Department of Applied Geology

School of Engineering and Technology

Dr. Harisingh Gour Vishwavidyalaya Sagar (M.P.)

A Central University

Syllabus

Ph.D. Programme In Applied Geology

(Session 2020-21)

Dr. Harisingh Gour Vishwavidyalaya, Sagar
Scheme of Ph.D. Programme in Applied Geology 2021-22

Ph.D. Course Work – 18 Credits

Course Code	Title	Credits
GEO CC 141	**Research Methodology**	04
GEO CC 142	**Instrumentation & Field Work**	04
	Elective	04
GEO EC 141	**Economic Geology**	
GEO EC 142	**Applied Micropaleontology**	
GEO EC 143	**Igneous, Metamorphic Petrology & Geochemistry**	
GEO EC 144	**Sedimentary Petrology**	
GEO EC 145	**Hydrogeology**	
GEO EC 146	**Geoinformatics**	
GEO EC 147	**Engineering Geology**	
GEO EC 148	**Structural Geology**	
GEO EC 149	**Environmental Geology**	
GEO CC 143	**Review of Published Research**	04
GEO RPE CC 144	**Research and Publication Ethics (RPE)**	02
Total Course Credits		**18**

Ph. D. Course Work

Credits: 04 **GEO CC-141** **(M.M. 100= 60 end sem. + 40 sessional)**

Research Methodology

Unit 1

Objective of research processes and steps in research methodology.

(Lecture 12)

Unit 2

Field methods used in geological mapping, format for writing thesis, reports and research papers.

(Lecture 12)

Unit 3

Statistical methods used in earth science /Geology. **(Lecture 12)**

Unit 4

Research proposal and concept. Basic preparation of major and minor research project.

(Lecture 12)

Unit 5

Principles and Techniques of Research Methodology. **(Lecture 12)**

Essential Reading

1. **D.L. Elhance** (1973) Practical Problem in Statistics. Kitab Mahal, Allahabad, P.707
2. **Kothari. C. R.** (2004) Research Methodology: Methods and Techniques, Pub. New Age International, 340p.
3. **Kumar, Rajendar** (2009) Research Methodology, Pub. APH Publishing 320p.
4. **Dhar, K** (2006) Research Methodology, Pub. Excel Books India, 423p
5. **Gupta, Mukul and Gupta,** (2010) Deepa Research Methodology, Pub.PHI Learning Pvt. Ltd. 378p.

Suggested Reading:

1. **Shukala M.M. and Sahay S.** (1977) Principle of Statistics. Sahitya Bhawan, Hospital Road, Agra, P.532

Credits: 04 **GEO CC-142 (M.M. 100= 60 end sem. + 40 Sessional)**

Instrumentation & Field Work

Unit 1

Basic idea of the state of the art instruments in geosciences especially for analyses of major oxides and trace elements minor elements including REE. **(Lecture 12)**

Unit 2

Principles of Microscopy, types of microscopes (polarizing, reflected light microscope), geographical information system (GIS), geographical positioning system (GPS), survey equipment. **(Lecture 12)**

Unit 3

UV spectrophotometer, flame photometer, soil and water testing equipment, sedimentological equipments, zoom-stereoscopic microscope, SEM, atomic absorption (AS), ground penetration radar (GPR). **(Lecture 12)**

Unit 4

G M counter, EPMA, ICPMS, XRD, Raman spectroscope, stimulatory thermal analyzer (STA), thermal gravity analysis (TGA),
differential thermal analyzer (DTA) and mass spectrophotometer(MS). **(Lecture 12)**

Unit 5

Computer Application in Geology Field Work on Geological Mapping for 10 days.
(Lecture 12)

Essential Reading

1. The metal Analysis (1962) Published by Buehler Ltd. And Adolph I Buehler Inc. illinois – USA.
2. Patrick, A. Domenico (1972) Concepts and models in Groundwater Hydrology McGraw-Hill Book Co., New York P. 405.
3. Babu, S. K. (1987): **Practical Manual of Crystal Optics**, CBS Pub. & Dist.
4. Ghosh, S. K. (1985): **Structural Geology- Fundamental & Modern Development**,.
5. Saraswati, P. K. & Srinivasan, M. S. (2016): **Micropaelontology, Principles & Applications**, Springer, 224p.
6. Craig, J. R. and Vaughan, D. J. (1994): **Ore microscopy and ore petrography**, John Wiley & Sons.
7. Philpotts Anthony R. (1992): **Principles of Igneous & Metamorphic Petrology**, Prentice Hall

8. Babu, S. K. & Sinha, D. K. (1987): **Sedimentary Petrology Practical**, CBS Pub., N. Delhi.
9. Hussain, A. M. (1985): **The Economics and Economic Geology of the Mineral Industries**, Allied Pub. (Pvt.) Ltd., New Delhi.
10. Beus, A. A. and Grigorian, S. V. (1977): **Geochemical Exploration Methods for Mineral Deposits**, Applied Publication, University of California, 287p.

