

CENTRAL UNIVERSITY OF KARNATAKA
Gulbarga, Karnataka

M.Sc. Applied Geology and Geoinformatics

(Choice based credit system)
Syllabus – Revised, June 2016

Department of Geology
School of Earth Sciences
Central University of Karnataka

M.Sc Applied Geology and Geoinformatics Curriculum, 2016, School of Earth Sciences, Central University of Karnataka.

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**Department of Geology
School of Earth Sciences**

**M.Sc. Applied Geology and Geoinformatics
Syllabus - 2016****I: PREAMBLE****A: Context**

Geology is the study of the Earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. It includes the study of organisms that have inhabited our planet. An important part of geology is the study of how Earth's materials, structures, processes and organisms have changed over time. Geology can also refer generally to the study of the solid features of any celestial body (such as the geology of the Moon or Mars).

In this context the Central University of Karnataka introduce integrated BSc-MSc course in Geology to reduce the disparity between the need and availability of competent professionals to cater the requirements of our nation. This programme is basically an academic programme which focuses on preparing the students for research, as well as, for application of Geological knowledge in various field settings.

B: Objectives

The Central University aims to create qualified professionals to meet the increasing social needs of the hour. Hence, this curriculum is instituted with the following objectives:

- To shape skilled and qualified geologists to serve the industrial, management, educational and developmental sectors of the society and the country.
- To contribute to the existing knowledge bank in geological sciences with an integrated and interdisciplinary approach.
- To bring subjects like environmental geology, disaster management, water security, resource management, application of remote sensing and GIS in the field of Geology etc., as academic subjects into the mainstream.
- To develop in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.

C: Course orientation

A two-year master's degree course in Geology is offered under the School of Earth Sciences following the 'choice-based credit system' with an integrated-interdisciplinary approach. The curriculum comprises inputs drawn from all basic geology streams and its application based study with the implication of Remote sensing techniques and GIS. The curriculum also focuses on the application of geo-informatics as a solution to major geological problems.

D: Unique features

The unique feature of this curriculum is that each core paper is integrated with theoretical knowledge and practical approach. The learning is mediated through class room facilitations, virtual classroom learning modalities, laboratory experiments, internship, supervised dissertations, field works, field tour, etc. Knowledge acquisition procedures are monitored through lecture, participatory and cooperative learning. The learning processes are facilitated by experienced faculty and experts drawn from various academic institutions of repute.

F: Career development

In addition to the prescribed curriculum, students will be given ample opportunities to enhance their personal and professional competencies holistically through active participation in seminars, workshops, conferences, and contributions through the journal, book, and media clubs periodically. Facilities will be provided to students to undergo personal counselling, career guidance and employment opportunity.

II: REGULATIONS

- 1. Name of the Course:** M.Sc. Geology (Department of Geology; under School of Earth Sciences)
- 2. Duration of the Course:** Two years (Four semesters)
- 3. Eligibility and Attendance:** As per University rules.
- 4. Intake:** 30 (Thirty only)
- 5.: Medium of Instruction and examination:** English
- 6. Miscellaneous:** All other matters not referred to specifically in these regulations shall be governed as per the Ordinances of the University as revised from time to time.
- 7. Course structure and credit allocation:** Each credit denotes 1hour for theory and two-hours for practicum. Total credits of the programme: 86 (24+22+20+20).
- 8. Specialization:** Application of Earth science in various related fields with the support of Geo-informatics.

III: SCHEME OF STUDY AND EXAMINATIONS

(L=Lecture, T= Tutorial, P= Practical) Interested students can opt additional single credit papers not exceeding four credits in every semester.

Semester 1							
	Papers	Code	Subject Title	Credits	L	T	P
1	Core Course Paper 1	CC1	Mineralogy and Geochemistry	4	4	0	0
2	Core Course Paper 2	CC2	Stratigraphy and Paleontology	4	4	0	0
3	Core Course Paper 3	CC3	Geomorphology, Structural Geology and Tectonics	4	4	0	0
4	Core Course Practical Paper1	CCP1	Practical: Mineralogy & Palaeontology	2	0	0	2
5	Core Course Practical Paper2	CCP2	Practical: Structural Geology & Geomorphology	2	0	0	2
6	Skill Enhancement Course 1 (Foundation Course-Manmaking)	SEC 1	Field work	2	0	0	2
7	Ability Enhancement Compulsory Course 1 (Foundation-Compulsory)	AECC 1	Fundamentals of Geoinformatics	3	2	1	0
8	Generic Elective Paper 1	GE1	Earth Resources / Fossils and Their Applications	3	2	1	0
Total				24			
Semester 2							
9	Core Course Paper 4	CC4	Igneous, Sedimentary and Metamorphic Petrology	4	4	0	0
10	Core Course Paper 5	CC5	Ocean, Atmosphere and Climate Science	3	2	1	0
11	Core Course Paper 6	CC6	Hydrogeology and Environmental Geology	3	3	0	0
12	Core Course Practical Paper3	CCP3	Practical: Petrology	2	0	0	2
13	Core Course Practical Paper4	CCP4	Practical: Hydrogeology, Environmental Geology , and DIP	2	0	0	2
14	Ability Enhancement Compulsory Course 2 (Foundation-Compulsory)	AECC2	Digital Image Processing (DIP)	3	3	0	0
15	Skill Enhancement Course 2 (Foundation Course-Man making)	SEC 2	Social Orientation Course	2	1	1	0
16	Generic Elective Paper 2	GE2	Hazards, Disaster Mitigation and Management/ Introduction to Earth Surface Processes	3	2	1	0
Total				22			

Semester 3							
17	Core Course Paper 7	CC7	Ore Geology and Mining Geology	4	4	0	0
18	Core Course Paper 8	CC8	Exploration Geology	3	3	0	0
19	Core Course Paper 9	CC9	GIS data analysis and Modelling	3	3	0	0
20	Core Course Practical Paper 5	CCP5	Practical: Exploration, Engineering Geology, and Ore Petrology	2	0	0	2
21	Core Course Practical Paper 6	CCP6	Practical: GIS, Cartography and Surveying	2	0	0	2
22	Discipline Specific Elective :1	DSE1	Advance Remote sensing in Geosciences	3	2	1	0
23	Ability Enhancement Compulsory Course 3 (Foundation-Compulsory)	AECC 3	Engineering Geology, Geodesy and Surveying	3	2	1	0
Total				20			
Semester 4							
24	Core Course Paper 10	CC10	Internship	8	0	0	8
25	Discipline Specific Elective 2	DSE2	Major Project and Dissertation	12	0	0	12
Total				20			
Grand Total				86			

