Govt. Nagarjuna P.G. College of Science
Raipur, C.G.

CURRICULUM & SYLLABI

(Based on CBCS & LOCF)

M.Sc. Geology
(III & IV Sem)
Session : 2025-26

Approved by:	Board of Studies	Academic Council
Date:	07-07-2025	

Department of Geology
Govt. Nagarjuna P.G. College of Science
Raipur, C.G.

SCHEME OF EXAMINATION

M. Sc. III[rd] Semester (2025-26)

S. No.	Paper/ Lab Course	Name of the Paper	Marks Allotted			
			Theory	Sessional	Total	Credit
1	GEO-301	Hydrogeology	80	20	100	04
2	GEO-302	Mineral Exploration & Mining Geology	80	20	100	04
3	GEO-303	Geochemistry & Environmental Geology	80	20	100	04
4	GEO-304	Engineering Geology and Geotechnical Investigation	80	20	100	04
5	GEO-305	Practical Lab Course – I			100	03
6	GEO-306	Practical Lab Course - II			100	03
Total Marks with total credits					**600**	**22**

Approved and Recommended by:-

S.No.	Designation	Name	Signature
1	Head of Department	Dr. Sandeep Vansutre	
2	External Subject Expert 1	Dr. Neeraj Vishwakarma	07/7/25
3	External Subject Expert 2	Dr. S.D. Deshmukh	
4	External Subject Expert 3	Dr. Ninad Bodhankar	07.07.25
5	Representative from Industry	Mr. Alok Verma	7/7/25
6	Student's Representative	Mr. Pradhumn Soni	

SCHEME OF EXAMINATION

M.Sc. IVth Semester (2025-26)

S. No.	Paper/ Lab Course	Name of the Paper	Marks Allotted			
			Theory	Sessional	Total	Credit
1	GEO-401	Mineral Resources of Chhattisgarh and their industrial applications	80	20	100	04
2	GEO-402	Photogeology, Remote Sensing and G.I.S.	80	20	100	04
3	GEO-403	Tools and Techniques in Field Geology	80	20	100	04
4	GEO-404	**Dissertation/ project work** **OR** **Elective paper-I** Advance hydrogeology **OR** **Elective paper-II** Mineral Resources: Exploration, Exploitation, Development and Management	80	20	100 **OR** 100 **OR** 100	04
5	GEO-405	Practical Lab Course – I			100	03
6	GEO-406	Practical Lab Course - II			100	03
Total Marks with total credits					**600**	**22**

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1	Head of Department	Dr. Sandeep Vansutre	
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4	External Subject Expert 3	Dr. Ninad Bodhankar	09.07.25
5	Representative from Industry	Mr. Alok Verma	
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M.Sc. GEOLOGY

SEMESTER-III

PAPER-I

HYDROGEOLOGY

UNIT –1

1.1 Introduction to hydrogeology and its relation with hydrology, meteorology, water balance, significance of hydrometeorological data in ground water geology.

1.2 Hydrologic cycle, occurrence and distribution of sub surface water.

1.3 Water bearing formation- aquifers, aquitard, aquiclude & aquifer. Aquifer types-perched, unconfined, semi confined & confined. Isotropic, Anisotropic aquifer.

1.4 Hydrological properties of water bearing formations: Porosity, permeability, transmissivity, specific yield, specific retention, Darcy's law and its application.

UNIT-2

2.1 Water table: Definition and location of water table, free unconfined water, water table in porous, fractured and cavernous rocks, perched water table, lowering of water table due to pumping, area of influence of pumping and drawdown and piezometric surface.

2.2 Water table maps, construction and interpretation. Fluctuation of water table and influencing factors.

2.3 Ground water mounds, trenches, divide, cascades, influent and effluent streams, artesian wells.

2.4 Ground water flow & permeability. Steady & unsteady flows. Bounded aquifer, barrier and recharge boundary, image well theory for location of boundary.

Unit-3

3.1 Ground water wells, types of wells and methods of their construction. Dugwells, drivenwells and drilled Wells.

3.2 Inverted wells, recharge wells, tube wells, dug cum tube wells, function of well screen, gravel treatment.

3.3 Well development and completion, principle and various methods of developing wells, testing of wells for yield, specific capacity of wells.

3.4 Causes of well failure, maintenance and well repair.

Unit-4

4.1 Well inventory: Tools and techniques of water level measurements in wells, monitoring of water level. Pre- and post-Monsoon water levels.

4.2 Methods of pumping test for aquifer, analysis of pumping test data.

4.3 Geological and geomorphological control of ground water.

4.4 Ground water provinces of India, hydrogeochemical provinces of India. Development of ground water in Chhattisgarh region.

Unit-5

5.1 Quality of ground water: Chemical and Physical Characteristics of ground water for domestic, agricultural and industrial use.

5.2 Quality criteria for ground water use WHO and Indian standards of potable water. Piper trilinear diagram and USGS diagram.

5.3 Ground water pollution: Sources, mechanism and methods of detection. Prevention and control measures of water pollution.

5.4 Ground water recharge- natural and artificial. Ground water development & management, conjunctive use of surface & ground water resources.