Suggested Reading:

11. Condi, K. C. (1989): **Plate tectonics and crustal evolution**, Pergamon,(3rd Ed.), 504p.
12. Patrick, A. (1972) : **Concepts and models in groundwater hydrology**. McGraw Hills
13. Lillesand, T. M. and Kiefer, R. (1987): **Remote sensing and image interpretation**, John Wiley.
14. Keller, A. E. (1978): **Environmental Geology** (5th Edt.) Charis and Merril Pub. Co.
15. Legget, R. F. (1983): **Handbook of geology in civil engineering**, McGraw Hill, New York.

GEO EC 141-149 Elective papers

Credits: 04 **GEO EC 141 (M.M. 100= 60 end sem. + 40 Sessional)**

Economic Geology

Unit 1

Ore mineral formation Systems & Processes. Ore deposit Classification. Ore deposit Association. Ore Texture, Zoning, Paragenesis. Model of Ore deposit and its type in India. **(Lecture 12)**

Unit 2

Non metallic Deposits. Mineral Fuels. Atomic Minerals. Ore microscopy and identification of Ore minerals. Study of common ore minerals in hand specimen with respect to structure, texture, association and genesis. **(Lecture 12)**

Unit 3

Polishing of ores, identification of polished ore minerals in reflected light; colour, reflectivity, internal reflection colour, cleavage, polishing hardness, reflection pleochroism, anisotropism, number of extinction positions, false bireflections recognition of common textures in ores. **(Lecture 12)**

Unit 4

Quantitative techniques which include: (a) Measurement of reflectivity by photocell method and (b) Determination of VHN. Interpretation of ore textures in terms of Paragenesis giving examples. **(Lecture 12)**

Unit 5

Industrial products of geological material and their specification. **(Lecture 12)**

Essential Reading

1. Craig, J. R. and Vaughan, D. J. (1994): **Ore microscopy and ore petrography**, John Wiley & Sons.
2. Evans, A. M. (1992): **Ore geology and industrial minerals**, Blackwell Science.
3. Jensen, M. L. & Bateman, A. M. (1981): **Economic mineral deposits**, John Wiley & Sons.
4. Misra, K. C. (1999): **Understanding Mineral Deposits**, Kluwer Academic Publishers.

Suggested Reading:

5. Mookherjee, A. (1998): **Ore genesis - a holistic approach**. Allied Publishers.
6. Stanton, R. L. (1981): **Ore Petrology**, McGraw Hill.

Ph. D. Course Work

Credits: 04 **GEO EC142 (M.M. 100= 60 end sem. + 40 sessional)**

Applied Micropaleontology

Unit 1

Scope in earth system sciences. Classification of microfossils based on wall- composition. Techniques of study in micropaleontology. **(Lecture 12)**

Unit 2

Morphology and outline of classifications of Foraminifera, Ostracoda, Calcareous Nanno Planktons and various groups of Pollen & Spores. Oceanographic parameters controlling the ecology/palaeoecology of microorganisms. **(Lecture 12)**

Unit 3

Significance and geological application of microfossils with especial reference to oil exploration.
(Lecture 12)

Unit 4

Identification of representative genera of foraminifera, nannoplanktons ostracoda and pollen & spores. Preparation of Range Chart based on identification of foraminifera, nannoplanktons ostracoda and pollen & spores. **(Lecture 12)**

Unit 5

Murrays Model of Interpretation of environment of deposition based on the ecological/ paleoecology parameters of foraminifera.
(Lecture 12)