IV: SYLLABUS

SEMESTER I

CC1 : Mineralogy and Geochemistry:

Unit 1: Crystallography: Periodicity and symmetry-concept of space lattice. Defects in minerals- point defects, line defects, and planar defects. Systematic mineralogy (atomic structure, mineral chemistry, and their P-T stability and mode of occurrence) of silicates, native elements, sulphides, sulfosalts, oxides, hydroxides and carbonates. Mineral assemblages. Semi precious stones. Graphical representation of mineral composition. Identification of mineral groups based on structure, mineral chemistry, stability, paragenesis and occurrence. Mineral chemical analysis – Bulk methods and beam methods; wet chemical analysis,

Unit 2: Introduction to analytical techniques: X-ray diffraction (powder diffraction) method, EPMA, Inductively Coupled Plasma, Mossbauer Spectroscopy, Gas source Mass spectrometry, Scanning electron Microscopy, Back scattered electron detectors. IR spectroscopic method etc.

Unit 3: Geochemical classification of elements. Radiogenic isotopes: Radioactive decay schemes of U-Pb, Sm-Nd, Rb-Sr, K-Ar, and growth of daughter isotopes. Radiometric dating of single minerals and whole rocks. Stable Isotopes: Nature, abundance and fractionation. Fluid interactions and biological processes.

Unit 4: Laws of thermodynamics, concept of free energy, activity, fugacity, and equilibrium constant, thermodynamics of ideal, non-ideal and dilute solutions. Principles of ionic substitution in minerals. Element partitioning in mineral/rock formation and concept of simple distribution coefficients and exchange reaction distribution coefficients. Element partitioning in mineral assemblage and its use in the pressure temperature estimation.

Books Recommended

1. Buerger M. Elementary Crystallography. The MIT Press (May 15, 1978)
2. L. V. Azaroff. Elements of X-ray Crystallography. McGraw-Hill Companies, The (March 1, 1968)
3. Winchell. Elements of Optical Mineralogy part I and II. John Wiley and Sons (1956)
4. Wahlstrom. Optical Crystallography. John Wiley & Sons Inc; 5 edition (July 1979)
5. J.A.K. Tareen and T.R.N. Kutty A Basic Course in Crystallography. Orient Blackswan Private Limited. 2001
6. L. V. Azaroff. Introduction to Solids. McGraw Hill Higher Education; New edition edition (1 Mar 1984)
7. W. H. Blackburn and W. H. Dennen. Principles of mineralogy. Dubuque, IA: Wm. C. Brown Publishers. 1993)
8. Bloss F. D. Crystallography and Crystal Chemistry. Mineralogical Society of Amer (June 1994)
9. Dana : Elements of Mineralogy. John Wiley & Sons, Inc. London: Chapman & Hall, Limited 1922)
10. Kerr : Optical Mineralogy. McGraw-Hill College; 4th edition (March 1, 1977)
11. Deer, Howie Zussman : Rock forming minerals, Vol. I – IV. Geological Society of London; 2nd edition (January 30, 2006)
12. Deer, Howie Zussman : An introduction to Rock forming minerals, Vol. I – IV. Longman, London; 1969)
13. Cracknell : Crystals and their structure. Pergamon Press (July 1969)
14. Frye Keith : Modern Mineralogy. Prentice Hall; First Edition edition (May 1974)
15. William D Nesse. Introduction to Optical Mineralogy. Oxford University Press, USA; 3 edition (August 21, 2003)
16. Rutley - Mineralogy. Springer; 27th edition (November 30, 1988)
17. L. V. Azaroff. Introduction to Solids. McGraw Hill Higher Education; New edition edition (1 Mar 1984)
18. Deer, Howie Zussman : Rock forming minerals, Vol. I – IV. Geological Society of London; 2nd edition (January 30, 2006)
19. Deer, Howie Zussman : An introduction to Rock forming minerals, Vol. I – IV. Longman, London; 1969)
20. Mason B, Moore. Principles of geochemistry. John Wiley & Sons; 4th Edition edition (13 Oct 1982)
21. Gunter Faure Principles and Applications of Geochemistry. Prentice Hall; 2 edition (December 24, 1997)
22. K.C. Misra, Introduction to Geochemistry: Principles and Applications, Wiley-Blackwell, 2012
23. Francis Albarède Geochemistry: An Introduction, Cambridge, 2009

CC2: Stratigraphy and Paleontology:

Unit 1 : Stratigraphy: Historical developments. Controls on the development of the stratigraphic records. Lithostratigraphy, Bio-stratigraphy, Chronostratigraphy, Magnetostratigraphy, Cyclo-stratigraphy, Event stratigraphy, Pedostratigraphy, Seismic stratigraphy, Sequence stratigraphy and Isotope stratigraphy. Correlation.

Unit 2: Indian Stratigraphy: Archaeans with reference to Karnataka. Classification, lithology and correlation of Kaladgi, Badami, Bhimas, Cuddaphas and Vindhyans. Paleozoic and Mesozoic stratigraphy, Gondwanas and Deccan traps.

Unit 3: Palaeoecology – principles and methods; application of fossils in the study of palaeoecology, palaeobiogeography and palaeoclimate. Ichnology-classification of trace fossils and their utility in palaeoenvironmental reconstructions.

Unit 4: Vertebrate Palaeontology: Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs Evolution of horse and intercontinental migrations. Human evolution; vertebrate fossil record from India (Gondwana formations, Deccan volcanic Province, Palaeogene and Neogene sequences of India). Palaeobotany: Early plant life, colonization of land, important stages in plant evolution; Gondwana flora and role of climate in its evolution. Introduction to palynology. Introduction to micropalaeontology.

