

M.Sc. (APPLIED GEOLOGY)
DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCE
FACULTY OF SCIENCE
THE KSKV KACHCHH UNIVERSITY, BHUJ

Year 2019 – 2020

M.Sc. (Applied Geology)

SEMESTER WISE COURSES FOR M.SC APPLIED GEOLOGY

Semester – I

Course No.	Course Name	Credits
CCAG- 2111	Mining Geology (C)	4.0
CCAG -2112	Applied Geomorphology and Quaternary Geology (C)	4.0
CCAG -2113	Remote Sensing and GIS Technology (C)	4.0
ECAG -2114	Hydrogeology (E)	4.0
ECAG -2115	Exploration Geophysics and Geochemistry (E)	4.0
CCAG -2116	Instrumentation and Mining Geology Lab (C)	2.0
CCAG -2117	Applied Geomorphology and Quaternary Geology Lab (C)	2.0
CCAG -2118	Remote Sensing and GIS Lab Hydrogeology Lab (C)	2.0
ECAG -2119	Hydrogeology Lab (E)	2.0
ECAG -2120	Exploration Geophysics and Geochemistry Lab (E)	2.0
TOTAL CREDITS		24.0

Semester – II

Course No.	Course Name	Credits
CCAG-2222	Dissertation/Project/Training	24.0

Course No.	Course Name	Credits
CCAG- 2111	Mining Geology (C)	4.0

Unit	Lecture Content	Total Lecture Hours / Unit
Unit 1	Processes of Ore Formation	9
	Process of Formation of Ore Deposits; Classification: Magmatic Concentration, Sublimation, Contact Metasomatism, Hydrothermal Process, Sedimentation, Evaporation, Residual and Mechanical Concentration, Oxidation and Supergene Enrichment and Metamorphism; Controls and Localization of Mineral Deposits; Metallogenic Epochs and	

	Provinces	
Unit 2	Study of Important Metallic and Non-Metallic Minerals	15
	Study of the following Metallic Mineral Deposits, their Origin, Occurrence & Distribution in India and Uses. Gold, Silver, Platinum, Aluminum, Iron, Manganese, Chromium, Vanadium, Molybdenum, Tungsten, Nickel, Cobalt, Titanium, Copper, Lead, Zinc, Magnesium minerals. Study of Important Non-Metallic minerals: Origin, Occurrence, Distribution in India and Uses of Asbestos, Mica, Barytes, Talc, Ceramic Minerals, Building Stones, Cement Raw Materials, Mineral Pigments, Refractory Materials, Abrasive Minerals, Fertilizer Minerals and Gemstones	
Unit 3	Mineral Economics	3
	Significance of Minerals in National Economy Demands and Supplies, Substitutes, Market Economy - Essential, Critical and Strategic Minerals, Mineral Conservation Policy- India's Status in Mineral Production.	
Unit 4	Mineral Exploration Techniques	18
	Panning of Soils and Their Interpretation, Trenching – Pitting – Exploratory Drilling and Calculation of Grades. Sampling and Surface Mining: Methods of Investigation of Ore Bodies: Mineral Sampling Techniques. Ore reserves estimation. Introduction to Mining: Classification of Mining Methods. Cycles of Mining Operation. Surface Mining, Drilling Methods and Types of Drills. Mine Explosives and Bench Parameters, Mine Haulage. Sub Surface Mining And Mine Environment: Subsurface mining methods. Basic concepts. Shaft, adit, winze, raise, stope, mine support and ventilation. Outline of underground coal mining methods. Mine machineries, organization and structure of a mine. Role of a geologist in mining industry. Mining legislations. Preparation of mine plans, mining scheme. Environmental Impact Assessment and Management Plans, Mine Accidents, Miner's Diseases.	