Course Outcome:-On completion of course student will be able to

1. Explain the origin and occurrence, distribution and types of groundwater
2. Describe the hydrologic properties of rocks, Darcy law, pumping test and quality characteristics of groundwater
3. Understand about Groundwater Basins, Recharge and Management studies
4. Describe various water bearing formations.

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M.Sc. GEOLOGY

SEMESTER-III

PAPER-II

MINERAL EXPLORATION AND MINING GEOLOGY

UNIT-1

1.1 Meaning and scope of prospecting and exploration: Planning a prospecting program.

1.2 Different stages of prospecting activities. Methods of prospecting: surface and sub surface.

1.3 Criteria for mineral prospecting. Target rings and intersecting locii

1.4 Guides to prospecting: Physiographic guides, structural guides, lithological guides(rock-mineral association), mineralogical guides, geobotanical guides.

UNIT-2

2.1 Basic principles of Physics in prospecting and exploration (Gravity and density, Electrical conductivity, magnetism, radioactivity and seismic characteristics etc.)

2.2 Basic principles of Geochemical prospecting and exploration: Mineral deposit as a geochemical anomaly, geochemical cycle, threshold value, background value, primary and secondary geochemical dispersion.

2.3 Concept of geochemical, geophysical, geological, stratigraphic, lithological prospecting methods.

2.4 Principles, instrumentation, application (type of ore) and limitation of Gravity, magnetic Seismic, radioactive and electrical methods

UNIT-3

3.1 Sampling: Methods of sampling, choice of sampling method depending upon type of ore, precaution during the sampling and reduction of bulk samples.

3.2 Different types of geophysical logging etc.

3.3 Ore reserve estimation: Principle of ore reserve estimation in general, choosing the ore reserve estimation method depending upon type of ore.

3.4 Calculation & interpretation of assay, average assay, grade, tonnage factor and reserve calculations there from

UNIT-4

4.1 Drilling in exploration activities. Definition of mining terms: pitting, trenching, panning, adits, tunnels, and shafts. Role of geologist in mining industry.

4.2 Geological structures of ore deposits and choice of mining methods. Subsidence and rock bursts, mine supports. Ventilation and drainage. Strata control in different rocks and structures

4.3 Open pit mining- geologic and geomorphic conditions.

4.4 Different methods of opencast mining, advantages and limitations.

UNIT-5

5.1 Underground mining methods- gophering, shrinkage, stoping, caving and slicing sublevel, over hand, under hand methods.

5.2 Coal mining methods, long wall, board and pillar.

5.3 Characteristics, mining methods and host rocks of important metalliferous mines of India Viz. Khetri, Malanjkhand, Bailadila, Dalli Rajhara, Zawar, Singhbhum, Mosabani, Sukinda and Bauxite mines of Chhattisgarh.

5.4 Case studies of important non-metallic mineral mines and coal mines of India. Chirmiri, Korba, Raniganj, Singrauli, Jhamarkotra, Neyweli, Palana Hirri Dolomite and limestone mines of Chhattisgarh

Course Outcome:-On completion of course student will be able to

1. Understand Prospecting & Exploration and tools and techniques of exploration such as mapping, sampling, drilling
2. Estimate grade and tonnage of ore.
3. Understand principles of geophysical methods of prospecting and interpret borehole log data.

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M.Sc. Semester III
Lab Course-I

- Water table contour maps: study and construction, analysis of hydrographs and estimation of infiltration capacity.
- Chemical analysis of water in practical and study area and problems thereon.
- Pumping test, time-draw down test and evolution of aquifer parameters.
- Study of electrical resistivity sampling data.
- Exercise on ground water exploration.
- Viva voce on exploration plans for different types of ores.
- Exercise on various types of exploration strategies like geochemical and geophysical.
- Exercise on exploratory drilling and techniques of borehole logging.
- Calculation of ore reserves and assay values for different types of sampling viz. Channel and Blanket.
- Diagrammatic representation of opencast and underground mining.
- Study of approved or otherwise mine planning.

Suggested Readings:-

1. D.K.Todd., L.W. Mays. Third Edition, (2005), Groundwater Hydrology.
2. K.R. Karanth, 1987, Groundwater- Assessment, Development & Management.
3. Davies, S.N. & De Wiest, R.J.M., 1966: Hydrogeology-John Wiley
4. Freeze, R.A. & Cherry, J.A., 1979: Ground Water-Prentice Hall
5. Fetter, C.W., 1990: Applied Hydrogeology-Merill Publishing
6. Raghunath, N.M., 1982: Ground Water-Wiley Eastern
7. Mining Geology II Ed. – H.E. McKinstry, 1962. Asia Publishing House,
8. Elements of Mining 3rd Ed. - R.S. Lewis and G.B. Clarke, 1964. John Wiley and Sons, New York
9. Courses in Mining Geology – R.N.P. Arogyaswami, 1973. Oxford and IBH Pub. Co., 916p.
10. Mineral Deposits and Earth Evolution – I. McDonald, et al (Eds), 2005. The Geological Society, London, 269pp.
11. Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing.