Essential Reading

1. **Kathal, P. K., Nigam, Rajiv & Talib, Abu** (2019): **Micropaleontology & its Applications**, Scientific Publishers, 242 p. New Delhi-Jodhpur.
2. **Saraswati, P. K. & Srinivasan, M. S.** (2016): **Micropaelontology, Principles & Applications**, Springer, 224p.
3. **Kathal, P. K. (2012): Applied Geological Micropaleontology**, Scientific Publishers, 230 p. New Delhi-Jodhpur.
4. **Murray, John,** (2006): **Ecology & Application of Benthic Foraminifera**, Cambridge University Press, 426 p.
5. **Clarkson, E. N. K.** (1979 & 2002), **Invertebrate Paleontology & Evolution**, London Gorge Allen & Unwin, 323 p.
6. **Sen Gupta, B. K.** (1998): **Modern Foraminifera**, Kluwer Academic Publishers, 371 p.
7. **Loelich, A. R. (Jr.) & Tappan, J.** (1988): **Foraminifera Genera & Their Classification** (v. 1 & 2), Van Nostrand Renhold. 970 p., pls. 847.
8. **Bignot, G.** (1985): **Elements of Micropaleontology,** Graham & Trotman, London, 212 p.
9. **Aldrige, R. J.** (1985): **Paleobiology of Conodonts,** (Ed.),British Micropaleontological Society,
10. **Kennet, J. P. and Srinivasan, M. S.** (1983): **Neogene-Planktonic Foraminifera**. Hutchison Ross Publ. Co., U. S. A., 263 p.
11. **Braiser, M. D., (**1982): **Microfossils**, Gorge Allen & Unwin, London, 193p.
12. **Haynes, J. R.** (1981): **Foraminifera**, MacMillan Pub. Ltd., 432p.

Suggested Reading:

13. **Haq, B. U. & Boersma, A.** (Eds.), (1978): **Introduction to Marine Micropaleontology**, Elsevier, New York, 250 p.
14. **Cushman, J. A.** (1947): **Foraminifera Their Classification & Economic Uses**, Harvard Univ.

Glassener, M. F. (1945): **Principles of Micropaleontology**, Haftner Press, New York, 645 p.

Credits: 04 **GEO EC143 (M.M. 100= 60 end sem. + 40 sessional)**

Igneous, Metamorphic Petrology & Geochemistry

Unit 1

Composition of the crust and upper mantle, their emplacement and their relation to plate tectonics. Magma, their nature, composition, constitution, origin and evolution. Factors causing diversity in igneous rocks. Assimilation, Liquid immiscibility and Differentiation.
(Lecture 12)

Unit 2

Plate tectonics and metamorphic facies series. Nature of metamorphic reactions. Regional metamorphism of pelitic rocks, calcareous, basic and ultrabasic rocks. Anataxis and origin of migmatite in the light of experimental studies. **(Lecture 12)**

Unit 3

UHP and UHT metamorphism. Petrogenesis of charnockites. Pressure-Temperature-Time paths. Geo thermo-barometry. Megascopic and microscopic study of igneous lithotypes. Identification of texture in igneous rocks: intergrowth, porphyritic, equigranular, reaction rims, panidiomorphic, perthitic & their petrogenetic significance. Megascopic & microscopic characters of metamorphic rocks of different metamorphic facies. Estimations of pressure–temperature & activity of common metamorphic minerals through different important models.

(Lecture 12)

Unit 4

Primary geochemical differentiation of the earth; Geochemical classification of elements. Minor and trace elements during magmatic crystallization. Significance of REEs in igneous petrology; Salient features of pegmatites, kimberlite. Geochemistry of sedimentary process, physico-chemical factors during sedimentary cycle. Hydrosphere, Atmosphere and Biosphere. Basic concepts; Geochemical environment, mobility, dispersion and dispersion patterns. Geochemical back-ground, threshold and anomaly.

(Lecture 12)

Unit 5

Geochemical exploration in relation to other methods of exploration; stages in geochemical survey. Geochemical methods of analysis; sampling; preparation of samples, decomposition and separation of elements. Methods of quick analysis; colorimetry, spot test, paper chromatography. Pathfinders and common geochemical associations of elements. **(Lecture 12)**

