation.

Igneous Rocks: Magma and its origin, formation of igneous rocks. Bowen's reaction principle. Crystallization of binary systems. Forms, Textures and structures of igneous rocks. Classification of igneous rocks.

Magmatic evolution and differentiation: Fractional crystallization, gravitational differentiation, gas streaming, liquid immiscibility and assimilation. Structures and textures: Definition, description, rock examples and genetic implications of common structures and textures of igneous rocks. Classification of igneous rocks: Mode, CIPW norm, IUGS and Irvine-Barger classifications; Magmatism and tectonics:

Unit – II

16 hours

Igneous rock suites: Form, structure, texture, modal mineralogy, petrogenesis and distribution of the

following igneous rocks: Ultramafic rocks: Dunite-peridotite-pyroxenite suite; kimberlites, lamprophyres, lamproites, komatiites; Basic rocks: Gabbro-norite-anorthosite-troctolite suite, Dolerites; Basalts and related rocks; Intermediate rocks: Diorite-monzonite-syenite suite; Andesites and related rocks; Acidic rocks: Granite-syenite-granodiorite-tonalite suite; Rhyolites and related rocks; Alkaline rocks: Shonkinite, ijolite, urtite, melteigite, malignite, alkali gabbros, alkali basalt, alkali granite, alkali syenite, nephelinesyenite and phonolite; Carbonatites; Ophiolite suite.

Unit-III

16 hours

Sedimentary rocks: 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-IV

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.

Books for Reference

1. Igneous And Metamorphic Petrology – Turner and Verhoogan
2. Text book of Petrology – G W Tyrrell
3. Petrology – Hyndman
4. Igneous and Metamorphic Petrology – Myren G Best
5. Petrology (Igneous, Sedimentary and Metamorphic) – Eeneest G Ehlers/Harvey Blatt
6. Igneous Petrology- McBirney
7. Principles of Igneous and Metamorphic Petrology- Anthoney R Phillips
8. Igneous Petrology – M K Bose
9. Petrology of Igneous rocks – Alok K Gupta
10. Metamorphism and Metamorphic rocks – Miyashiro
11. Metamorphic Petrology – B Bhaskar Rao
12. Sedimentary Petrology – Pettijohn
13. Igneous and Metamorphic Petrology – W D Winter
14. Petrology (Igneous, Sedimentary and Metamorphic) – Loren A Raymond



ESH 202: PALEONTOLOGY AND INDIAN STRATIGRAPHY

Unit I: PALEONTOLOGY

16 hours

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

Fossils: Mode of preservation of fossils. Morphology and Geological distribution of Foraminifera, Brachiopods, Lamellibranch, Gastropods, Cephalopods, Echinoids & Trilobites.

Plant fossils: Morphology and distribution of Lepidodendron, sigillaria, calamities, Glossopteris, ptilophyllum.

Unit – II: INDIAN STRATIGRAPHY

16 hours

Principles of stratigraphy, Geological time scale, Lithostratigraphic 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, Vindhya group & equivalents and economic importance.

Unit – III: INDIAN STRATIGRAPHY

16 hours

Paleozoic group- Cambrian rocks, Ordovician and Silurian rocks, Devonian rocks, Permian-Carboniferous rocks. **Mesozoic group-** Triassic rocks, Jurassic rocks, Cretaceous rocks-

Gondwanasuper 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.

Books for References:

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

ESH 203: HYDROGEOLOGY AND WATER RESOURCE MANAGEMENT

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.

Unit – II

16 hours

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 – III

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 IV: Water Resource Management

16 hours

Water Quality: Physical and chemical properties of water, Classification of water for Domestic, Irrigation and Industrial purposes based on physical, chemical and biological properties. Methods of interpretation of chemical data and Hydro chemical facies.

Groundwater Development and Management: Groundwater development, Water Logging, Conjunctive use, Desalination, Groundwater Legislation.

Concepts of basin management, equation of Hydrologic equilibrium, Groundwater Basin Investigations, Data Collection and Field Work, Alternative Basin yield, Evaluation of Perennial yield, Salt Balance, Basin Management by Conjunctive Use

Water Conservation Techniques/Practices, Rain Water Harvesting: Surface and Roof top, Drought Monitoring: Forecasting and Management, Flood Monitoring: Forecasting and Management.

Books of 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.

ESS 201: DIGITAL IMAGE PROCESSING AND REMOTE SENSING APPLICATIONS

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.

