UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY : : CHENNAI 600 025

I TO IV SEMESTERS OF CURRICULUM AND SYLLABUS (FT)

REGULATIONS - 2013

M.Sc. APPLIED GEOLOGY

I SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AG8101	Geomorphology	3	0	0	3
AG8102	Mineralogy	3	0	0	3
AG8103	Stratigraphy and Paleontology	3	0	0	3
AG8104	Structural Geology and Geotectonics	3	0	0	3
MA8152	Applied Mathematics for Geologists	3	0	0	3
PRACTICAL					
AG8111	Mineralogy Lab	0	0	2	1
AG8112	Structural Geology Lab and Geological Mapping	0	0	2	1
AG8113	Survey Practical	0	0	6	3
	TOTAL	**15**	**0**	**10**	**20**

II SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AG8201	Exploration Geophysics	3	0	0	3
AG8202	Geochemistry	3	0	0	3
AG8203	Igneous and Metamorphic Petrology	3	0	0	3
AG8204	Sedimentology and Sedimentary Petrology	3	0	0	3
	Elective I	3	0	0	3
PRACTICAL					
AG8211	Exploration Geophysics Lab	0	0	3	2
AG8212	Geochemistry Lab	0	0	3	2
AG8213	Igneous and Metamorphic Petrology Lab	0	0	2	1
AG8214	Sedimentology and Paleontology Lab	0	0	2	1
	TOTAL	**15**	**0**	**10**	**21**

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III SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
THEORY					
AG8306	Economic Geology	3	0	0	3
AG8307	Engineering Geology	3	0	0	3
AG8308	Geological Remote Sensing and GIS	3	0	0	3
AG8304	Hydrogeology	3	0	0	3
AG8305	Petroleum Geology	3	0	0	3
	Elective II	3	0	0	3
PRACTICAL					
AG8311	Geological Fieldwork and Industrial Training (4 weeks)	0	0	0	2
AG8312	Geological Remote Sensing And GIS Laboratory	0	0	2	1
AG8313	Hydrogeology Lab	0	0	2	1
AG8314	Seminar	0	0	2	1
	TOTAL	**18**	**0**	**6**	**23**

IV SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
	Elective III	3	0	0	3
	Elective IV	3	0	0	3
PRACTICAL					
AG8411	Project Work	0	0	20	10
	TOTAL	**6**	**0**	**20**	**16**

TOTAL CREDITS : 80

ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
AG8001	Advanced Remote Sensing And GIS For Geological Applications	3	0	0	3
AG8002	Applied Hydro geochemistry	3	0	0	3
AG8003	Coal Geology	3	0	0	3
AG8004	Earthquake disaster and mitigations	3	0	0	3
AG8005	Environmental Geochemistry	3	0	0	3
AG8006	Environmental Geology	3	0	0	3
AG8007	Environmental Hydrogeology	3	0	0	3
AG8008	Geoprospecting	3	0	0	3
AG8009	Groundwater contamination	3	0	0	3
AG8010	Industrial Geology	3	0	0	3
AG8011	Marine Geology	3	0	0	3
AG8012	Medical Geology	3	0	0	3
AG8013	Micropaleontology and Palynology	3	0	0	3
AG8014	Mineral evaluation and Management	3	0	0	3
AG8015	Mining Geology	3	0	0	3
AG8016	Natural Hazards and Mitigations	3	0	0	3
AG8017	Nuclear Isotope Geology	3	0	0	3
AG8018	Oil Exploration and Production	3	0	0	3
AG8019	Ore Geology and Mineral Technology	3	0	0	3
AG8020	Planetary Geology	3	0	0	3
AG8021	Quaternary Geology	3	0	0	3
AG8022	Sequence Stratigraphy	3	0	0	3
AG8023	Soil Science	3	0	0	3

AG8101 **GEOMORPHOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To upgrade and teach the latest geomorphic tools to understand landscape evolution through time and space, understand varied geomorphic processes that operate on the landscape.

OUTCOME:

- Students will be able to appreciate various natural processes that operate and sculpt the landforms both on surface and subsurface, evaluate varied environmental regions, ecology and natural resources.

UNIT I INTRODUCTION TO GEOMORPHOLOGY 9

Basic concepts- endogenous and exogenous processes, multi and interdisciplinary approach, tropics, marine, fluvial types and tools, processes of weathering and soil formation, planation surfaces and geomorphic cycle.

UNIT II FLUVIAL PROCESSES AND LAND FORMS 9

Drainage basin types and network characteristics, genetic classification of streams, river valleys, work of river, sediment load, yield, channel geometry. Bedrock channels, classification of rivers and river metamorphosis. Karst landforms.