Books Recommended

1. Text book of Geology – P.K Mukherjee, World Press.
2. Geology of India, D. N. Wadia (1978), Tata Mc. Graw Hill.
3. Geology of India and Burma (6 edition) – M.S Krishnan. 2006, CBS Publishers & Distributors
4. Fundamentals of historical geology and stratigraphy of India- Ravindra Kumar. 1985. Wiley Eastern,
5. Principles of paleontology (3rd edition)-Michael Foote & Arnold I. Miller. 2006. W.H. Freeman
6. Principles of paleontology (2nd edition) – Roop and Stanley. 1978. W. H. Freeman
7. Micropaleontology – Bilal Ulla haq. 1998. Elsevier
8. Geology of India- Ramakrishana.M. & Vidyanadan, R. 2010. Geological Society of India
9. Raup, D.M. and Stanley, S. M. 1971. Principles of Palaeontology, W.H. Freeman and Company. .
10. Benton, M. 1997. Basic Palaeontology: An introductory text D.Harker Addison Wesley Longman. "
11. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Palaeobiology, McGraw Hill.
12. Benton, M.J. 2005. Vertebrate palaeontology (3rd edition). Blackwell Scientific, Oxford.
13. Willis, K.J. & McElwain, J.C. 2002. The evolution of plants Oxford University Press. '
14. Brechley, P. J., and Harper, D. A. T. 1998. Palaeoecology: Ecosystems, Environments and Evolution. By Chapman and Hall:
15. Sequence Stratigraphy: D. Emery, and K. Meyers (1996) Blackwell Publishers .
16. Principles of Sequence Stratigraphy Octavian Cateneau (2006) Elsevier
17. The geology of stratigraphic sequences: A.D. Miall (1997) Springer

CC3: Geomorphology, Structural Geology and Tectonics:

Unit1: Geomorphology: Geomorphic principles. Weathering and soils, Mass wasting. Influence of climate on processes. Concept of erosion cycles. Geomorphology of fluvial tracts, arid zones, coastal regions, 'Karst' landscapes and glaciated ranges. Geomorphic mapping, slope analysis and drainage basin analysis. Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. Topographical maps. Geomorphology of India.

Unit 2: Structural Geology: Stress and strain. Behaviour of rocks under stress. Mohr circle. Stereographic projections. Determination of strain in deformed rocks. Linear and planar elements in rocks - Geometry and mechanics of development of boudins, foliations and lineations. Superposed deformation. Relationship between crystallisation and deformation. Fold and folding – mechanism, geometry, stress in folds. Joints. Faults – genetic, geometric study and relation to stress. Unconformities and basement-cover relations. Gravity induced structures. Petrofabric Analysis: Concept, Types and Techniques. Geometrical analysis of simple and complex structures on macroscopic scale.

Unit 3: Tectonics: Recent advances, Dynamic evolution of continental and oceanic crust. Mid-ocean ridges, deep sea trenches, continental shield areas and mountain chains. Palaeomagnetism. Seafloor spreading and Plate Tectonics. Island arcs, Oceanic islands and volcanic arcs. Isostasy, orogeny and epeirogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

Books Recommended

1. Physical Geology. Carla. W Montgomery, Wm C. Brown Publishers, 1990
2. A Text Book of *Geomorphology*. Dayal, P, Rajesh Publication, New Delhi 2007
3. Principles of Geomorphology, W.D Thornburry Wiley, 1969
4. Geomorphology. Charley, R.J., Suhumm, S.A & Sugden, D.E, Routledge, 1985
5. Earth: An Introduction to Physical Geology (10th Edition), Tarbuck, E.J., Lutgens, F.K & Dennis Tasa. Prentice Hall, 2010
6. Billings, M.P. Structural Geology. Prentice-Hall; 3rd Rev. e. edition (April 1972)
7. Lahee. Field Geology. RareBooksClub.com (May 19, 2012)
8. Ramsay, J.G. Folding and fracturing of rocks. The Blackburn Press (February 2004)
9. Whitten, E.H.T. Structural Geology of folded rocks. Chicago, Rand McNally. 1966
10. Badgley, P.C. Structural methods for the exploration geologist. Harper; First Edition edition (1959)
11. Martin Bott, H.P. The interior of the Earth. Edward Arnold (1971)
12. Manual of Field Geology- Robert R Compton. John Wiley & Sons, Inc. (1962)

CCP1: Practical: Mineralogy & Paleontology:

Unit 1: Mineralogy: Crystallography (Study of 32 point groups, Representation of symmetry on stereograms, Stereographic projection, Axial ratios). Descriptive Mineralogy (Study of minerals belonging to major groups and their identification with the aid of megascopic characters).

Optical mineralogy (Relative refractive index by Becke method, Determination of vibration direction, pleochroism and optic sign for rock forming minerals. Identification of common rock forming minerals under microscope).

Unit 2: Paleontology: Study of invertebrate, vertebrate and plant fossils. Study of microfossils. Chronostratigraphy.

CCP2: Practical: Structural Geology & Geomorphology:

Unit 1: Structural Geology: Preparation and interpretation of geological maps and sections. Dip and strike & thickness problems. Interpreting underground structure from borehole data. Structural problems concerning economic mineral deposits. Recording and plotting of field data. Plotting and interpretation of petrofabric data and resultant diagrams. Study of large tectonic features of the Earth.

Unit 2: Geomorphology: Toposheet reading, Preparation of drainage map, Preparation Contour map, Morphometry, Preparation of drainage, Preparation of drainage density map, Preparation of drainage frequency map, Preparation of Relative Relief map. Drainage pattern analysis.

AECC1: Fundamentals of Geoinformatics:

Unit 1: Basic principles of Remote Sensing: Definition and components, Electro Magnetic Radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Black body radiation; Reflectance; spectral reflectance of land covers.

Unit 2: Sensors and platforms:Types of sensors: Multispectral, Hyper-spectral, Microwave, scanners-along track and across track; Platform and their types-Geostationary and Polar orbiting, platforms based on altitudes. Satellite missions –MODIS, IRS, LANDSAT, SPOT, marine/ocean observation satellites.