Unit IV: Remote Sensing Applications

16 Hours

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

Books for Reference

1. Introductory Digital Image Processing: A Remote Sensing Perspective: By J.R. Jensen 4th 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).
3. Fundamentals of Remote Sensing and Air Photo Interpretation, Avery T.E. and G.L. Berlin,
4. Introduction to Remote Sensing Campell, J.B. 1996, 2nd Edition. The Guilford Press,
5. Introduction to Modern Photogrammetry, John Wiley Publishing Company, New York.
6. Manual of Photogrammetry, 3rd Edition, 1966, American Society of Photogrammetry

PRACTICAL: II SEMESTER

ESHP 201: IGNEOUS, SEDIMENTARY, AND METAMORPHIC PETROLOGY

1. Study of megascopic structures
2. Megascopic study of Igneous rocks ;Granite-Granodiorite-Diorite, Syenites, Ultramafic rocks, lamphyres, dolerites, pegmatites and Basalts
3. Megascopic study of sedimentary rocks-rudaceous, arenaceous, calcareous and argillaceous rocks
4. Megascopic study of metamorphic rocks;-Schists, gneisses, amphibolites and granulites
5. CIPW calculations, Variation diagrams, Binary-ternary diagrams,
6. PT estimation, Thermogeobarometry calculations

ESHP 202: PALEONTOLOGY AND GEOSTATISTICS

1. **Identification of invertebrate fossils-** Brachiopods, Lamellibranch, Gastropods, Cephalopods, Echinoids & Trilobites.
2. **Plant fossils-**Morphology and distribution of Lepidodendron, sigillaria, calamities, Glossopteris, ptilophyllum.
3. Identification of Microfossils: Foraminifera, Ostracod,
4. Central tendency, mean, median, mode, standard deviation, correlation, Principle component analysis.

ESHP 203: HYDROGEOLOGY AND HYDROGEOCHEMISTRY

1. Analysis of rainfall data
2. Calculation of Evapotranspiration by different methods
3. Preparation of water level contour maps and their interpretation
4. Calculation of Porosity, permeability, and groundwater storage

- Water budget calculations
- Pumping test data analysis
- Groundwater flow direction calculation
- Volumetric analysis of Iron, manganese, calcium and magnesium etc.,
- Instrumental Analysis: Use of pH, conductivity, colorimeter, flame photometer, Fluorimeter, DO, BOD, COD meters and Ion Analyzer., spectrophotometer, atomic absorption spectrophotometer (AAS) to determine various Physico - chemical parameters.
- Graphical Representation of Water Quality data, Quality determination of water samples, Classification of water for various purposes

ESSP 201: DIGITAL IMAGE PROCESSING AND REMOTE SENSING APPLICATIONS

- Introduction to Image Software and Image Data
- Image Enhancement
- Rectification
- Image Classification – Unsupervised
- Image Classification – Supervised
- Object Based image analysis
- Radiometric Correction (Empirical Line Calibration)
- Image operation and Image fusion
- Accuracy Assessment
- Vegetation indices
- Watershed analysis

III Semester

Paper Code	Title of the Paper	Credits	Theory/ Practical		Total
			IA	Main Exam	
ESH 301	Ore Geology and Indian Mineral Deposits	4	25	75	100
ESH 302	GIS Data Processing and Disaster Management	4	25	75	100
ESH 303	Exploration Geology - Geological, Geochemical and Geophysical methods	4	25	75	100
Soft Core Paper (Theory)					
ESS 301	Mining , Engineering and Fuel Geology	4	25	75	100
Hard Core Papers (Practical)					
ESH 301	Ore geology and ore reserve estimation	2	-	50	50
ESH 302	GIS Data Processing and Disaster Management	2	-	50	50
ESH 303	Exploration Geology	2	-	50	50
Soft Core Paper (Practical)					
ESFW 301	Field work	2	-	50	50
	Inter Departmental Elective Paper	2	10	40	50
Total		26	110	540	650

ESH 301: ORE GEOLOGY AND INDIAN MINERAL DEPOSITS

Unit I

16 Hours

Modern concept of ore genesis. Ore deposits and Plate Tectonics. Mode of occurrence of ore bodies- morphology and relationship of host rocks. Textures, paragenesis and zoning of ores and their significance. Ore bearing fluids, their origin and migration. Wall-rock alteration. Structural, physico-chemical and stratigraphic controls of ore localization. Fluid inclusion in ores: Principles, assumptions, limitations and applications. Geothermometry of ore deposits.