Internet Exposures:-

1. https://scioly.org/wiki/images/0/0c/Magikarpmaster629_Hydrogeology_Notes.pdf
2. https://ocw.mit.edu/courses/1-72-groundwater-hydrology-fall-2005/pages/lecture-notes/
3. https://www.southalabama.edu/geology/haywick/GY111/111-23.pdf
4. http://egyankosh.ac.in//handle/123456789/79953
5. https://www.mlsu.ac.in/econtents/1921_Geoexploration%20Methods.pdf
6. https://old.amu.ac.in/emp/studym/99994571.pdf
7. http://egyankosh.ac.in//handle/123456789/78247

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M.Sc. GEOLOGY

SEMESTER-III

PAPER-III

GEOCHEMISTRY AND ENVIRONMENTAL GEOLOGY

UNIT-1

1.1 Composition of the Earth (Crust, mantle, Core) – A geochemical approach

1.2 Geochemical classification of elements. Principles of ionic substitution in minerals. Isomorphism, polymorphism and pseudomorphism

1.3 Radiogenic isotopes, Stable isotopes: nature, abundance and fractionation

1.4 Geochemistry of oceanic crust. Composition of continental crust. Geochemistry of island arcs.

UNIT-2

2.1 Element partitioning : Compatible and incompatible elements, Simple distribution coefficients and their application in P-T estimation.

2.2 Geochemical cycle : Primary and secondary dispersion of elements. Eh-pH diagrams.

2.3 Geochemical Sampling :tools and techniques and its application in geochemical exploration

UNIT-3

3.1 X-ray Diffractometry, X-ray Fluorescence spectrometry

3.2 Scanning Transmission Electron Microscopy (STEM), Electron Probe Microanalysis (EPMA)

3.3 Thermal Ionization mass spectrometry (TIMS), Gas Source Mass Spectrometry (GSMS)

3.4 Principles and application of AAS. Principles and application of cathodoluminescence, thermoluminescence

UNIT-4

4.1 Concept of Environmental protection in Ancient Indian literature.

4.2 Definition, history and scope of Environmental Geology. Basic concepts of Environmental Geology. Environment, Ecology, Ecosystems and habitat

4.3 Climate Change and global warming: causes and impact. Greenhouse effect. Geological hazards- Lands slides, volcanic activity. Earthquake.

4.4 Draught and desertification, river flooding, erosion and sedimentation, coastal erosion, cyclones and tsunamis.

UNIT-5

5.1 Measures of mitigation of the above geological hazards.

5.2 Environmental degradation in urban areas, causes and remedies. Human settlement and contamination of atmosphere, soil, surface water, ground water and solid wastes.

5.3 Elementary idea about Environmental policies and laws of the the Central and State Government for air and water pollution.

5.4 Environment Impact Assessment and main components of Environment Impact Assessment report. Environment management plans.

Course Outcome:-On completion of course student will be able to

1. Describe the chemical composition characteristics of the Earth,
2. Discuss the geochemical classification of elements, Major, minor and trace and elements
3. Explain element partitioning in minerals and rocks.
4. Explain instrumentation and analytical techniques used in geochemical analysis.
5. Assess the basics of Environmental Geology and Natural Disaster Management
6. Explain the concept of Natural Disaster Management
7. Analyze the risk and mitigation of hazards.
8. Assess the impact of human activities on soil, groundwater and other natural resources
9. Understand environmental policies of the Government for air and water pollution.

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M.Sc. GEOLOGY

SEMESTER-III

PAPER-IV

ENGINEERING GEOLOGY & GEOTECHNICAL INVESTIGATIONS

UNIT-1

1.1 Importance of Engineering Geology in Civil Engineering.

1.2 Work activities of engineering geologist.

1.3 Guidelines for writing an engineering Geology report.

1.4 Engineering properties of rock material : specific gravity, density, porosity ,permeability, absorption , compressive strength, tensile strength ,shear strength, deformation, moduli- Poisson's ratio.

UNIT-2

2.1 Engineering behavior of rock mass, description of rock mass. Rock mass classification of Terzaghi and NGI, RQD.

2.2 Metal & concrete aggregate, desirable properties for aggregate viz. compressive strength, tensile strength, chemical resistance, hydrophilic and hydrophobic properties.

2.3 Tests and properties of for rocks to be used as foundation stones, building stone, road metal and dimension stones.

2.4 Grouting: Ground improvement techniques for rocks, Geotechnical consideration, and different types of grouting. Grouting for various engineering structures, efficacy of grouting .Rock bolting and anchoring, dental filling.

UNIT-3

3.1 Dam: Terminology & appurtenance, types of dam, types of spill ways with their parts.

3.2 Forces acting on dam, foundation and abutment problem, dam failure.

3.3 Geotechnical considerations for selection of dam sites and reservoirs. Consideration for successful reservoirs, erosion of catchments area and siltation, reservoir capacity & life, environmental impact of creation of a reservoir.

3.4 Case studies of some important dam sites of India viz. Bhakhra Nangal dam, Indira Sagar dam, Rudri dam, Nagarjun Sagar dam, Tehri dam

UNIT-4

4.1 Tunnels: components and types of tunnels, different stages of geotechnical investigation for tunnel.

4.2 Tunneling through rocks and soft ground: geological consideration.

4.3 Geological hazards in tunneling, effect of tunneling on the ground. Methods of tunneling and support system.

4.4 Case studies of some important tunnels: Jawahar tunnel, Dr. Shyama Prasad Mukherjee tunnel, Pir Panjal Railway tunnel, Atal tunnel.