Unit 3:Introduction to RADAR, LIDAR, SAR and Hyperspectral remote sensing.Integration of GIS with remote sensing.

Unit 4: Aerial Photography:Interpretation keys; Instruments used in the analysis. Photogrammetry - Measurements.Applications of aerial photography in geological studies.

Books Recommended

1. D.R.Lueder. Aerial photographic interpretation, Principles and applications. McGraw-Hill New York. (1959)
2. Photogeology - Miller, J.C.
3. Manual of colour aerial photography -Ed. Smith, J.T.Jr. American society of photogrammetry. 1968
4. Manual of photogrammetry - Ed: MorrieM.Thompson.
5. Manual of Remote sensing - Ed: Robert G Reeves.
6. Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern.
7. Remote sensing in Geology - Parry S. Siegal& Alan. R.Gillespie
8. Manual of photographic interpretation - Ed: Colwell, R.N.
9. Thomas M Lillesand, R W Kieffer, J W Chipmas. Remote sensing and image interpretation. John Wiley & Sons, 2009

GE1 : Generic Elective

(Courses offered to students from other departments)

GE1 : Earth Resources

OR

GE1: Fossils and Their Applications

GE1 : Earth Resources

Unit 1: Earth Resources: Resource reserve definitions; mineral, energy and water resources. A brief overview of classification of mineral deposits with respect to processes of formation.Methods of mineral conservation.

Unit 2: Primary and Secondary Energy. Difference between Energy, Power and Electricity.Renewable and Non-Renewable Sources of Energy.Major Types and Sources of Energy.Resources of Natural Oil and Gas, Coal and Nuclear Minerals.Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based power and Energy.

Unit 3: Water resources and its role in the development. Hydrological cycle and processes.

Books Recommended

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill
2. Global Energy Perspectives by NebojsaNakicenovic 1998, Cambridge University Press.
3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer

4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.
5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer

OR

GE1: Fossils and Their Applications

Unit 1: Introduction to fossils. Definition of fossil, fossilization processes (taphonomy), taphonomic attributes and its implications, modes of fossil preservation, role of fossils in development of geological time scale and fossils sampling techniques.

Unit 2: Introduction to various fossils groups. Brief introduction of important fossils groups: invertebrate, vertebrate, microfossils, spore, pollens and plant fossils.

Unit 3: Application of fossils: Principles and methods of paleoecology, application of fossils in the study of paleoecology, paleobiogeography and paleoclimate. Societal importance of fossils in hydrocarbon exploration. Application of spore and pollens in correlation of coal seams. Fossils associated with mineral deposits, fossils as an indicator of pollution.

Books Recommended

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods. VanNostrand Reinhold.
2. Clarkson, E.N.K. 1998. Invertebrate Paleontology and Evolution George Allen & Unwin
3. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.
4. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.
5. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time,
6. Edwin H. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

SEC1: Field work

Compulsory field work on places of Geological importance.

Semester II

CC4: Igneous, Sedimentary and Metamorphic Petrology

Unit 1: Petrogenesis: Definition, Magma and its Origin, formation igneous rocks. Bowen's reaction principle. Forms, Textures and structures of igneous rocks. Classification of igneous rocks.

Unit 2: Igneous Petrology: Composition, origin and mode of occurrence of granite – Granodiorite - Diorite, syenite – Nephelinesyenite; Gabbro – Peridotite – Dunite; Anorthosites, Lamprophyres, Kimberlite, Carbonatites; Dolerites, Pegmatites; Rhyolites – Trachytes; Andesites & Dacites, Basalts.

Unit 3: Sedimentary petrology: Sedimentary processes and their products. Classification of sediments. Diagenesis & Lithification. Sedimentary structures. Classification of sedimentary rocks. Mineral composition, structure and textures of Clastic and non Clastic sediments and Residual deposits. Origin, occurrence and characteristics of common sedimentary rocks - quartz arenites, arkoses and greywacks. Siliceous and calcareous deposits. Sedimentary environments and facies. Palaeocurrents and basin analyses.

Unit 4: 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 Recommended

1. Igneous and Metamorphic Petrology – Turner and Verhoogan. 1960. McGraw-Hill
2. Text book of Petrology – G W Tyrrell. 1978, Taylor and Francis
3. Igneous and Metamorphic Petrology – Myren G Best. 2003. Black well Science
4. Petrology (Igneous, Sedimentary and Metamorphic). Harvey Blat, Robert Trachy, Barent Owens. 2005. Freeman
5. Igneous Petrology (3rd edn) McBirney. 2007. Jones & Bartlett
6. Principles of Igneous and Metamorphic Petrology- Anthony R Phillips & Jay J. Ague. 2009. Cambridge University Press
7. Igneous Petrology – M K Bose. 1997. World Press.
8. Petrology of Igneous rocks – Alokh K Gupta. 1998. Allied Pub. Ltd
9. Metamorphism and Metamorphic rocks – Miyashiro. 1973. Wiley
10. Metamorphic Petrology – B Bhaskarrao. 1986. Taylor & Francis
11. Sedimentary rocks – Pettijohn. 1975. Harper & Row
12. Sedimentary Petrology: An introduction to the origin. Tucker, M.E. 2011. John Wiley
13. Igneous and Metamorphic Petrology (2nd Edn) – W D Winther. 2009. Prentice Hall
14. Petrology (Igneous, Sedimentary and Metamorphic) – Loren A Raymond. 2002. McGraw-Hill
15. Principles of Metamorphic Petrology- Vernon, R.H and Clarke, G.L. 2008. Cambridge university press
16. An introduction to metamorphic petrology. B.W.D. Yardley. 1989 Longman Scientific & Technical

CC5: Ocean, Atmosphere and Climate Science:

Unit 1 : Ocean: Beach and various types of Beaches. Different types of coasts. Coastal Protection. Sea mount and origin of sea mount. Morphology and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Hydrothermal vents-. Ocean margins and their significance. Continental Margins and its types. Marine Sediments. Factors controlling the deposition and distribution of oceanic sediments; Tectonic evolution of the ocean basins. Marine Mineral Resources. Phosphatic nodules, Ferro-Manganese nodules and copper crust. Gas Hydrates.