Total Hours of Teaching: 45

Text Book

1.Park, K., Park's Text book of Preventive and social medicine, M/s Banaras bhanot publishers Jabalpur.2013,

Reference Book

- 1.David Werner et. al., " Where there is no doctor", Reprinted, Macmillan, 1993.
- 2.Singh, R.Y., Geography of settlement, Reprinted, Rawat publications, 2007.
- 3.Purohit, N.J., Earth Science, Geology(Environmental and the Universe), 1st Edition, 2014, Swastik Publications, New Delhi, India
- 4.Gurugnanam, B., Essential of Hydrology, 2009, New india publishing agency, New Delhi, India.
- 5.Pradeepkumar, A.P. et al., Disaster risk and Vulnerability conference, 24-26 April 2014, Proceedings of the 2nd DRVC.
- 6.Skinner C.H and Berfer R.A., Geology and Health, 2000, Oxford University Press.
- 7.Selinius (Ed), Essentials of Medical Geology, Elsevier, 2000.
- 8.Gurugnanam, B., Geographical Information System, New India Publishing, 2009.
- 9.Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd edition, BS publication, 2010.

Course No.	Course Name	Credits
CCAG -2112	Applied Geomorphology and Quaternary Geology (C)	4.0

Unit	Lecture Content	Total Lecture Hours / Unit
Unit 1	Landscape and landscape-scale processes as the unfilled niche in the global environmental change debate: an introduction Mountains, Lakes and lake catchments, Rivers, Estuaries, coastal marshes, tidal flats and coastal Dunes, Beaches, cliffs and deltas, Coral reefs, Deserts, Landscape, landscape-scale processes and global environmental change: synthesis and new agendas for the twenty-first century	9
Unit 2	Methods of geomorphological investigation, Process determination in time and space, Introduction to morphometry, General problems in morphometry, General geomorphometry, Geomorphology and geochronology, Specific geomorphometry, Drainage basin morphometry, River channel form, Hillslope profiles, Cartographic techniques in geomorphology. MATERIAL PROPERTIES Introduction, Physical properties ,Chemical properties, Strength of materials , Measuring and recording devices PROCESS Denudation and weathering, Slope processes, Solutes, River channels, Glacial processes, Aeolian processes, Coastal processes EVOLUTION Radiocarbon dating: principles, application and sample Collection, Uranium-series disequilibrium dating methods, Applications of stable isotopes in waters, sedimentary deposits, and fossil plants and animals, Additional dating methods:Tree-ring dating (dendrochronology),Lichenometry, Peats and lake sediments: formation, stratigraphy, description and nomenclature, Raised shorelines Palaeosols Introduction to Tectonic Geomorphology Geomorphic Markers Establishing Timing in the Landscape:-Dating Methods Stress, Faults, and Folds Short..Term Deformation: Geodesy Paleoseismology Rates of Erosion and Uplift Holocene Deformation and Landscape Responses Deformation and Geomorphology at Intermediate Time Scales Tectonic Geomorphology at Late Cenozoic Time Scales Numerical Modeling of Landscape Evolution	15
Unit 3	Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy	10

	and magnetostratigraphy. Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies). Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary.	
Unit 4	History of Quaternary Geology, Ice age Earth, Study of Landforms during Quaternary, Advances in Quaternary Studies and Dating Techniques	11

Total Hours of Teaching: 45

Reference Books:

Geomorphology and Global Environmental Change by Olav Slaymaker, Thomas Spencer, Christine Embleton-Hamann

James P. McCalpin (2009), Paleoseismology, Academic Press

Schumm, S. A. (1977), The Fluvial System Wiley New York

Bull W. D. (1991) Geomorphic Responses to Climatic Change, Oxford Uni. Press New York

Keller E. A. (1986) Active Tectonics National Academic Press, New York

Bull and Mc Fadden, Tectonic Geomorphology

Williams, M.A.J. et al., Quaternary Environments, Edward Arnolds (1993).

Lowe, J.J. & Walker, M.J.C. Reconstructing Quaternary Environments, Longman (1984).

Course No.	Course Name	Credits
CCAG -2113	Remote Sensing and GIS Technology (C)	4.0