UNIT-5

5.1 Bridge: Major types, supports and foundations of bridges.

5.2 Geological investigation of a bridge site, some case studies on bridges including Collapse Bridge. Laxman Zoola, Bandra -Vorli Sea Link, Howrah bridge, Pamban bridge, Golden bridge, Corronation bridge.

5.3 Earthquakes: magnitude & scale, Seismic zoning map of India and code for earthquake resistance. Seismotectonic frame work of India, geological consideration in seismic design.

5.4 Landslides: Types, description, causes, landslide hazard zonation mapping, landslide hazard mitigation& Prevention.

Course Outcome:-On completion of course student will be able to

1. Explain role of engineering geology in civil construction and mining industry.
2. Describe various stages of engineering geological investigations for civil engineering projects.
3. Describe engineering properties of rocks and physical characters of building stones.
4. Analyze influence of geological conditions on various engineering structures.

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M.Sc. Semester III

Lab Course-II

- Study of engineering properties of rocks.
- Study of maps and models of important engineering structures on dam sites tunnels etc.
- Study of the important ongoing engineering projects (Dams, Tunnels, building constructions, town planning (special reference to Naya Raipur and river front projects).
- Exercise on important Engineering projects viz. Bhakhra Nangal dam, Indira Sagar dam, Rudri dam, Nagarjun Sagar dam, Tehri dam and its representation on map of India.
- Geochemical analysis study on drinking water quality, agriculture and industrial water.
- Exercise on case studies of geochemical analysis in your own area.
- Exercise on WHO and Indian Standards of drinking water quality.
- Study of seismic and flood-prone areas in India.
- Analyses for alkalinity, acidity, pH and conductivity (electrical) in water samples.
- Presentation of chemical analyses data and plotting chemical classification diagram

Suggested Readings:-

1. Mason, B. and Moore, C.B., 1991: Introduction to Geochemistry-Wiley Eastern
2. Krauskopf, K.B., 1967: Introduction to Geochemistry-McGraw Hill
3. Faure, G., 1986: Principles of Isotope Geology-John Wiley
4. Hoefs, J., 1980: Stable isotope Geochemistry –Springer Verlag
5. Valdiya, K.S., 1987: Environmental Geology-Indian Context-Tata McGraw Hill
6. Keller, E.A., 1978: Environmental Geology-Bell and Howell, USA
7. Bryant, E., 1985: Natural Hazards-Cambridge University Press
8. Patwardhan, A.M., 1999: The Dynamic Earth System-Prentice Hall
9. Krynine, D.H. and Judd. W.R. (1998)-Principles of Engineering Geology-CBS Edition
10. Singh, B and Goel, R.K. (2011)-Engineering Rock Mass Classification: Tunneling, Foundations, And Landslides-Elsevier.
11. N.C. Kesavulu (2009) Textbook of Engineering Geology. Macmillan Publishers India Ltd.
12. Bell, F.G. (2007)-Engineering Geology-Elsevier.
13. Braja M Das (2006) Principles of Geotechnical Engineering. Cengage Learning.
14. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley.

15. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y.

Internet Exposures:-

1. https://www.uvm.edu/~gdrusche/195%20-%20Geochemistry.html
2. https://www.irsm.cas.cz/materialy/oddeleni/2/Geochemistry-book.pdf
3. http://www.geo.cornell.edu/geology/classes/Geo656/656notes03.html
4. https://gimmenotes.co.za/wp-content/uploads/2018/12/001_2014_4_b-2.pdf
5. http://unaab.edu.ng/funaab-ocw/opencourseware/Environmental%20Geo%20sciences.pdf
6. https://www.iare.ac.in/sites/default/files/lecture_notes/EG_LECTURE_NOTES.pdf
7. https://vardhaman.org/wp-content/uploads/2021/03/ENGINEERING-GEOLOGY-1.pdf
8. https://backbencher.club/engineering-geology/

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M.Sc. GEOLOGY

SEMESTER-IV

PAPER-I

MINERAL RESOURCES OF CHHATTISGARH AND THEIR INDUSTRIAL APPLICATIONS

UNIT-1

1.1 Geological Setup of Chhattisgarh State and its correlation with other equivalent formation of Indian Subcontinent.

1.2 Study of Geological Map of Chhattisgarh with mineral resources.

1.3 Metallogeny in time and space in Chhattisgarh state.

1.4 Enlisting of major and minor minerals found in Chhattisgarh state.

UNIT-2

2.1 Metallic deposits and mineral resources of Chhattisgarh.

2.2 Nonmetallic deposits and mineral resources of Chhattisgarh.

2.3 Geology of bauxite, Iron Ore, Tin Ore and Gold deposits of Chhattisgarh:.

2.4 Geology of coal deposits of Chhattisgarh and its industrial applications.

UNIT-3

3.1 Geology of non-metallic deposits of Chhattisgarh like limestone, Gypsum, fluorite, Clay minerals, quartz and quartzite, flagstone and Gem Minerals.