Unit 2: Atmosphere: Earth's Atmosphere: Composition of the Atmosphere, Early atmosphere, Vertical structure of atmosphere, Layers of Atmosphere. Atmospheric circulations: Forms and scales of atmospheric motion, the molecular scale, micro scale circulation, meso scale circulation, synoptic – scale circulations and local winds, global – scale structures and general circulation, ocean – atmosphere interactions.

Unit 3: Climate Science: Climate and weather, Weather Forecasting, Acquisition of weather Information, forecasting techniques, satellites and weather forecasting, Earth's energy budget. Temperature: Temperature and Heat transfer, Humidity: Humidity variables and measuring Instruments, Humidity variations. Clouds: Basic cloud genera (classification of clouds), clouds with vertical development, mechanism of clouds formation. Precipitation: process, precipitation types, precipitation modification, measuring precipitation and Instruments. Global warming and greenhouse effect, the temperature record, Global warming and the future. Air pressure and winds, Air masses and cyclones, Thunderstorms. Indian monsoons: Components of Monsoon, Synoptic systems of Monsoon, Indian Monsoon Rainfall and its variability.

Books Recommended

1. Physical Geology Earth Revealed (Sixth Edition). 2006. Carlson-Plummer-McGeary. McGraw-Hill
2. Marine Geology by John Wiley & Sons (1950),
3. Weisberg J., and Parish, H., Introductory Oceanography. McGraw Hill, 1974.
4. Ahamed, E. Coastal geomorphology of India. Orient long man, New Delhi,
5. Meteorology by Eric W. Danielson, James Levin, Elliot Abrams
6. Essentials of Meteorology: An invitation to the Atmosphere by C. Donald Ahrens
7. Meteorology: Moran and Morgon
8. Meteorology by Eric W. Danielson, James Levin, Elliot Abrams
9. Essentials of Meteorology: An invitation to the Atmosphere by C. Donald Ahrens
10. Meteorology: Moran and Morgon
11. Climatology, DS Lal, Sharda Pustak Bhavan (2011)
12. Climatology, Savindra Singh, Prayag Pustak, (2006).
13. Environmental Geology (9 edition) – Montgomery. 2010. McGraw-Hill
14. Ecology, environment and pollution – A Balasubramanian
15. Environmental Geology – K S Valdia
16. Environmental Geology – Flawn
17. All you wanted to know disasters – B K Khanna. 2005. \New India Publishing Agency
18. Environment- A Global concern (12 edition) – William Cunningham & Mary Cunningham. 2011. McGraw-Hill
19. Geohazards: Natural and human. Nicholas K. Coch. 1995. Prentice Hall

CC6: Hydrogeology and Environmental Geology:

Unit 1: Origin of water; Hydrologic cycle; Classification of aquifers; hydrological properties of rocks; water table contour maps, Hydro-stratigraphic units, Theory of groundwater flow, Darcy's Law and its applications, determination of permeability in laboratory and in field.

Unit 2: Groundwater quality, graphical presentation of water quality data; Coastal aquifers and salt water intrusions. Types of wells, drilling methods, construction, design, development and maintenance of wells. Pumps tests: methods, data analysis and interpretation; Surface and Subsurface geophysical methods of exploration.

Unit 3: Time scales of global changes in the ecosystems and climate. Impact of circulations in atmosphere and oceans on climate, rainfall and agriculture. Waterlogging problems due to indiscrete construction of canals, reservoirs and dams.

Unit 4: Soil profiles and soil quality degradation due to irrigation; Use of fertilizers and pesticides. Influence of neotectonics in seismic hazard assessment. Preparation of seismic hazard maps. Distribution, magnitude and intensity of earthquakes. Landslide hazards: causes and investigations. Floods: causes and control.

Books Recommended

1. Todd, D.K. Groundwater Hydrology
2. R.J. Lynch 1976 Formation Evaluation. English Book Depo
3. S.N. Davis & R.J.M. Wiest 1966 Hydrogeology. John Wiley and Sons
4. V. Chow Handbook of Applied Hydrology
5. E.E. Johnson 1982 Ground Water and Wells. Johnson Division, UOP Inc
6. W.C. Walton 1970 Groundwater Resource Evaluation. Mc-Graw Hill Inc
7. Bouwer 1978 Groundwater Hydrology. Mc-Graw Hill Inc
8. C.W. Fetter 1990 Applied Hydrogeology. CBS Publishers and Distributors
9. S.P. Garg 1987 Groundwater and Tube Wells. Oxford and IBH Publishing Co. Pvt. Ltd.
10. H.M. Raghunath 1983 Ground Water. Wiley Eastern Limited
11. H.M. Raghunath 1986 Hydrology. Wiley Eastern Limited
12. Harinarayan Exploration Techniques for Groundwater. COSTED
13. O.P. Handa 1988 Water Well Technology. Oxford and IBH Publishing Co. Pvt. Ltd.
14. Karanth 1989 Hydrogeology. Tata Mc-Graw Hill Publ. Comp. Ltd.
15. Valdiya, K.S. 1987 Environmental Geology – Indian Context. Tata McGraw Hill.
16. Keller, E.A. 1978 Environmental Geology, Bell and Howell, USA.
17. Bryant, E. 1985 Natural Hazards, Cambridge University Press.
18. Patwardhan, A.M. 1999 The Dynamic Earth System. Prentice Hall.
19. Subramaniam, V. 2001 Textbook in Environmental Science, Narosa International.
20. Bell, F.G. 1999 Geological Hazards, Routledge, London.
21. Smith, K. 1992 Environmental Hazards. Routledge, London.

CCP3: Practical: Petrology and Ore Petrology:

Unit1: Petrology: Study of mega structures, textures and mineralogy of igneous, sedimentary and metamorphic rocks. Microscopic study of Igneous, sedimentary and metamorphic rocks. Interpretation of Geochemical data

Unit 2: Ore petrology: Megascopic study of common metallic minerals, industrial minerals and rocks. Reflected-Microscope and its application. Study of the Metallic mineral under reflected light microscope

CCP4: Practical: Hydrogeology, Environmental Geology, DIP:

Unit 1: Hydrogeology:Preparation of water level contour maps and their interpretation; Calculation of Porosity, permeability, groundwater storage; Groundwater Exploration by Resistivity methods(Schumberger and Wenner methods); Pumping Test Data analysis; Water Quality data analysis

Unit 2: DIP:Interpretation of Images; Registration: Transfer of Information from Imagery to Base Map; Classification; Exposure to various Image Processing Techniques and Generation of digitally processed outputs.