Essential Reading

1. Best, Myron G. (2002): **Igneous and Metamorphic Petrology**. Wiley-Blackwell Science
2. Bose, Mihir K., (1997): **Igneous Petrology**, The World Press Pvt. Ltd., Calcutta, p.568.
3. Carmichael, I. S. E., Turner, F. J. & Verhoogen, J. (1971) **Igneous Petrology**, Mc Graw Hill
4. Ehlers, E.G. & Blatt, H. (1982): **Igneous, Sedimentary and Metamorphic Petrology**, CBS Pub. Dist., New Delhi
5. Winter, J. D. (2012): **Principles of Igneous and Metamorphic Petrology** 2nd Edition, PHI Learning Pvt. Ltd., New Delhi
6. Philpotts Anthony R. (1992): **Principles of Igneous & Metamorphic Petrology**, Prentice Hall
7. E-content available at CEC-UGC-MHRD New Delhi website
8. Massive open Online Course on Petrology: Swayam Plateform Govt of India.
9. S. C. Chatterjee (1974): **Igneous and Metamorphic Petrology**
10. Tyrell, G. W. (1963): **Principles of Petrology**, Metheun

11. Best, M. G. (2002): **Igneous and Metamorphic Petrology**, Wiley-Blackwell Science
12. Blatt, H. and Tracy, R. J. (1996): **Petrology (Igneous, Sedimentary &, Metamorphic)**, W.H. Freeman and Co., New York.
13. Winter, J. D. (2012): **Principles of Igneous & Metamorphic Petrology** (2nd Ed.)' PHI Learn.
14. Winkler, H. G. F. (1967): **Petrogenesis of Metamorphic Rocks**, Springer–Verlag./Narosa.
15. Thomas, H. (2005): **Metamorphism and Crustal Evolution** (Edited)
16. Albarede, F. (2009):**Geochemistry an Introduction,** Cambridge Univ. press, (II Ed) 330p
17. Beus, A. A. and Grigorian, S. V. (1977): **Geochemical Exploration Methods for Mineral Deposits**, Applied Publication, University of California, 287p.
18. Brownlow, A. H. (1979): **Geochemistry,** Englewood Cliffs and London Prentice Hall, 498p.
19. Deckin, A. P.(2005): **Radiogenic Isotope Geology,** Cambridge University press, 492p (II Ed)
20. Hawkes, H. E. & Webb, J. S. (1962): **Geochemistry in Mineral Exploration,** Harper & Row .
21. Krauskopf, K. B. and Bird, D. K.(1995): **Geochemistry,** McGraw Hill, New York,640p

Suggested Reading:

1. A.K. Gupta (1998): **Igneous Petrology**
2. Alexander, P. O. (2008): **Handbook of Minerals, Crystals, Rocks & Ores**, New India Pub.
3. Blatt, H. and Tracy, R. J. (1996): **Petrology (Igneous, Sedimentary &, Metamorphic)**, W.H. Freeman and Co., New York
4. Tyrell, G. W. (1963): **Principles of Petrology**, Metheun
5. Kretz, R. (1994): **Metamorphic Petrology**
6. E-content available at CEC-UGC-MHRD New Delhi website
7. Mason, R. (1978): **Petrology of Metamorphic Rocks,** CBS Pub. & Dist., New Delhi
8. Levinson, A.A. (1980): **Introduction to Exploration Geochemistry**, (2nd Ed) App. Pub., 924p.
9. Mason, B. and Moore, C. B. (1982): **Principles of Geochemistry,** Wiley Eastern Ltd., 344p.
10. Fairbridge, R. W. (1972): **Encyclopedia of Geochemistry and Environmental Sciences,** Von Nostrond Reinhold Co, 1321p.

Credits: 04 **GEO EC144 (M.M. 100= 60 end sem. + 40 sessional)**

Sedimentary Petrology

Unit 1

Sedimentary environment: physical and chemical properties of depositional environment and its classification. Lithologies, structures and vertical sequences formed in fluvial, deltaic, coastal, deep sea, glacial, aeolian & carbonate depositional environments. Province: **(Lecture 12)**

Unit 2

light minerals, heavy minerals and insoluble residue in provenance studies and correlation of sedimentary rocks. **(Lecture 12)**

Unit 3

Diagenesis: compaction, cementation, chemical alteration & recrystalisation. Sedimentation and Tectonics: tectonic control of sedimentation. Geosynclines and their lithological associations. **(Lecture 12)**

Unit 4

Plate tectonics in relation to type & evolution of basins. Study of clastic and non-clastic rocks in hand specimen. Microscopic examination of important rock types. **(Lecture 12)**

Unit 5

Separation of heavy minerals and study of their microscopic characteristics. Grain size analysis by sieving, plotting of size distribution data. Determination of roundness and sphericity of grains. **(Lecture 12)**