3.2 Minerals used in Iron and Steel Industry: dolomite, iron ore, coal, limestone with their specification and causes of use

3.3 Minerals used in Aluminum based industry with their quality specifications and causes of use.

3.4 Minerals used in cement industry viz. Limestone, gypsum and clay with their quality specifications and causes of use.

UNIT-4

4.1 Minerals used in refractory industry with their quality specifications and causes of use.

4.2 Minerals used in fertilizer industry with their quality specifications and causes of use.

4.3 Present status of mineral based industries in Chhattisgarh- Metallic .

4.4 Present status of mineral based industries in Chhattisgarh- Non Metallic. .

UNIT-5

Industrial uses of following minerals with special reference to causes of use, specification, locality, present status and future prospects

5.1 Silica, Lepidolite, dolomite, gypsum,

5.2 Diamond, corundum, fluorite, glauconite.

5.3 UNFC (United Nations Framework Classification), Elementary idea about Mining Plan.

5.4 Role of mineral resources of Chhattisgarh in socio-economic development, Chhattisgarh District Mineral Foundation(DMF)Trust Rules(2015).

Course Outcome:- On completion of course student will be able to

1. Describe the geological setup of Chhattisgarh with their mineral resources.
2. Describe metallic deposits of Chhattisgarh and its industrial use.
3. Describe non metallic deposits of Chhattisgarh and its industrial use.
4. Describe cold deposits of Chhattisgarh and its industrial application.
5. Explain present status of mineral based industries in Chhattisgarh and possible industrial application of the mineral resources of Chhattisgarh.

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M.Sc. GEOLOGY

SEMESTER-IV

PAPER-II

PHOTOGEOLOGY, REMOTE SENSING AND G.I.S.

UNIT-1

1.1 Introduction to Photogeology and Remote Sensing, Types of Aerial photographs: Vertical, Low-oblique, High-oblique with their geometry.

1.2 Photogrammetry: Flight plan, Nadir point, focal length of camera, principal point, Fiducial mark,

1.3 Scale of aerial photograph Photo-Scale variation and its causes. Flight Procedure, Tip and Tilt, Mosaic.

1.4 Stereoscopic vision, Stereoscope types, Pocket and Mirror stereoscope and their uses, Parallax, Vertical Exaggeration.

UNIT-2

2.1 Interpretation of Aerial photographs, Tone, Texture and patterns, Landforms and Drainage, Glacial landforms, fluvial, coastal and aeolian landforms.

2.2 Photointerpretation of Igneous, Extrusive and Intrusive rocks.

2.3 Photointerpretation of Sedimentary rock- coarse clastic sediments, fine clastic sediments and chemically precipitated sedimentary rocks.

2.4 Photointerpretation of Metamorphic rocks in Stereo pair, Structural and stratigraphic relationships, Dip and strike, Unconformity, Structural relations.

UNIT-3

3.1 Satellite Remote sensing, Types of sensors, Electromagnetic radiation (EMR) Interaction of EMR with earth objects.

3.2 Types of Images, MSS, Thermal Image, Qualitative interpretation of thermal image.

3.3 Multispectral Thermal data, Radar Image, Interaction between Radar waves and surface material. Geological features on Radar Image

3.4 Indian Remote Sensing satellite missions.

UNIT-4

4.1 Introduction to Digital Image Processing, Image Histogram, Contrast stretching, spatial frequency filtering.

4.2 Principal component Analysis, Band Rationing, Pattern recognition, Change detection.

4.3 Application and significance of Remote Sensing studies in identification of lineaments folds. faults.

4.4 Groundwater targeting, Drainage pattern and its relation to rock types and structural features

UNIT-5

5.1 Use of remote sensing data in Mineral Exploration, Groundwater targeting, Petroleum exploration.

5.2 Use of remote sensing data in Engineering geology and environmental geology, Urban Land use.

5.3 Global Positioning system, GIS, its principle, Significance of GIS in Geology. Handling digital Geographical Information System data.

5.4 Analysis and use of multiple data planes, and Topographic Data in raster format. Synergistic interpretation of Geographic Information System.

Course Outcome:-On completion of course student will be able to

1. Explain basic principles of photogeology and aerial photography
2. Understand basic concepts of electromagnetic radiation, its interaction with the earth's surface and atmosphere
3. Understand resolution properties to interpret, process and evaluate remotely sensed images
4. Explain about the GIS principles and applications
5. Apply basic analytical tool in GIS for the preparation of thematic maps6. Identify the satellite data for various applications.

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M.Sc. Semester-IV
Lab Course-I

- Exercise on metallic minerals deposits in Chhattisgarh and its plotting on map of Chhattisgarh.
- Exercise on non metallic mineral deposits in Chhattisgarh and its plotting on map of Chhattisgarh
- Exercise on metallic deposits of Chhattisgarh related to its origin, locality, mode of occurrence and genesis.
- Exercise on non metallic deposits of Chhattisgarh related to its origin, locality, mode of occurrence and genesis.
- Exercise on industrial application of metallic deposits viz. Iron ore, Aluminium ore, Tin ore etc with their specification in various industries and causes of use.
- Exercise on industrial application of non metallic deposits viz. Coal limestone dolomite gypsum talc etc.
- Study of Areal photograph (Stereo pair) with the help of stereoscope.
- Study of land set imageries, identification of forest, water bodies, lineament band other Geological structure.
- Various notation of imageries.