Unit II

16 Hours

Ores of mafic-ultramafic association- diamonds in kimberlite; Ti-V ores; chromite and PGE; Ni ores; Cu, Pb-Zn. Ores of silicic igneous rocks with special reference to disseminated and stock work deposits, porphyry associations. Ores of sedimentary affiliation-chemical and clastic sedimentation, stratiform and stratabound ore deposits (Mn, Fe, non-ferrous ores), placers and palaeoplacers. Ores of metamorphic affiliations-metamorphism of ores, Ores related to weathering and weathered

surfaces laterite, bauxite, Ni/Au laterite.

Unit III

16 Hours

Mineralogy, Origin, Occurrence and Distribution of mineral deposits; Gold, Copper, Iron, Manganese, Chromium, Aluminum, Uranium, Lead and Zinc, Industrial Minerals- abrasives, ceramics, refractory's, insulators. Coal and Petroleum.

Unit IV

16 Hours

Application of rock mechanics in mining. Planning, exploration and exploratory mining of surface and underground mineral deposits involving diamond drilling, shaft sinking, drifting, cross cutting, winzing, stoping, room and pillaring, top-slicing, sub-level caving and block caving. Cycles of surface and underground mining operations. Exploration for placer deposits. Open pit mining. Ocean bottom mining. Mine ventilation, Types of drilling methods. Mining hazards: mine inundation, fire and rock burst.

Books for References:

1. Craig, J.M. & Vaughan, D.J., 1981: Ore Petrography and Mineralogy-John Wiley
2. Evans, A.M., 1993: Ore Geology and Industrial Minerals-Blackwell
3. Sawkins, F.J., 1984: Metal deposits in relation to plate tectonics-Springer Verlag
4. Stanton, R.L., 1972: Ore Petrography-McGraw Hill
5. Torling, D.H., 1981: Economic Geology and Geotectonics-blackwellSci publ.
6. Barnes, H.L., 1979: Geochemistry of Hydrothermal Ore Deposits-John Wiley
7. Klemm, D.D. and Schneider, H.J., 1977: Time and Strata Bound Ore Deposits-Springer Verlag
8. Guibert, J.M. and Park, Jr. C.F., 1986: The Geology of Ore Deposits-Freeman
9. Mookherjee, A., 2000: Ore genesis-a Holistic Approach-Allied Publisher
10. Arogyaswami, R.P.N., 1996: Courses in Mining Geology.IV Ed.-Oxford IBH

ESH 302:GIS DATA PROCESSING AND DISASTER MANAGEMENT

Unit-I:

16 hours

Introduction, significance of spatial Analysis, Vector Based - Various types of overlay analysis operations: Topological overlays, Polygon-in-polygon overlay, line-in-polygon overlay, Point-in-polygon overlay, Logical operations (Boolean operations), Conditional operations, Buffer analysis, Site suitability analysis.

Unit-II:

16 hours

Raster Based - Introduction, Advantages and disadvantages of raster analysis, Grid operations used in map algebra, important raster analysis operations, Grid based spatial analysis - Neighborhood analysis

Conditional, Density, Distance, interpolation, Map algebra, Overlay - weighted overlay, reclassification, surface analysis - aspect, contour, hillshade, slope etc., Network analysis, Connectivity rules, Utility Networks, Transportation Networks, Geometric network, Logical Network, Network based model, Applications of network analysis

Unit III:

16 hours

Concepts of disaster: **Natural:** Cyclone, flood, landslide, Forest fire and earthquake. Issues and concern for various causes of disasters. **Manmade:** Fundamental Concepts of Environment. Air, Water, Land, and Noise pollution - Types, sources and causes of pollution. Effect of pollution on ecology and environment. Global warming, Ozone depletion. Types of wastes and their management. Hazard assessment, monitoring, and management of Earthquakes, Volcanoes, floods, landslides, subsidence, draught and Coastal hazards.

Unit IV:

16 hours

Disaster management, mitigation, and preparedness: Mitigation through capacity building, legislative responsibilities of disaster management: disaster mapping, assessment, pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation: disaster related infrastructure development. Remote-Sensing and GIS applications in real time disaster assessment, monitoring, and prevention of Earthquakes, Volcanoes, floods, landslides, subsidence, draught, hurricanes, cyclones, tsunamis.

Books for References:

1. Introduction to Environmental Geology – Edward A Keller
2. Environmental Geology – Montgomery
3. Ecology, environment and pollution – A Balasubramanian
4. Environmental Geology – K S Valdia
5. Environmental Geology – Flawn
6. All you wanted to know about disasters – B K Khanna
7. Environmental science- A Global concern –
8. Remote sensing of Environment (An earth resource Perspective)- J R Jenson
9. Methodology for Land use planning- N.CGoutham Centre for land use management Hyderabad- 2001
10. Technical Guidelines for mapping- IRIS – DA NRSA-Hyderabad 2003
11. Rajiv Gandhi National drinking water mission –technical guidelines for preparation of ground water prospect map NRSA-Hyderabad 2003
12. Integrated Mission for Sustainable Development- Technical Guide lines NRSC-Hyderabad 1995

ESH 303: EXPLORATION GEOLOGY - GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL METHODS**Unit – I****16 hours**

Geological and Geomorphological Exploration: Geological and geomorphological criteria for mineral and ground water prospecting. Indicators of ore. Methods of geological exploration and prospecting. Drilling and core logging. Preparation of technical report.