UNIT III AEOLIAN, GLACIAL PROCESSES AND LANDFORMS 9

Aeolian landforms: sand deposits and types. Age of desert, weathering in deserts, major causes of aridity. Glacial forms - glacial erosion, deposition and processes. Glaciations during the Quaternary period in the Himalaya and other examples

UNIT IV COASTAL PROCESSES AND FORMS 9

Coastal landforms, coral reefs, time based coastal changes, coasts of the world. Seal level changes, causes and neotectonism.

UNIT V NATURAL HAZARDS AND ENVIRONMENTAL MANAGEMENT 9

Methods, models of sediment deposition due to mass movement, natural hazards, mitigation, studies in three and four dimensions and methods of environmental management

REFERENCES:

1. Pelletier J D. Quantitative Modelling of Earth Surface Processes, Cambridge University Press, Cambridge, 2008.
2. Schumm S A. River Variability and Complexity, Cambridge University Press, Cambridge, 2007.
3. Kale V.S. and Gupta A. Introduction to Geomorphology, Orient Longman, Hyderabad, 2001.
4. Holmes A. Principles of physical geology, Thomas Nelson and Sons, USA, 1964.
5. Goudie A.S. Geomorphology, Springer, UK, 1998.
6. Kondolf M. G. and Piégay H.. Tools in Fluvial geomorphology, Wiley, John Wiley & Sons Inc, Somerset, New Jersey, U.S.A. 2003.

AG8102 **MINERALOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the crystallization process, formation of minerals and their physical and chemical characteristics to understand the nature of geological framework with time and space and to review the potentiality of economic resources for exploration.

OUTCOME:

- Student will be prepared to address the geological resources for economic resources evaluation and exploitation programme.

UNIT I CRYSTALLOGRAPHY 9

Classification of crystals, systems and classes of symmetry; International system of crystallographic notation; Use of projection diagrams to represent crystal symmetry. Unit Cells, Motifs and Lattices. Point groups and space groups.

UNIT II ELEMENTS AND MINERALS 9

Stoichiometry, atomic substitution, solid solution series and exsolution. Chemical bonding and mineral properties. Rules governing atomic close-packing in crystalline solids and co-ordination number. Positioning of trace elements in minerals

UNIT III DESCRIPTIVE MINERALOGY 9

Physical, chemical and crystallographic characteristics of common rock forming silicate mineral groups. Structural classification of silicates. Common minerals of igneous and metamorphic rocks. Minerals of the carbonate, phosphate, sulphide and halide groups. Clay minerals.

UNIT IV OPTICAL MINERALOGY 9

Optical properties of common rock forming silicate minerals, uniaxial and biaxial minerals. Extinction angles, pleochroism, birefringence of minerals and their relation with mineral composition. Twinned crystals. Dispersion. U-stage and its applications

UNIT V X-RAY CRYSTALLOGRAPHY 9

Principle of X-ray powder diffraction, Measurement of X-ray powder diffraction patterns, Powder diffractometers, Goniometer design in powder diffractometry, Monochromatic radiation, Bragg-Brentano geometry, Debye-Scherrer geometry.

TOTAL: 45 PERIODS

REFERENCES:

1.Ford, W.E., Dana's Text book of mineralogy (Fourth Edition), Wiley Eastern Limited., New Delhi, 1989.
2. Putnis, A Introduction to mineral sciences, Cambridge University Press, New Delhi, 1992.
3. Deer, Howie and Zusmann, Introduction to Rock forming minerals, IBH Publishers, New Delhi, 1998.
4. Rogers and Kerr Optical Mineralogy, McGraw Hill Book Company, New Delhi, 1986.
5. Winchel and Winchel, Elements of Optical Mineralogy, John Wiley & Sons, INC. USA.,1989.
6. Dexter Perkins, Mineralogy, Prentice Hall, USA, 2002
7.Hans Rudolf Wenk and Andrei Bulakh, Minerals their constitution and origin, Cambridge University Press, UK, 2004

AG8103 STRATIGRAPHY AND PALAEONTOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To train the students to address the exposed and subsurface rock layers, its description with respect to tectonics, rock type, structures and geological frame work and interpretation of stratigraphic architecture. The knowledge in paleontology is to equip the students for understanding paleoenvironment of the sedimentary basin systems.

OUTCOME:

- Students will develop the knowledge on sedimentary basin history and environment to review it's potentially for resource evaluation

UNIT I PRINCIPLES OF STRATIGRAPHY 9

Nomenclature, stratigraphic code, litho, bio and chronostratigraphy units, stratigraphic correlation, Walther's law. Geological time scale. Geological events

UNIT II INDIAN STRATIGRAPHY 9

Precambrian stratigraphy, stratigraphy of the Paleozoic, Mesozoic and Cenozoic formations of India. Gondwana system, rise of Himalaya and evolution of Siwalik basin, Deccan volcanic, and quaternary stratigraphy

UNIT III APPLIED STRATIGRAPHY 9

Applications of stratigraphy in mineral, metal, non-metal, coal and hydrocarbon explorations, study of principles of seismic stratigraphy, principles of clastic, carbonate and fluvial sequence stratigraphy, chemostratigraphy, and magnetostratigraphy.