Suggested Readings:-

1. Panda B.C. , Remote Sensing : Principles and Application- Viva Books
2. Basudeb Bhatta- Second Edition- Remote Sensing and GIS – Oxford University Press
3. M. Anji Reddy – Third Edition – Textbook of Remote Sensing and GIS – BS Publications
4. Lilesand and Kiefer. John Wiley & Sons Inc; 7th edition (17 March 2015) - Remote Sensing and Image Interpretation
5. George Joseph and C Jeganathan – Third Edition - FUNDAMENTALS OF REMOTE SENSING
6. S. M. Ramasamy – 2003 – Remote Sensing in Geology – Rawat Publications
7. S.A. Drury -Nelson Thornes Ltd; 2nd edition (21 October 1993) – Image interpretation in Geology
8. Jr. Sabins, Floyd F., James M. Ellis,- Waveland Pr Inc (1 April 2020) -Remote Sensing: Principles, Interpretation, and Applications

9. S. N. Pandey- John Wiley & Sons Inc (1 January 1987) - Principles and Applications of Photogeology

10 .Victor C. Miller, Calvin F. Miller, - McGraw-Hill Inc.,US (1 December 1961)- Photogeology (International Series in Earth Science)

12 .Ganpat Singh Roonwal, K. Shahriar, Hojjatollah Ranjbar · 2005-Mineral Resources and Development – Daya Publishing House

13 · . P.K. Jain · 2006.- Mineral Policy, Mining Laws and Development - Scientific Publishers.

Internet Exposures:-

1. https://ncert.nic.in/textbook/pdf/kegy307.pdf
2. https://kanchiuniv.ac.in/coursematerials/Dr_K_Anitha_Course%20Material_Remote%20Sensing%20and%20GIS.pdf
3. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_CE_RS%20and%20GIS_Lecture%20notes.pdf
4. https://yunus.hacettepe.edu.tr/~kdirik/ileri%20fotojeoloji%201-5.pdf
5. https://pubs.usgs.gov/bul/1043a/report.pdf
6. https://chhattisgarh.pscnotes.com/chhatttisgarh-geography/minerals-in-chattisgarh/
7. https://unacademy.com/content/bank-exam/study-material/general-awareness/natural-resources-of-chhattisgarhs/
8. file:///C:/Users/dell/Downloads/PKJ-IBM-6.8.2022.pdf

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1	Head of Department	Dr. Sandeep Vansutre	
2	External Subject Expert 1	Dr. Neeraj Vishwakarma	02/7/25
3	External Subject Expert 2	Dr. S.D. Deshmukh	
4	External Subject Expert 3	Dr. Ninad Bodhankar	07-07-
5	Representative from Industry	Mr. Alok Verma	7/7/25
6	Student's Representative	Mr. Pradhumn Soni	

M.Sc. GEOLOGY

SEMESTER-IV

PAPER-III

TOOLS AND TECHNIQUES IN FIELD GEOLOGY

UNIT –1

1.1 Definition, scope and necessity of Field Geology, literature survey and its importance

1.2 Pre requisites for field excursion: System of numbering of toposheets, symbols on toposheets, reading of toposheet, toposheet orientation and scales of toposheets

1.3 Contour patterns and their interpretation, Outcrops dip and strike. Measurement of dip and strike using clinometer compass and Brunton compass

1.4 Plotting of location on toposheet, concept of fore bearing, back bearing and triangulation

UNIT-2

2.1 Essential tools for field excursion and their importance Magnifying glass, field notebook, hammer and chisel, sample bag, cap and shoes, magnet, multi pocket apron, geometry box and first aid box, whistle and torch

2.2 Global Positioning system : Principle and application for geological excursion, Camera and basic techniques of field photography

2.3 Folds and faults : basic terminology, classification and recognition on geological map and field

2.4 Joints, unconformities, lineation and foliation : basic terminology, classification and recognition on geological map and field

Unit-3

3.1 Structures, textures, mineral composition and classification of igneous rocks, identification of igneous rocks in field

3.2 Structures, textures, mineral composition and classification of sedimentary rocks, identification of sedimentary rocks in field

3.3 Structures, textures, mineral composition and classification of metamorphic rocks, identification of metamorphic rocks in field

3.4 Recording of field data and collection and preparation of samples (rock, mineral and fossil).

Unit-4

4.1 Geological mapping methods: Reconnaissance, Contact following method, Dip traverse method, baseline offset method, radial method

4.2 Types of Geological map: Geomorphological map, lithological map, photogeological map, Structural map, hydrogeological map

4.3 Components of a geological map : Map symbols and marking of North direction, scale, colour coding , Index, contour lines and other features with special reference to study of District Resource Map of Raipur (prepared by G.S.I.)

4.4 Essential components of field report writing. Layout of report: Title page, Acknowledgement, Content, Abstract, Introduction, Main body/ text, A locality Index, Photography, Conclusion, Bibliography, References, Appendices

Unit-5

5.1 Principle and applications of DGPS, guidelines about use of DGPS by IBM for the preparation of mining plan. Use of DGPS for the preparation of Khasra naksha for the revenue department of Government of Chhattisgarh.