Unit 3: Environmental Geology: Study of seismic and flood prone areas of India. Classification of ground water for use of drinking, irrigation and industrial purposes. Evaluation of Environmental impact of air pollution, ground water, landslides, deforestation, cultivation and building construction in specified areas.

AECC2: Digital Image Processing:

Unit 1:Data collection, data analysis, data collection errors, Remote sensing data requirements, image processing functions, image data formats.Image quality assessment: 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 2:Image Rectification and Restoration: Geometric correction, geometric errors, types of geometric corrections: Image to map, Image to Image, hybrid approach, rectification logic, Mosaicking.

Unit 3: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.

Unit 4:Thematic map accuracy: Landuse/Landcover map accuracy assessment, sources of errors in remote sensing derived thematic products, error matrix, analysis to assess the accuracy of remote sensing derived information.

Books Recommended

1. John R Jensen Remote Sensing of the Environment: An Earth Resource Perspective (2nd Edition). Prentice Hall; 2 edition (May 11, 2006)
2. James B. Campbell. Introduction to Remote Sensing, Fifth Edition. The Guilford Press; Fifth Edition, Fifth Edition edition (June 21, 2011)
3. David P. Paine, James D. Kiser. Photography and Image Interpretation. Wiley; 3 edition (February 14, 2012)
4. Robert H. Webb PhD, Diane E. Boyer and Raymond M. Turner Dr. Repeat Photography: Methods and Applications in the Natural Sciences. Island Press; 1 edition (November 15, 2010)

SEC2: Social Orientation Course

Unit 1: Social Problems: Importance of the Study of Social Problems; Problems of Aged. Awareness on anticorruption: Ethics, Anti-corruption, Vigilance, Details of the organization/agencies associated with anticorruption, Corruption free Society. Youth in nation building

Unit 2: Yoga: Concept and Practice, International day of Yoga. Mental and physical health through Yoga.

Unit 3: Smart cities program of Government of India. Its Mission and Objectives: Urban development. Role of various stake holders associated with Smart city programs in India. Swachh Bharat Abhiyan' (Clean India Mission): Mission, objective and citizen responsibilities

Unit 4: Indian Constitution; Public Administration;

Books Recommended

1. Ahuja, Ram 2000. Social Problems in India, New Delhi: Rawat Publications.
2. Beteille, Andre 1992. Backward Classes in Contemporary India, New Delhi: OUP
3. Beteille, Andre 1974. Social Inequality, New Delhi: OUP
4. Bereman, G.D. 1979. Caste and Other Inequalities: Essay in Inequality, Meerut: Folklore Institute.
5. Dube, Leela 1997. Women and Kinship, Comparative Perspectives on Gender in South andSoutheast Asia, New Delhi: Sage Publication.
6. Desai, Neera&UshaThakkar 2007. Women in Indian Society, National Book Trust, India.
7. SatyaMurty, T.V. 1996. Region, Religion, Caste, Gender and Culture in Contemporary India, NewDelhi: OUP.

GE2 : Generic Elective

(Courses offered to students from other departments)

GE2: Hazards, Disaster Mitigation and Management

OR

GE2: Introduction to Earth Surface Processes

GE2: Hazards, Disaster Mitigation and Management:

Unit 1: Concepts of disaster; Types of disaster: natural and manmade - cyclone, flood, land slide, land subsidence, fire and earthquake,tsunami and volcanic eruption. Issues and concern for various causes of disasters.Disaster management, mitigation, and preparedness, Techniques of monitoring and design against the disasters, Management issues related to disaster.

Unit 2: Disaster Management in India: Risk, Vulnerability and Hazard 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.

Unit 3: Hazard Zonation Mapping, Remote-sensing and GIS applications in real time disaster monitoring. Prevention and rehabilitation.

Books Recommended

1. Bell, F.G., 1999. Geological Hazards, Routledge, London.
2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.
3. Smith, K., 1992. Environmental Hazards.Routledge, London.
4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International

OR

GE2: Introduction to Earth Surface Processes:

Unit 1: Historical development in the concepts of earth surface processes, terrestrial relief, scales in geomorphology. Weathering and formation of soils.

Unit 2: Karst and speleology, slope and catchment erosion processes. Fluvial, aeolian, glacial, peri-glacial and coastal processes and resultant landforms.

Unit 3: Controlling factors (tectonics, climate, sea level changes and anthropogenic) and surface Processes. Climate change and geomorphic response. Geomorphic response to tectonics, sea level/base level change, anthropogenic affects. Surface processes and natural hazards. Applied aspects of geomorphology.

Books Recommended

1. Alien, P.A., 1997. *Earth Surface Processes*, Blackwell publishing.
2. Bloom, A.L., 1998. *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms*, Pearson Education.
3. Bridge, J.S. and Demicco, R.V., 2008. *Earth Surface Processes, Landforms and Sediment Deposits*, Cambridge University Press.
4. Esterbrook, D.J., 1992. *Surface Processes and Landforms*, MacMillan Publ.
5. Kale, V.S. and Gupta A 2001 *Introduction to Geomorphology*, Orient Longman Ltd.
6. Leeder, M. and Perez-Arlucea M 2005 *Physical processes in earth and environmental sciences*, Blackwell' publishing.
7. Summerfield M A 1991 *Global Geomorphology* Prentice Hall.
8. Wilcock, P.R., Iverson R M (2003) *Prediction in geomorphology* ' AGU Publication.

Semester III

CC7: Ore Geology and Mining Geology:

Unit 1: Processes of formation of ore deposits. ore bearing fluids, fluid inclusion and wall rock alterations. Structural, physico-chemical controls of ore localization. Morphology of the ore deposits. Textures, paragenesis and zoning of ores and their significance. Genetic classification of ore deposits.