UNIT IV PALEONTOLOGY 9

Morphology and time range of fossil groups, principles of evolution and evolutionary changes in molluscs and mammals, Arthropod and echinodermata in geological time. Siwalik vertebrate fauna, Gondwana flora and their distribution in India

UNIT V MICROPALEONTOLOGY. 9

Morphology and taxonomy of benthic and planktic Foraminifera, Ostracoda, nanofossils and dinoflagellate cysts. Interpretation of age, paleoenvironment and paleobathymetry. Use of species and genera of foraminifera in biostratigraphic correlation.

TOTAL: 45 PERIODS

REFERENCES:

1. Ramakrishnan, M and Vaidhyanathan, R. Indian Geology, Geological Society of India, Publication, Bangalore, 2007
2. Krishnan, M.S., Geology of India and Burma III Ed.IBH Publishers, New Delhi, 1984
3. G. Emery D and Myers, K Sequence stratigraphy, Blackwell Science, Publ. UK,1996
4. Shorock and Twenhofel Principles of Invertebrate Palaeontology, IBH New Delhi, 1983
5. Ravindra Kumar, Fundamentals of historical Geology and stratigraphy of India, Wiley Eastern Ltd. New Delhi, 1985
6. G.Bignot. Elements of Micropaleontology, Graham and Trotman, International student edition Bordas, Paris, 1982
7. Roup and Stanly, Principles of Paleontology

AG8104 STRUCTURAL GEOLOGY AND GEOTECTONICS L T P C
3 0 0 3

OBJECTIVES:

- This course is an introduction to the fundamentals of structures and the underlying physical processes of rock deformation and geotectonics. It describes the geological structures and identification of structural features, how to recognize them in the field, their significance in geological setup, and exploration of geological resources.

OUTCOME:

- After completing this course, students can identify important structures and will have better understanding on various structural signatures, and tectonic setups.

UNIT I INTRODUCTION 9

Concept, approach and scope of structural geology, primary and secondary structures. Principles of geological mapping and map reading, projection diagrams.

UNIT II DEFORMATION MECHANISMS & MICROSTRUCTURES 9

Behaviour of minerals, sediments and rocks under deformation conditions. Joints and shear fractures. Cleavage, foliation, lineation: Unconformities. Structural behaviour of igneous intrusions. Introduction to petro fabrics, Kinematic analysis: Dynamic analysis and structural analysis - Liquefaction

UNIT III FAULTS 9

Fault rocks, recognition, classification of faults and fault surfaces, slip sense and surface effects. Dynamic analysis of faults, thrust fault terminology, role of fluid pressure. Normal faults, strike-slip faults.

UNIT IV FOLDS 9

Folds: Elements of fold geometry, fold classification. Folding mechanisms, Regional fold styles. Study of superposed folds.

UNIT III GEOTECTONICS 9

Heterogeneity of the earth's crust. Major tectonic features of the Oceanic and Continental crust. Continental drift. Seafloor spreading and Plate Tectonics. Island arcs, Oceanic islands and volcanic arcs. Isostasy, orogenic and epi-orogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

TOTAL: 45 PERIODS

REFERENCES:

1. Barber D. J. & Meredith, Deformation processes in minerals, ceramics and rocks, Unwin Hyman, Boston,1990.
2. Billings, M. P. Structural Geology, Prentice-Hall, Inc, New Jersey, USA, 1972.
3. Condie, K. C. Plate Tectonics & Crustal Evolution, 4th Edition, Butterworth-Heinemann, Boston, 1977.
4. Hobbs, B. E., Means, W. D., & Williams, P. E. An Outline of Structural Geology, John Wiley & Sons, Inc, Australia 1976.
5. Hull, D. & Bacon, D. J. Introduction to Dislocations, 3rd Edition, Pergamon Press, New York 1984.
6. Robert J. Twiss, Eldridge M. Moores. Structural Geology, Second Edition, W. H. Freeman and company, New York. 2007.

MA8152 APPLIED MATHEMATICS FOR GEOLOGISTS L T P C
3 0 0 3

OBJECTIVES:

- To train the students to address the mathematical problems involved in geological science and understand various sampling, quantitative and statistical problems pertaining to geology.

OUTCOME:

- Students will develop the knowledge on mathematics and statistics and its use in resource evaluation and assessment.