5.2 Principle and applications of Drone survey, guidelines about use of Drone Survey by IBM for the preparation of mining plan . Other Uses of Drone Survey in the upcoming technical era

5.3 GIS as a tool in geological mapping and its interpretation: Georeferencing, preparation of map layers, their overlapping and their interpretation

5.4 Commercial applications of DGPS, Drone, GIS software and their scope as a startup for geology students and entrepreneur

Course Outcome:- On completion of course student will be able to

1. Learn Idea about toposheets and its interpretation.
2. Learn about tools requires for field excursion.
3. Recognize various structures on field and map.
4. Identify igneous, sedimentary and metamorphic rocks in detail.
5. Learn about Recording and collection of data and its interpretation.
6. Have an Idea about DGPS, Drone Survey , GIS Software.
7. Do his entrepreneurship or academic dissertation.
8. Start his own startup after learning from new tools like DGPS, Drone and GIS software.

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3	External Subject Expert 2	Dr. S.D. Deshmukh	
4	External Subject Expert 3	Dr. Ninad Bodhankar	
5	Representative from Industry	Mr. Alok Verma	
6	Student's Representative	Mr. Pradhumn Soni	

M.Sc. GEOLOGY
SEMESTER IV
DISSERTATION/PROJECT WORK

Student will have to submit a dissertation/project work of 100 marks on the topic allotted to him by the supervisor. Distribution of 100 marks will be as below:

Field work and training- 80 marks

Report writing and Viva-voce 20 marks

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M.Sc. GEOLOGY
SEMESTER IV
ELECTIVE PAPER-I
ADVANCE HYDROGEOLOGY

UNIT-1

1.1 Types of aquifer: Unconfined, perched, semiconfined, confined, leaky aquifer.

1.2 Occurrence of ground water in varied geological conditions: Unconsolidated formations, compact sedimentary formation, calcareous formations.

1.3 Occurrence of ground water in igneous and metamorphic rocks, in permafrost region, in desert area, in coastal area.

1.4 Saline water intrusion, relation to fresh water, fresh water and salt water interface, slope and movement of interface, Ghyben-herzberg relation prevention and control of saline water intrusion.

UNIT-2

2.1 Ground water flow, Darcy's law and Reynolds's number, Head distribution, Laminar and turbulent flow, formation constant (T,S)

2.2 Flow net analysis, steady and non-steady state of flow, boundary conditions, redial flow to well and cone of depression.

2.3 Evaluation of aquifer parameter, pumping test, assumptions for formula of pumping test, methods of pumping test, data analysis and interpretation.

2.4 Bounded aquifers, barrier boundary and recharge boundary, image well theory location of boundary. measurement of discharge of wells.

UNIT-3

3.1 Geologic and hydrologic method of exploration, basic concept of geophysical exploration for ground water, surface geophysical methods.

3.2 Sub surface methods of exploration, Geophysical well logging.

3.3 Application of remote sensing techniques and GIS in ground water exploration. Care studies and examples from India.

3.4 Ground Water modelling: Concept and principles involved in the modelling types of modelling, care study.

UNIT-4

4.1 Bacteriological, Physical and Chemical quality salinization of GW, Hydrogeochemical process involve in salinization.

4.2 Chemical analysis of natural water, major and track constituents, total dissolved solid and EC.

4.3 Interpretation of chemical data, diagrammatic and graphic representation of chemical data, Hardness, SAR value, Permeability Index, salinity hazard, Na Hazard.

4.4 Ground Water contamination, Natural pollutants, man-made pollutants, pollution mechanism, detection and prevention.

UNIT-5

5.1 Fundamental of ground water development and management, estimation of ground water recharge and discharge, ground water balance study.

5.2 Well interference, safe yield, overdraft, conjunctive use, water logging - care study.

5.3 Artificial recharge techniques and design, direct and indirect methods, ground water conservation techniques, suitability of recharge structure. Roof Top rainwater harvesting, impact assessment of A.R.

5.4 Watershed Management: Concept and objective, remote sensing and GIS application in watershed management: Examples and care study, Ground Water legislation.

Course Outcome:-On completion of course student will be able to

1. Describe about different types of aquifer.
2. Understand and Explain occurrence of groundwater in varied geological conditions.
3. Explain about evaluation of aquifer parameters.
4. Describe geologic and hydrologic method of exploration.
5. Describe about various parameters for groundwater quality.
6. Describe about fundamental of Groundwater development and management.

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M.Sc. GEOLOGY

SEMESTER-IV

ELECTIVE PAPER-II

MINERAL RESOURCES: EXPLORATION, EXPLOITATION, DEVELOPMENT AND MANAGEMENT

UNIT-1

1.1 Meaning and scope of prospecting and exploration, different stages of prospecting and exploration.

1.2 Various methods of prospecting and exploration, surface and subsurface , opting a suitable prospecting and exploration method depending upon targeted ore search.

1.3 Concept and application of geological, lithological, stratigraphic, geobotanical, geochemical, and geophysical methods of prospecting and exploration.

1.4 Principles, applications, procedure and instrumentation of gravity, magnetic, seismic, electrical method of geophysical prospecting, Borehole- Lithological and geophysical logging.