Essential Reading

1. Babu, S. K. & Sinha, D. K. (1987): **Sedimentary Petrology Practical**, CBS Pub., N. Delhi.
2. Blatt, M. and Murray (1980): **Origin of sedimentary rocks**, Printice Hall Inc.
3. Blatt, H. E., (1972): **Sedimentary Petrology**, 2nd Ed. W. H. Freeman & Co. New York.
4. Collins, J. D. and. Thompson, D. B (1982): **Sedimentary Structures**, George Allen & Unwin,.
5. Pettijohn, F. J. (1975): **Sedimentary rocks**, Harper and Row Publ., New Delhi.
6. Reading, H. G. (1986): **Facies**. Blackwell Scientific Publication.
7. Reinbeck, H. E. & Singh, I. B. (1980): **Depositional Sedimentary Environments**. Springer.

Suggested Reading:

8. Boggs, Sam (Jr.) (1996): **Princiles of Stratigraphy and Sedimentology**. 2nd Ed. Prentice Hall.
9. Selly, R. C. (1976): **An Introduction of Sedimentology**. Academic Press London.

10. Sengupta, S. M. (2007): **Introduction of Sedimentology**. 2nd Ed. CBS Pub., New Delhi.
11. Sukhtankar, R. K. (2004): **Applied Sedimentology**. 1st Ed. CBS Pub. & Dist., New Delhi.
12. Tucker, M. E. (1981): **Sedimentary Petrology: an introduction**. John Willey & Sons, New York.

Ph. D. Course Work

Credits: 04 **GEO EC 145 (M.M. 100= 60 end sem. + 40 Sessional)**

Hydrogeology

Unit 1

Hydrometeorology, hydrologic cycle, occurrence and movement of groundwater, well hydraulics, artificial recharge techniques, groundwater exploration, **(Lecture 12)**

Unit 2

Construction of wells and their completion, watershed development, groundwater budgeting, water quality assessment and management. Impact of climate change on water resources.

(Lecture 12)

Unit 3

Nuclear techniques in groundwater hydrology, groundwater modeling and use of Computer program in groundwater hydrology. Methods of water quality testing and sampling. **(Lecture 12)**

Unit 4

Preparation & interpretation of water table/pressure surface maps, Determination of aquifer parameters using different methods of pumping test data. Determination of specific capacity of wells. **(Lecture 12)**

Unit 5

Representation and interpretation of water quality data evaluation of water pollution; interpretation of electrical resistivity data; interpretation of rainfall data. Its relation with other climatic data. Groundwater modeling. **(Lecture 12)**

Essential Reading

1. **Tolman, C. F.** (1937): **Groundwater,** Mcgraw Hills Book co inc. New York and London
2. **Todd, D. K.** (1980): **Groundwater hydrology**, Toppan Co. ltd., Tokiyo, Japan
3. **Ramakrishnan, S.** (1998): **Groundwater**
4. **Freeze, R. A. and Cherry, J. A.** (1979): **Groundwater**. Prentice Hall.

Suggested Reading:

5. **Patrick, A.** (1972): **Concepts and models in groundwater hydrology**. McGraw Hills
6. **Sharma, R. K.** (1979): **A text book of hydrology & water resources**, Dhanpatrai & Sons.

Walton, W. C. (1970): **Ground water resource evaluation** McGraw Hills Book Co.

Credits: 04 **GEO EC146 (M.M. 100= 60 end sem. + 40 Sessional)**

Geoinformatics

Unit 1

Collection/processing/mapping of analogue and digital data and integration of these with GPS data; **(Lecture 12)**

Unit 2

website providing freeware for mapping; acquiring digital data from (NDC,NRSC, bhuvan, Google earth and GLCF etc.); **(Lecture 12)**

Unit 3

DEM & DTM; application of Geoinformatics for various purposes. **(Lecture 12)**

Unit 4

Photogrammetry and photo geological mapping on different bands of EMR. **(Lecture 12)**

Unit 5

Digital data analysis, mapping and interpretation, preparation of maps using aerial photos, satellite imageries and digital data. **(Lecture 12)**

Essential Reading

1. Avery, T. U. and Berlin, G. L. (1992): **Fundamentals of Remote Sensing and Air Photo Interpretation**, McMillion Publishing Co., New York.
2. Burrough, P. A. (1986): **Principles of Geographic Information Systems for Land Resources Assessment**.
3. Campbell, J. B. (1996): **Introduction to Remote Sensing**, 622pp.
4. Drury, S. A. (1987): **Image Interpretation in Geology**, Chapman and Hall.
5. Gupta, R. P. (2003): **Remote Sensing Geology.** 2nd Ed., Springer-Verlag, Heidelberg.
6. Jensen, J. R. (1986): **Introductory Digital Image Processing-A Remote Sensing Perspective,** Prentice Hall, New Jersey.
7. Lillesand, T. M. and Kiefer, R. (1987): **Remote sensing and image interpretation**, John Wiley.
8. Miller, V. C. (1961): **Photogeology,** McGraw Hill Book Co., New York.