Unit 2: Ore petrology: Ores associated with mafic –ultramafic – diamonds in Kimberlite, REE in Carbonatites, Ti-V, Chromite and PGE, Ni ores; Ores in acidic igneous rocks – Fe-P, Zn-Pb-Cu ores. Ores of sedimentary affiliation viz., Chemical and Clastic sediments, stratiform and strata bound ore deposits – Fe-Mn and non-ferrous ores. Placer deposits. Ores of metamorphic association and ores related to weathering – Residual Deposits – Laterite, Bauxite, Ni/Au Laterites.

Unit 3: Indian Mineral Deposits: Mineralogy, Origin, Occurrence and Distribution of the following mineral deposits; Metallic – Au, Cu, Fe, Mn and Al. Non Metallic- abrasives, ceramics, refractories, insulators, fossil fuels.

Unit 4: 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. Types of drilling methods. Mining hazards: mine inundation, fire and rock burst. Alluvial mining, Surface mining and quarrying, Underground mining and coal mining methods.

Books Recommended

1. The Geology of Ore Deposits – Gillbert and Park. 2007, Waveland Press,
2. Interpretation of ore Texture- Bastin E S. 1950 Geological Society of America.
3. Economic mineral deposit- Mead LeRoy Jensen & Alan Mara Bateman. 1981. Wiley.
4. Ore Microscopy - Cameron E N. 1961. Wiley,
5. Geology of Mineral deposits- Smirnov, V.I. 1976. Mir Publishers
6. Ore Petrology – Stanton R L. 1972. McGraw-Hill
7. Ore Microscopy and Ore Petrography – Craig and Vaughan. 1994. Wiley
8. India's Mineral resources – Krishnaswami S. 1979. Oxford & IBH
9. Mineral Resources of Karnataka – B.P Radha Krishna. 1996. Geological Society of India
10. Industrial minerals and rocks – S Deb. 1980. Allied Publishers
11. Introduction to ore forming processes- Laurence Robb. 2005. Blackwell Science. Ltd
12. Ore Geology and Industrials Minerals: an Introduction- A.M. Evans. 1993. John Wiley & Sons
13. Understanding Mineral deposits- Misra, K.C. 2000. Kluwer Academic Pub.

CC8: Exploration Geology:

Unit 1: Geological exploration: Geological criteria for mineral prospecting, Indicators of ore, Stages and methods of geological exploration and prospecting. Sampling: methods and types. Drilling and core logging, Preparation of technical report.

Unit 2: Geochemical exploration: Basic principles-geochemical dispersion, geochemical mobility, geochemical 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.

Unit 3 & 4: 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. 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 recommended

1. Manual of mineral exploration - GSI Mispubln No 33. 1975.
2. Geological Methods in Mineral Exploration and Mining. Roger Marjoribanks. 2010. Springer
3. Principles and practices in mineral exploration - P K Ramam. 1989. Geological Society of India,
4. Introduction to Mineral exploration – Evans. 2006. John Wiley & Sons
5. Economic Geology: Principles and Practice. Walter L. Pohl 2011. John Wiley & Sons
6. Ore microscopy and mineral exploration – R Dhanaraju. 2010. Geological Society of India,
7. Geochemistry in Mineral Exploration – Rose, Hawks and Webb. 1979. Academic Press.
8. Introduction to Exploration Geochemistry. Alfred Abraham Levinson. Applied Pub., 1980
9. Introduction to Geophysical prospecting – M B Dobrin. 1988. McGraw-Hill
10. Outlines of geophysical prospecting: a manual for geologists. M.B. Ramachandra Rao. 1975. University of Mysore.
11. Lectures on exploration geophysics for geologists and engineers. Bheemasankaran and V K Gour. 1977. Association of Exploration Geophysicists,
12. Method of Geophysical exploration – T V ramachandra. 2009. Geological Society of India
13. An Introduction to Geophysical Exploration (3rd Edn). Philip Kearey Michael Brooks & Ian Hil. 2009. Wiley
14. Mining Geology-R.N.P. Arogya Swamy

CC9: GIS data analysis and Modelling

Unit1: Introduction to Geographic Data: Representing geographic space, representing spatio-temporal relationships, File formats for spatial data. Introduction to Database: Database-definition and advantage, computer file structures – simple lists, ordered sequential files, indexed files. Query

Unit 2: Database management system: Essentials of DBMS, levels of data abstraction and data models, characteristics and functionality of DBMS, Types of DBMS structures- Hierarchical, Network system, relational and object oriented. Hybrid database models. Database Design and storage: Conceptual database design, logical database design, and physical database design. Data Storage: Raster and vector data storage and Compression techniques

Unit 3: Spatial analysis meaning and scope: Spatial Decision support system, spatial statistics, Geo-computation, Typology of spatial analysis technologies. Geo-statistical measurements, Boolean operations- overlay, buffering, density analysis, Trend surface analysis. Advanced spatial analysis: Network and raster connectivity operations, Spatial interpolation and proximity operations, Fuzzy analysis. Integration and modeling of spatial data: suitability modeling, hydrographic modeling, network modeling, Distance modeling, surface modeling.

Books Recommended

1. Lo, C.P. and A.K.W., Yeung. 2007. Concepts and Techniques in Geographic Information, Systems. 2nd, Upper Saddle River, Prentice Hall (ISBN 0-13-149502-X)
2. Longley, P.A., M.F. Goodchild, D.J. Maguire and D.W. Rhind. 2007. Geographic Information Systems and Science. 2nd, John Wiley & Sons (ISBN 978-0-470-87001-3)
3. Michael N. Demers, Fundamentals of Geographic Information Systems, 2005. Third edition, John Wiley and sons, , USA, (ISBN: 0-471-20491-9)
4. Tor Bernhardsen, Geographic information System An introduction, 3rd Edition, Wiley India private ltd, New Delhi. (ISBN: 978-81-265-1138-9)
5. Peter A. Burrough and Rachael A. McDonnell, Principles of Geographic Information Systems, 2009, Oxford University press, New York, (ISBN: 0-19-922862-0)
6. B. Bhatta, Remote Sensing and GIS, 2008, Oxford University Press, New York, (ISBN: -0-19-560239-X).
7. Michael N. DeMers, GIS for Dummies, 2009, Wiley publications, Inc (ISBN: 978-0-470-23682-6).
8. Paul A. Longley, Geographical Information Systems and Science, 2nd edition, John Wiley & sons, Ltd., ISBNs: 0-470-87000-1 (HB)
9. U.M. Shamsi, GIS Applications for Water, 2009 wastewater and storm water Systems
10. Francis J. Pierce, David Clay, "GIS Applications in Agriculture", 2007 by Taylor & Francis Group, LLC, CRC press, (ISBN: 10: 0-8493-7526-6)