UNIT-2

2.1 Open cast mining, underground mining and features associated with viz. pit, adit, tunnel, stoss, raise,etc.

2.2 Essential conditions for opting open cast and underground mining, mine support, ventilation, rooting, drainage, etc.

2.3 Introduction to mining equipments viz. drilling, shovel, dumpers, excavators, conveyer belt, etc.

2.4 Role of lithology, structures, topography, geology in mining operations.

UNIT-3

3.1 Definition, scope of mineral development, Concept of acts, rules and restrictions of rules.

3.2 Meaning and scope of Reconnaissance permit (RL), prospecting license (PL), and mining license (ML).

3.3 MMDR- Mines and Mineral Development and regulation act -1957 and amendment therein.

3.4 Chhattisgarh Minor Mineral rule -2015.

UNIT-4

4.1 Understanding of Mining and Environment, Environmental degradation due to mining and preventive and curative measures.

4.2 Concept of Environmental Management Plan (EMP), Environment impact assessment (EIA), and Environmental Status Report (ESR).

4.3 Mineral resources and mineral production with special reference of Chhattisgarh viz. Iron ore, bauxite, Tine ore.

4.4 Mineral resources and mineral production with special reference of Chhattisgarh viz Coal, Limestone, Dolomite, Talc , Gypsum.

UNIT-5

5.1 Procedure for obtaining prospecting license, mining lease, quarry lease, composite license (PL+ML), understanding of loyalty, dead rent and other fees.

5.2 Understanding of mining plan, progressive and final mine closure plan.

5.3 Role of mining officers and mining inspectors in mineral administration of the state.

5.4 Role of mineral resources of Chhattisgarh in socio-economic development, Chhattisgarh, District Mineral Foundation (DMF) trust rules (2015)

Course outcome:-On completion of course student will be able to

1. Understand and Explain about prospecting and exploration.
2. Describe various surface and subsurface methods of prospecting and exploration.
3. Describe about open cast mining and underground mining.
4. Understand uses of mining equipments.
5. Have an Elementary idea about Mineral Development.
6. Learn Concept of EMP And Have an idea about mining plan and final mine closure plan.

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M.Sc. Semester – IV
Lab Course – II

- Exercise related to contour and contour maps viz. valley, hills, etc.
- Exercise related to numbering of toposheets, reading of toposheet, toposheet orientation, scales of toposheets.
- Exercise related to clinometer compass and brunton compass.
- Exercise related to essential tools for field excursion.
- Exercise related to fold, fault, joint, unconformity, foliation, lineation in field.
- Exercise related to geological, lithological, structural, hydrogeological and photogeological maps.
- Exercise related to district resource map of Raipur of GSI.
- Exercise related to DGPS survey, Drone survey and ideas about startup in this domain.
- Exercise related to geophysical logging viz. caliper, density, natural radioactivity, magnetic and seismic.
- Exercise related to mining operation methods through models or pictorial representation.
- Exercise related to mineral resources and mineral production of Chhattisgarh with marking places of occurrence viz. Iron ore, bauxite, tin ore.
- Exercise related to mineral resources and mineral production of Chhattisgarh with marking places of occurrence viz. Coal , Limestone, dolomite, talc, gypsum.
- Water table contour maps: study and construction, analysis of hydrographs and estimation of infiltration capacity.
- Chemical analysis of water in practical and study.
- Pumping test, time-draw down test and evolution of aquifer parameters.

Suggested Readings:-

1. Lahee F.H.- Sixth Edition (1 January 1987) – Field Geology – CBS Publishers.
2. Mathur S.M - Prentice Hall India Learning Private Limited; New title edition (1 January 2001) - Guide to Field Geology.
3. Geikie James - Structural and Field Geology.
4. Robert R. Compton- John Wiley & Sons Inc (1 December 1962) - Manual of Field Geology.
5. Mining Geology II Ed. – H.E. McKinstry, 1962. Asia Publishing House,

6. Elements of Mining 3rd Ed. - R.S. Lewis and G.B. Clarke, 1964. John Wiley and Sons, New York
7. Courses in Mining Geology – R.N.P. Arogyaswami, 1973. Oxford and IBH Pub.
8. Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing.
9. D.K.Todd., L.W. Mays. Third Edition, (2005), Groundwater Hydrology.
10. K.R. Karanth, 1987, Groundwater- Assessment, Development & Management.
11. Davies, S.N. & De Wiest, R.J.M., 1966: Hydrogeology-John Wiley

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2. https://eis.hu.edu.jo/ACUploads/10769/GFT%201.pdf
3. file:///C:/Users/dell/Downloads/7-GEOLOGICAL-FIELD-TECHNIQUES-min.pdf
4. https://www.eolss.net/sample-chapters/c01/E6-64-01-04.pdf
5. https://www.southalabama.edu/geology/haywick/GY111/111-23.pdf
6. http://egyankosh.ac.in//handle/123456789/79953
7. https://www.mlsu.ac.in/econtents/1921_Geoexploration%20Methods.pdf
8. https://old.amu.ac.in/emp/studym/99994571.pdf
9. http://egyankosh.ac.in//handle/123456789/78247

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