Unit – II**16 hours**

Geochemical Exploration: Basic principles-geochemical dispersion, geochemical mobility, geochemical reaction, and dispersion of elements under deep-seated conditions, mobility under surficial conditions. Association of elements. Patterns of geochemical distribution. Patterns of deep-seated origin-ore type, geochemical provinces. Epigenetic anomalies in bed rocks. Mechanical and biological dispersion in sulphide environments. Surficial dispersion patterns. Anomalies in overburdens, natural water and drainage sediments. Geochemical drainage surveys. Vegetation surveys. Geochemical methods in mineral exploration.

Unit - III**16 hours**

Geophysical Exploration: Magnetic methods- fundamental principles, magnetic surveying techniques, magnetic data interpretation. Gravity method- Principles, instruments, field measurements and interpretation. Seismic method – General principles. Seismic reflection methods- recording instruments, field procedures, data acquiring and interpretation. Principles of Seismic refraction method.

Unit IV**16 Hours**

Electrical method – Introduction, principles, instruments, field procedures, interpretation and application. Radioactive method – Introduction, radioactive decay, instruments, field procedures and applications and interpretation of data. Well logging methods – Classification and interpretation

Books for References:

1. Geochemistry in Mineral Exploration – Rose, Hawks and Webb
2. Principles of Geochemical prospecting – Gillsberg
3. Introduction to Geophysical prospecting – M B Dobrin
4. Exploration Geophysics for Geologists and engineers – Bheemasnkaran and V K Gour
5. Manual of mineral exploration - Mispubln No 33 GSI
6. Principles and practices in mineral exploration - P K Ramam
7. Introduction to Mineral exploration - Evans
8. Ore microscopy and mineral exploration – R Dhanaraju
9. Method of Geophysical exploration – T V ramachandra

ESS 301: MINING, ENGINEERING AND FUEL GEOLOGY

Unit I

16 Hours

Application of rock mechanics in mining. Planning, exploration and exploratory mining of surface and underground mineral deposits involving diamond drilling, shaft sinking, drifting, cross cutting, winzing, stoping, room and pillaring, top-slicing, sub-level caving and block caving. Cycles of surface and underground mining operations. Exploration for placer deposits. Open pit mining. Ocean bottom mining. Mine ventilation, Types of drilling methods. Mining hazards: mine inundation, fire and rock burst.

Unit II:

16 hours

Role of engineering geology in civil construction and mining industry. Engineering properties of rocks; rock discontinuities. Physical characters of building stones. Metal and concrete aggregates. Various stages of engineering geological investigation for civil engineering projects. Geological consideration for evaluation of dams and reservoir sites. Dam foundation rock problems. Geotechnical evaluation of tunnel alignments and transportation routes, method of tunneling; classification of ground for tunneling purposes; various types of support. Earthquake and seismicity, seismic zones of India, design of buildings in earthquake zones.

Unit III

16 hours

Definition and origin of kerogen and coal. Sedimentology of coal bearing strata. Rank, grade and types of coal. Indian and international classifications. Chemical characterisation: proximate and ultimate analyses. **Atomic Minerals:** Mode of occurrence and association of atomic minerals in nature. Atomic minerals as source of energy. Methods of prospecting and productive geological horizons in India

Unit IV:

16 hours

Composition and different fractions. Origin, nature and migration (Primary and secondary) of oil and gas. Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen. Characteristics of reservoir rocks and traps (structural, stratigraphic and combination). Oil field fluid-water, oil and gas occurrences. Prospecting for oil and gas, drilling and logging procedures. Oil bearing basins of India and world. Geology of the productive oil fields of India.