Unit	Lecture Content	Total Lecture Hours / Unit
Unit 1	<p>Remote Sensing – An Introduction, History and Development of Remote Sensing, Fundamental Principle of Remote Sensing, Stages in Remote Sensing Process, Types of Remote Sensing , Advantages of Remote sensing, Aerial Photograph, Basics, Stereo models, Photo Mosaics and Photo scale</p> <p>The Electromagnetic, Wave Model Spectrum, Particle Theory, Electromagnetic Spectrum, Radiation Law and Related Terms, Blackbody Radiation</p> <p>Electro Magnetic Radiation (EMR): EMR Spectrum – EMR Interaction with Atmosphere: Absorption, Scattering & Atmospheric windows, EMR Interaction with Earth surface.</p>	9
Unit 2	<p>Satellite and Sensors, Platforms Satellite Orbits : Geostationary, Sun synchronous Satellites, Resolution: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Multispectral Resolution, Scanning Mechanisms: Across Track Scanning, Along Track Scanning</p> <p>Satellites In Orbits: Landsat Series, SPOT Series, Indian Remote Sensing Satellites, Quickbird Satellite, World View, Geo Eye, Aster, Modis, NOAA</p> <p>Photo Interpretation Keys & Elements: Definition, its parts, Key sets, Types of Study,</p> <p>Photo Interpretation Elements - Tone, Texture, Shadow, Size, Shape, Pattern, Association.</p> <p>Geotechnical / Geomorphic Elements - Landforms, Drainage, Erosional Pattern, Vegetative Cover, Land use, Shape & size of objects.</p> <p>Thermal Remote Sensing: Basic concepts and Data Interpretation, Microwave Remote Sensing: Basic concepts and Data Interpretation, Hyper spectral Remote Sensing: Basic concepts.</p>	15
Unit 3	<p>GPS Basic Introduction – Satellite, Control and User Segments – Signal Components, Errors in GPS observations, GPS positioning, Differential GPS, GPS Mapping : Static Kinematic GPS □ Semi kinematic (Stop & Go), Rapid static Mobile mapping</p>	10

Unit 4	<p>Principles of Image Processing: Digital Image formats - Image Processing systems - Raster & Vector files, Image Rectification & Restoration: Geometric Errors: Sources, of Errors, Correction Processes, Radiometric errors: Sources of errors, correction processes.</p> <p>Image Enhancement: Single Band Enhancement: Image Reduction & Magnification, Contrast Stretching, Filtering & Edge Enhancement</p> <p>Multiband Enhancement: Band Rationing, Colour Composites Generation, Principal Component Analysis, NDVI.</p> <p>Image Classification: Pattern Recognition, Supervised classification, Unsupervised classification, Sub pixel classification, Classification accuracy assessment, Multi-Mode Image Analysis: Image Registration, Multisensor & Multimode data fusion 2</p> <p>Different image processing packages. ERDAS, ENVI</p> <p>Computer Applications in Geology Introduction to Geological softwares</p> <p>GIS Overview: Introduction to GIS and GIS Infrastructure.</p> <p>GIS hardware components and GIS roles. Geographic data and database □Data and information definitions □Geographic data: spatial data, types of GIS database and descrcerte and continuos data □GIS data characteristics</p> <p>Spatial Data Relationships, Proximity Relationships □Time and GIS data</p> <p>Raster and vector data: Raster and Vector data and Models</p> <p>□Raster data: Raster Coding, Resolution, Gridding and Linear features □Raster Precision and Accuracy □Vector Data</p> <p>□Raster and Vector Structures □Raster and Vector Advantages and Disadvantages□Topology, Appling Topology □Topology Tables</p> <p>□Multiple Connectivity □Topology and Relational Queries</p> <p>□Topology contribution</p>	11

Total Hours of Teaching: 45

Text Book

1. Anji Reddy, M, Textbook of Remote Sensing & GIS, BS Publications, Hyderabad, 2012.
2. Curran, P. Principles of Remote Sensing, Longman, London. 1985.
3. Sabins, F. F. Jr., Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco. 2007.
4. Principles of Remote Sensing, Longman, London. 1985.
5. Nilblack, W. An Introduction To Digital Image Processing, III Edition, Prentice Hall International. 1986.

Reference Books:

1. John, T. and Smith Jr., Manual of Colour Aerial Photography (I Edition) American Society of Photogrammetry, ASP Falls Church, Virginia, 1973.
2. Lillesand, T.M. And Kiefer, P.W., Remote Sensing and Image Interpretation, John Wiley & Sons, New York. Third Edition, 2007.
3. Rampal, Handbook of Aerial Photography and Interpretation, Concept publishing. 1999. 4. Shiv N. Pandey, Principles and Applications of Photo geology, Wiley Eastern Limited, India. 1987.
4. Jenson, Introduction to digital image processing, Prentice Hall: 3 Edition, 2004. 3. Lillesand, T.M. and Kiefer, P.W, Remote Sensing and Image Interpretation, John Wiley & Sons, New York. 2003.
5. Paul J. Gibson and Clara H. Power, Introductory Remote Sensing, Digital Image Processing and Applications, Routledge, 2000. 5. Pratt, S.K. Digital Image Processing, Wiley - Inter Science, New York. 1990.