DSE1: Advanced Remote sensing in Geosciences:

Unit 1: Spectral characteristics of vegetation, temporal (phenological) characteristics of vegetation, vegetation index. Crop type classification concepts, spectral response of different crops. Crop diseases and assessment, advances in crop monitoring, forest change detection, forest damage assessment and forest monitoring

Unit 2: Remote Sensing of Soils, Remote Sensing of Rocks and Minerals; Imaging Spectroscopy of Rocks and Minerals. Geological Applications in Geomorphology; Remote Sensing in Lithology: Sedimentary, Igneous, Metamorphic – Identification of Mineral assemblages

Unit 3: Remote sensing in urban and infrastructure planning: Urban/suburban resolution considerations, urban land use/land cover classification system, Residential Land use, Commercial Land use, Industrial land use, Transportation infrastructure, Communication and Utilities, transport infrastructure facilities, , methods of surveys in town planning, preparation of development plans.

Unit 4: 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.

Books Recommended

1. John R Jensen Remote Sensing of Environment –
2. Remote Sensing with special reference to agriculture and forestry, National academy of Sciences, Washintond.C., 1970, ISBN: 309-01723-8
3. Remote sensing of forest environments, concept and case studies, Kluwer academic publications, ISBN:1-4020-7405-0
4. Remote Sensing Geology, Ravi P. Gupta, Second edition, Springer, ISBN: 3-540-43185-3
5. Image interpretation in Geology, Steve Drury, Third edition, Blackwell Publications, ISBN: 0-07487-64992
6. Applied Remote Sensing for Urban planning, Governance and sustainability, M Netzband, W L Stefanov, C Redman(Eds), Springer, ISBN:978-3-540-25546-8
7. Remote Sensing and Geographic Information Systems for design and operation of Water Resources, Micheal F. Baumgartner, Gret A. Schultez and A. IvanJhonson.
8. Remote sensing and Image Interpretation, Lillesand, TM and Kiefer RW, 1987, John Wiley
9. Image Interpretation in Geology, Drury, SA, 1987, Alien and Unwin

AECC3: Engineering Geology, Geodesy and Surveying:

Unit 1: Various stages of engineering geological investigation for civil engineering projects. Engineering properties of rocks; rock discontinuities. Physical characters of building stones. Metal and concrete aggregates. 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.

Unit 2: Mass movements with special emphasis on landslides and causes of hill slope instability. Earthquakes and seismicity, seismic zones of India. Aseismic design of building. Influence of geological conditions on foundation and design of buildings. Introduction to geotechnical engineering.

Unit 3: Geodesy: History of determining the shape and size of the earth; Coordinate Systems, Basics of geodesy, Ellipsoids and Datums. Surveying: Conventional surveying: Chain Survey, Prismatic Compass, Plane table Surveying, Dumpy level, Theodolite Surveying, classification, types and uses. Modern Surveying: Total Station Survey, Survey specifications, second & third order survey.

Books Recommended

1. Engineering and general geology. Parbingsingh, S K Kataria & Sons. 2009
2. Foundations of Engineering Geology. Tony Waltham. CRC Press; 3 edition (21 April 2009)

3. Engineering Geology. David George. Springer; 1 edition (November 21, 2008 Elementary surveying, Major basil Jackson
4. Surveying Volume-1, Dr. B.C. Punmia, Ashok k. Jain, Arun K. Jain, 16th edition, Lakshmi Publication Pvt. LTD, ISBN:81-7008-054-1
5. Surveying for field Scientist, JC Pugh, Metheun Ltd, ISBN:0-416-075207
6. Geodesy, Wolfgang Torge, 3rd Edition, de Gruyter, Germany, ISBN:3-11-0717072-
7. Introduction to Geodesy, the history and concepts of modern Geodesy, James R. Smith.Wiley, ISBN:0-471-16660X
8. Geodesy, George Lenard Hosmer, Jhon Wiley & sons.

CCP5: Practical: Exploration, Engineering Geology, and Ore Petrology:

Unit 1: Exploration: Mineral resources evaluation, Estimation of tonnage, averaging assay, economic analysis and resource estimation.. Estimation of subsurface resources by borehole log data.

Unit 2: Engineering Geology: Engineering properties of rocks.Study of map, models of important engineering structures as dam sites and tunnels.Interpretation geological maps for landslide problems.

Unit 3: Ore Petrology :Megascopic study of common metallic minerals, industrial minerals and rocks. Reflected-Microscope and its application. Study of the Metallic mineral under reflected light microscope

CCP6: Practical: GIS, Cartography and Surveying:

Unit 1:GIS & Cartography:Map appreciation and conventional signs, Relief and slope Maps; Representation Dot maps, Density maps-colour and gray scale patterns, index of concentration and diversification, transport networking analysis, flow maps.Quantitative symbolization and location maps: point and line pattern analysis, cartograms and 3D maps.Map registration and feature extraction.

Unit 2: Surveying: Plane table chain survey, Dumpy level/auto leveling

Semester IV

CC10: Internship:

Internship in GIS/RS/Geological organizations/institutions based on student's choice to be finalized in consultation with concerned faculty.

DSE2: Project report and viva:

Students will have to produce a Project Report and submit to the department by the end of the semester which will be evaluated and graded by the University for award of marks.

There is no financial commitment on the part of the University for the internship/project. However the University may assist the candidate in locating him / herself and issue letters to concern besides supplying any other documents / references etc.

The project will be of 4 – 5 months.