Suggested Reading:

9. Pandey, S. N. (1987): **Principles and Applications of Photogeology**. Wiley Eastern Ltd., Delhi.
10. Ray, R. G. (1969): **Aerial photographs in Geologic Interpretation**. USGS Professional Paper 373.
11. Siegal, B. S. and Gillespie, A. R. (1980): **Remote Sensing in Geology**. John Wiley & Sons.

Credits: 04 **GEO EC147 (M.M. 100= 60 end sem. + 40 sessional)**

Engineering Geology

Unit 1

Engineering characterization of rocks/soil and their classification; **(Lecture 12)**

Unit 2

Methods of sampling, testing and mapping; advance techniques of reinforcement and improvement of rocks/soil; **(Lecture 12)**

Unit 3

Discussion of engineering projects and case histories. **(Lecture 12)**

Unit 4

recent trends and development in engineering/ geotechnical engineering. **(Lecture 12)**

Unit 5

Determination of strength and index properties of rocks and soils; preparation of engineering/ geotechnical maps for engineering projects. **(Lecture 12)**

Essential Reading

1. Beavis, F. C. (1985): **Engineering Geology**.
2. Bell, F. G. (1999): **Geological Hazards**, Routledge, London.
3. Bieniawski, Z. T. (1989): **Engineering Rock Mass Classification**, John Wiley.
4. Bryant, E. (1985): **Natural Hazards**, Cambridge University Press.
5. Goodman, R.E. (1980): **Introduction to rock mechanics**.
6. Jagger, J. C. and Cook, N. G. W. (1979): **Fundamental of rock Mechanics**, Champman & Hall.
7. Johnson, R. B. and DeGraff, J. V. (1988): **Principles of Engineering Geology**, John Wiley.

Suggested Reading:

8. Legget, R. F. (1983): **Handbook of geology in civil engineering**, McGraw Hill, New York.
9. Schultz, J. R. & Cleaves, A. B. (1951): **Geology in Engineering,** John Willey & Sons, New York.
10. Schuster, R. I. & Krizek, R. J. (1978): **Landslides analysis and control,** Trans. Res. Board Spec. pub. 176 Nat. Acad. Sci. Washington D.C.
11. Vutukuri, V. S., Lama, R. D. and Saluja, S. S. (1974): **Handbook on mechanical properties of rocks,** Transtech Publications, Clausthal, Germany

Credits: 04 **GEO EC 148 (M.M. 100= 60 end sem. + 40 sessional)**

Structural Geology

Unit 1

Primary & Secondary structures of ligneous Sedimentary & Metamorphic rocks. Genesis of Structure, **(Lecture 12)**

Unit 2

Classification of Structures- Planar, linear structures. Geometric & Genetic class of Structure. **(Lecture 12)**

Unit 3

Fold, Fault, Joint & Foliation & Lineation's. Studies on thrust tectonics. Mechanical Principles & its application in Structural Geology. Strain stress Analysis. **(Lecture 12)**

Unit 4

Tectonic Analysis of Deformed, Terrain. Nature of Superimposed Structures. Petro fabrics Analysis. Structural Analysis of data using Schmidt stereographic Net.

(Lecture 12)

Unit 5

Tectonic setting of Himalaya & Alps. Tectonic analysis of deformed rock using structural Data. Petrofabric analysis. Schmidt stereographic projection. Analysis determination of plunge of fold on the map & Schmidt. EA stereo net. Measurement of throw of fault, net slip. Strain deformation measurement. **(Lecture 12)**

Essential Reading

1. Billing, M.P. (1974): **Principle of Structural Geology**, III Edi. Prentice Hall Int. Inc.
2. Ghosh, S. K. (1985): **Structural Geology- Fundamental & Modern Development**,.
3. Ramsay, J. G. (1967): **Folding & Fracturing of Rocks**, Pergamon Press, Mc Graw Hill, New Delhi.
4. Ramsay, J. G. (1983): **Strain Analysis & Deformation**, Academic Press.
5. Saklani, P. S. (1983): **Structural & Tectonics of Himalaya**, Today & Tomorrow Pub. New Delhi
6. Hills, S. E. (1950): **Structural Geology**.