Course No.	Course Name	Credits
CCAG -2114	Hydrogeology (E)	4.0

Unit	Lecture Content	Total Lecture Hours / Unit
1	Hydrological Properties of Rocks: Porosity, Permeability, Specific Yield and Retention, Base Flow, Transmissivity and Storage Coefficient. □ Ground Water Flow Equations: Steady and Transient Flow. Darcy's Law: Hydraulic Conductivity, Steady, Unsteady and Radial Flow. Aquifers: Types and Hydrostratigraphic Units. Pumping Tests: Definition, Methodology, Data Collection, and Interpretation by Theis, Cooper-Jacob's, and Chow's method. Drilling Methods for Groundwater Bore Wells.	12
2	Outline of Water Quality Standards and Guidelines: WHO, BIS and ICAR. Physical Parameters of Groundwater Quality. Analysis of Major and Minor Elements in groundwater using APHA standards. Water Quality Parameters for Drinking, Agriculture, and Industrial Uses. Graphical Representation and Interpretation of Water Quality Data: Wilcox, USSSL, Gibbs plot, Piper, Donean and Durov diagrams. Coastal Aquifers: Ghyben-Herzberg relation and Saline Water Intrusion.	11
3	Groundwater Basins: Drainage and Basin Morphometry. Methods of determining groundwater flow and preparation of water table contour maps. Problems due to over exploitation of groundwater. Groundwater recharge: natural and artificial methods. Rainwater harvesting: definition, methods, and design of harvesting structures. Outline of methods of groundwater exploration.	11
4	Groundwater provinces of India and Gujarat: Kachchh.	11

Total Hours of Teaching: 45

Text Book

1. David Keith Todd, Larry W. Mays, Groundwater Hydrology, Wiley, 2013
2. Fetter, C.W., Applied Hydrology, CBS Publications, 2007.
3. Gurugnanam, B., Essentials of Hydrogeology, 2005.
4. Herman Bouwer, Groundwater Hydrology, McGraw Hill Education Private Limited 2014.
5. Raghunath, H. M., Groundwater, New Age International Publications, 2003.

Reference Books:

1. Bmoanok, M.C.J. Smith G.S and Verstappen, H.T. (eds), Remote Sensing for resources development and environmental management, A.A. Balkema Publishers, Rotterdam, Netherlands. 1986.
2. Paine, D.P., Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 1981.
3. Ramakrishnan. S. Groundwater, CBS Publishers & Distributors, 1998.

Course No.	Course Name	Credits
CCAG -2115	Exploration Geophysics and Geochemistry (E)	4.0

Unit	Lecture Content	Total Lecture Hours / Unit
1	Properties of the earth: Gravitational, Electrical, Magnetic, Thermal and Chemical. Definition, Principles, Instruments, Field's procedures of Gravity Methods. Anomalies applications and limitations of Gravity Methods. Definition, Principles, Instruments, Field's procedures of radioactive methods, Anomalies Applications and Limitations of Radioactive Methods. Radioactive Elemental Surveys.	12
2	Definition, Principles, Instruments, Field's procedures of Magnetic Methods. Anomalies applications and limitations of Magnetic Methods: limitations of Magnetic Methods. Definition, Principles, Instruments, Field's procedures of Electromagnetic Methods, Anomalies applications and limitations of Electromagnetic Methods: Brief outline of Telluric and Magneto Telluric Fields. Definition, Principles, Instruments, Field's procedures of Electrical Methods Anomalies applications and limitations of Electrical Methods: Electrode Configurations Wenner – Schlumberger – Gradient – Pole – Dipole and Dipole. Dipole Methods. Interpretation of Resistivity Data. Self Potential and Induced Polarization Methods.	11
3	Definition, Principles, Instruments, Field's procedures of Seismic methods Anomalies applications and limitations of Seismic methods. Refraction Methods and Reflection Methods. Geological exploration: prospecting criteria of various mineral deposits. Ore guides, regional and local parameters for exploration. Regional and detailed exploration. Drilling methods: selection sites, angle and direction of bore holes, logging, bore hole deviation.	11
4	Exploration Geochemistry: Outline and Classification of Elements. Geochemical Anomaly and Province, Geochemical cycle. Primary and Secondary Dispersion of elements: Controls of dispersion. Mobility of elements. Application of Utility of path finder elements and minerals Geochemical surveys: Definition – Types. Sampling Methodology – Application to mineral deposits. Outline of analytical methods used in Exploration Geochemistry. Short account on geo-botanical prospecting.	11