Books for References:

1. Mining Geology – P Arogyaswamy
2. Elements of Mining Geology – Young
3. Mineral processing – S K Jain
4. Principles of Mineral dressing – A M Gaudin
5. Surveying and Levelling – T.P Kanetkar & S.V kulkarni
6. Taylor, G H., telchmuller, M davis, a., Diessel, C,F K. littke, R and Robert, P 1998: Organic petrology, GebruderBorntraeger, Stuttgart.
7. Chandra, D Singh R M and Singh M P 2000: Text book coal of coal (Indian context). Tara book agency, Varanasi
8. Singh, M.P. (Ed.), 1998: Coal and Organic Petrology. Hindustan Publ. Corp., New Delhi.
9. Stach, E., Mackowsky, M.T.H., Taylor G.H., Chandra, D., Teichmuller, M., and Teichmuller, R., 1982: Stach's Text book of Coal Petrology, GebruderBorntraeger, Stuttgart.
10. Holson, G.D. and Tiratsoo, E.N., 1985: Introduction of Petroleum Geology. Gulf Publ. Houston, Texas.
11. Tissot, B.P. and welte, D.H., 1984: Petroleum Formation and Occurrence. Springer – Verlag.
12. Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press.
13. Durrance, E.M., 1986: Radioactivity in Geology. Principles and Application. Ellis Hoorwood
14. Dahlkamp, E.J., 1993: Uranium Ore Deposits. Springer Verlag.
15. Boyle, R.W., 1982: Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier.

PRACTICAL: III SEMESTER
ESHP 301: ORES AND ORE PETROGRAPHY

1. Megascopic study of common metallic minerals.
2. Megascopic study of industrial minerals and rocks
3. Reflected-Microscope and its application.
4. Study of the Metallic mineral properties viz.; reflectivity, colour, birefringence and isotropism&anisotropism. Internal reflection and Micro indentation hardness.

ESHP 302:GIS DATA PROCESSING AND DISASTER MANAGEMENT

1. Spatial data query – based on attributes
2. Spatial query – based on location
3. Spatial data query - based on condition, Boolean operation, multiple query.
4. Spatial data query - Location suitable site based on attributes and location.
5. Spatial data query – raster data – mathematical operations, logical conditions, Boolean operations.
6. Topological overlay analysis – Vector data
7. Overlay analysis – Raster data
8. Neighborhood analysis
9. Network analysis
10. Flood prone area mapping
11. Landslide prone area mapping
12. Earthquake prone area mapping
13. Drought Prone area mapping

ESHP 303: EXPLORATION GEOLOGY

Analysis of data by following methods

1. Magnetic survey
2. Seismic reflection and refraction
3. Resistivity survey
4. Gravity survey
5. Surveying – Total Station, plain table, compass surveys
6. Radiometric methods

ESSP 301: Field work

The students have to undergo a compulsory field training program up to a minimum of 7 days. The students have to submit an individual field report for evaluation. The evaluation of the field report will be through viva examination.

Paper Code	Title of the Paper	Credits	Theory/Practicals		Total
			IA	Main Exam	
IV Semester					
ESPW 401	Project Work	6	-	-	200
ESPV 402	Project Viva	2	-	-	50
	Total	08	-	-	250

ESPW 401 Project Work

Students will have to submit an individual Project Report/dissertation at the end of the IV semester which will be evaluated by internal/supervisor and external examiners. The duration of the project will be for 4 months/one semester. The dissertation will be evaluated by two examiners consisting of supervisor and one external, outside the University for 4 Credits consisting of 200 marks.

ESPV 402 Project Viva

The candidate will have to defend his/her dissertation in an open viva examination for 2 credits and for 50 marks.

INTER DEPARTMENTAL ELECTIVE

AGE 201: Water Resources

16 hours

Unit – I

Surface Water Hydrology: Global distribution of water. Hydrological Cycle - Precipitation, Interception, Infiltration, Soil Moisture, Evaporation, Evapotranspiration: Potential and actual evapotranspiration, and Runoff. Methods of measurements and instruments. Description of surface water resources including ponds, lakes, streams, rivers and reservoirs. Global water budget. Artificial recharge of water and Rainwater harvesting.

16 hours

Unit – II

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, Hydraulic Resistance, Leakage factor, Drainage factor. Definitions and hydrologic properties: Aquifers - Confined, Unconfined and Perched aquifers, Aquiclude, Aquifuge, Aquitard, Coastal Aquifers, Fresh and salt-water relationships in coastal and island areas.

AGE 301: NATURAL DISASTER MANAGEMENT

Concepts of disaster: Cyclone, floods, landslides. Forest fire and earthquake. Issues and concern for various causes of disasters. Earthquakes, volcanoes, floods, Tsunamis, landslides, draughts and coastal hazards.

Disaster management, mitigation and preparedness: Mitigation, through capacity building, legislative responsibilities of disaster management: disaster mapping, assessment, pre-disaster risk and vulnerability reduction, post-disaster recovery and rehabilitation. Remote sensing and GIS application in real time disaster assessment and monitoring.