Suggested Reading:

7. Ramsay, J. G. and Huber, M. I. (1993): **The Techniques of Modern Structural Geology**, V. I & II, Academic Press.
8. Seyfert, C. K. (1987): **Encyclopedia of Structural Geology**, Vay Norstand Reinhold, New York.
9. Valdiya, K. S. (1980): **Geology Kumaun Himalaya**, WIHG, H.T. Press, Dehradon
10. Jain, A. K. (2014): **Structural Geology**, Geol. Soc. of India, Bangalore.

Credits: 04 **GEO EC 149 (M.M. 100= 60 end sem. + 40 sessional)**

Environmental Geology

Unit 1

Environmental impact assessment of Engineering projects and mining activities. **(Lecture 12)**

Unit 2

Disaster management: control, mitigation/preventive measures and protection laws. Methods of sampling/analysis of soil/water. **(Lecture 12)**

Unit 3

Environmental impact assessment of Engineering projects and mining activities around Sagar District/industries complex in the nearby areas. **(Lecture 12)**

Unit 4

Strength of different rocks using Hammers. **(Lecture 12)**

Unit 5

Determination of liquid limit of different soil from Sagar district. **(Lecture 12)**

Essential Reading

1. Valdia, K. S. (1987): **Environmental Geology**, Tata McGraw hills, New Delhi
2. Keller, A. E. (1978): **Environmental Geology** (5th Edt.) Charis and Merril Pub. Co.
3. Montgometry, C. W. (2016): **Environmental Geology**, Mc Graw Hall Global education Holding publishers

Suggested Reading:

4. Tonk, W. R. (1986): **Environmental Geology**, Oxford University Press, New York 1983

Credits: 04 **GEO CC 143 (M.M. 100= 60 end sem. + 40 sessional)**

Review of published research

Presentation of Project work along with detail synopsis on the basis of literature survey, using search engines. Seminar Topic of each candidate will be decided in the field of the optional paper chosen by the candidate in due consultation with the concerned coordinator. The candidate will have to prepare a power point presentation for viva voce examination to be conducted by the concerned coordinator of the optional paper

Research and Publication Ethics (RPE)

Credits: 02

Course Structure

- **The course comprises of six modules listed in the table below. Each module has 4-5 units.**

Modules	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
Practice		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	Total	30 **(Credits: 02)**

Syllabus in detail

THEORY

- **RPE 01 Philosophy And Ethics (4hrs.)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

- **RPE 02 Scientific Conduct (4hrs.)**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

- **RPE 03 Publication Ethics (7hrs.)**

1. Publication ethics: definition, introduction and importance
2. Best practices/ standars setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest

4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Indentification of publication ethics, misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

- **RPE 04 Open Access Publishing (4 hrs.)**

1. Open access publications and initiatives
2. Sherpa/RoMEO online resource to check publisher copyright & self archiving policies
3. Software tool to indentify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elscvier Jouranl finder, Springer journal suggester, etc.

- **RPE 05 Publication Misconduct (4hrs.)**

A. Group Discussion (2hrs)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2hrs)
Use of Plagiarism software like Turnitin and other open source software tools

- **RPE 06 Databases and Research Metrics (7hrs)**

A. Databases (4hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3hrs.)

1. Impact factor of journal as per journal Citation reports, SNIP, SJR, IPP, Cite score
2. Metrics: h-index, g index, i10 index, altmetrics

References

Bird, A (2006), Philosophy of Science, Routledge.
Macintyre, Alasdair (1967) A short history of Ethics, London.
P. Chaddah, (2018) Ethics is competitive Research: Do not get scooped: do not get Plagiarized, ISBN: 978-9387480865
National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On being a Scientist: A Guide to Responsible Conduct in Research: Third Edition, National Academy Press.
Resnik D.B. (2011) What is ethic in research & why is it important, National institute in Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
Bcall J. (2012). Predatory publishers are corrupting open access. Nature, 489 (7415), 179-179.
Indian National Science Academy (INSA). Ethics in Science Education, Research And Governance (2019).
ISBN: 978-81-939482-1-7, http://www.insaindia.res.in/pdf/Ethics_Book.pdf