Total Hours of Teaching: 45

Text Books:

1. Lowrie, W., Fundamentals of Geophysics. 2nd ed. Cambridge University Press, New Delhi, 2007.
2. Ramachandra Rao, M.B., Outlines of Geophysical Prospecting. EBD, Dhanbad, 1993.
3. Telford, W.M., Geldart, L.P. & Sheriff, R.E., Applied Geophysics. 2nd ed. Cambridge University Press, New Delhi, 1990.

Reference Books

1. Arogyaswamy R.N.P. Courses in Mining Geology. Oxford & IBH, New Delhi, 1980.
2. Banerjee, P. K. & Ghosh, S. Elements of Prospecting for Non Fuel Mineral Deposits. Allied Publishers, Chennai, 1997.
3. Dobrin, M. B. & Savit, C.H., Introduction to Geophysical Prospecting. 4th ed. McGraw Hill. New Delhi, 1988.
4. Hartman, H. L., SME Mining Engineering Handbook. SMME Inc. Colorado 1992.
5. Hawkes, H. E., Principles of Geochemical Prospecting. Bulletin 1000F. USGS, 1959.
6. Kearey, P., Brooks, M & Hill .I. An Introduction to Geophysical Exploration, 3rd ed. Blackwell Science., 2002.
7. Moon, C. J., Whateley, M. K. G. & Evans, A. M., Introduction to Mineral Exploration. Wiley Blackwell, New Delhi, 2006
8. Mussett, A.E. & Khan, M.A., Looking into the Earth: An introduction to Geological Geophysics. Cambridge University Press, New Delhi, 2000.
9. Parasnis, D.S, Principles of Applied Geophysics. Chapman & Hall. New York., 1975.
10. Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, New Delhi. 1997.

CCAG -2116	Instrumentation and Mining Geology Lab (C)	2.0
CCAG -2117	Applied Geomorphology and Quaternary Geology Lab (C)	2.0
CCAG -2118	Remote Sensing and GIS Lab Hydrogeology Lab (C)	2.0
CCAG -2119	Hydrogeology Lab (E)	2.0
CCAG -2120	Exploration Geophysics and Geochemistry Lab (E)	2.0

Each Lab will have 25 teaching Hours

Course No.	Course Name	Credits
CCAG-2222	Dissertation/Project/Training	24.0

(24 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)

(Dissertation can be opted from CCAG- 2111, CCAG -2112, CCAG -2113, CCAG -2114, CCAG -2115)

APPLIED MASTERS' THESIS

(Dissertation/ Project work/ Industrial Training Report Environmental Issue/Survey Project Report)

The purpose of this exercise is to become familiar with research methods, computer application, literacy and the presentation skills. Moreover, to think about how to approach, communicate and assess geology and geological problems from various viewpoints. All viewpoints must be addressed in your outline and project. The student has the freedom to select any research problem related to geology; they can also work for their masters' thesis in the department or research institutes or industry with prior communication and approval from both the side.

1. Select any geological problem/ Research Problem in consultation with the faculty for proper guidance.
2. Learn what resources are available and how to access them
3. Collect references, secondary information on the topic and prepare bibliography
4. Set the methodology, approve it from faculty/supervisor and proceed for field and experimental work.
5. Collect findings Record Results (statistics/data tables)
6. Interpret and explain results (using charts)
7. Conclusion and preparation of detailed report/thesis
8. Use outline and related research for presentation of your work

The outline must include the following:

- For guidelines and format/ consult faculty.
- Literature Review section should include citations and/or references from previous studies of the topic
- References must be taken from a book, journal, newspaper and Internet.
- Make certain that your cited sources are in APA Citation Style.

A 15-minute formal oral presentation during the final examination.