UNIT I SYSTEM OF LINEAR EQUATIONS AND INTERPOLATION 9

Simultaneous linear equations – Direct method - Gauss elimination,Gauss - Jordan methods – Iterative method – Jacobi and Gauss-eidal methods.Difference table – Newton's forward and backward interpolation – Newton's divided differences – Lagrangian interpolation**.**

UNIT II NUMERICAL INTEGRATION AND ORDINARY DIFFERENTIAL EQUATIONS 9

Numerical integration – Trapezoidal and Simpson's 1/3 rules. Taylor serie and Euler methods-Runge – Kutta method of fourth order – Adam– Bashforth Predictor - Corrector method.

UNIT III EMPIRICAL STATISTICS 9

Types of Sampling - Description of discrete and continuous data – Measures of Central tendency and dispersion for grouped and ungrouped data – Measures of position – Box and Whisker plot.

UNIT IV ESTIMATION THEORY 9

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT V TESTING OF HYPOTHESES 9

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, χ^2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

TOTAL: 45 PERIODS

REFERENCES:

1. Grewal ,B.S. and Grewal ,J.S. ," Numerical methods in Engineering and Science ", 6th Edition, Khanna Publishers , New Delhi ,2002
2. P.S. Mann, "Introductory Statistics", John Wiley and Sons. Inc 5th edition, 2004.
3. D.C. Montgomery and G.C. Runger, "Applied Statistics and Probability for Engineers", Wiley Student Edition, 2007.
4. Balagurusamy ,E," Numerical Methods ", Tata Mc Graw Hill Pub.Co. Ltd, New Delhi, 1999.
5. Walpole,R.E. and Myers R.H, Myers ,S.L. and Ye, K,"Probability and Statistics for Engineers and Scientists ", Pearson Education, Asia, 8th edition, 2007.

AG8111 **MINERALOGY LAB** **L T P C**
0 0 2 1

OBJECTIVES:

- Practical training to the students on mineral identification, crystal systems and chemical composition. Also to train them to understand various geochemical processes and environment of formation of minerals, exploration of economical minerals and ores.

OUTCOME:

- Students will have good training on identification of rock forming minerals and economic ores.

UNIT I CRYSTALLOGRAPHY **6**

Stereographic projections – axial ratios – Napier's theorem and problems –

UNIT II MINERAL MEGASCOPY **6**

Systematic megascopic study of common rock forming minerals: Habit – cleavage – hardness – specific gravity – colour – luster – streak – fusibility – fluorescence – magnetic property

UNIT III MINERAL CALCULATION **6**

Calculation of structural formula for important rock forming mineral groups.

UNIT IV MINERAL MMICROSCOPY **6**

Systematic microscopic study of common rock forming minerals – RI – Birefringence – extinction angles – optic sign etc.

UNIT I 4- AXES UNIVERSAL STAGE **6**

Determination of anorthite content and twin law in plagioclase feldspars

TOTAL:30 PERIODS

AG8112 STRUCTURAL GEOLOGY LAB AND GEOLOGICAL MAPPING **L T P C**
0 0 2 1

OBJECTIVES:

- Practical training to the students on various geological kits, identification of topographical and structural features, mapping techniques and on understanding of various geodynamic processes for exploration of oil, and economic minerals. Also to impart analytical and interpretational skills with better understanding to the students on various structural elements, and geological maps etc.

OUTCOME:

- Students will be trained on professional aspects of geological mapping.

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration in hours	Name	Quantity
1	Identification and interpretation of structural elements in geological maps: Faults, folds, unconformities etc.	3	Toposheets, Structural and Geological maps	25

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2	Preparation of geological maps and section maps.	3	Clinometer, brunton compass, Map measurer, GPS and Geologist's kit	25
3	Exercises on preparation of contours for different land forms, determination of strike, true dip and apparent dip, measurement of thickness and width of outcrops.	3	Work table	-
4	Interpretation of three point problems, drawing of profiles.	3	Work table	25
5	Exercises on construction of geological cross-sections, stratum contours, isopach maps. Study of geological map of India.	4	Clinometer, brunton compass, Map measurer, GPS and Geologist's kit	25
6	Stereographic plotting of planes and lines, Determination of true and apparent dip, plunge and pitch of linear structures	4	Wulf's Net	25
7	Hands-on exercises on computer aided analysis of structural data. Strain measurements from deformed fossils and other markers.	4	Computers, Softwares such as Geo Orient, Poly3D, FABRIC 7, ROCKWORKS, Stereonet etc	25
8	Geological Field work, Toposheet reading, Use of GPS, method of traverses, Recconnaitory traverse, Outcrop study, Structural Mapping, Oriented Sampling, Shear zone studies, Visit to mines.	6	Clinometer, brunton compass, Map measurer, GPS and Geologist's kit	25

TOTAL: 30 PERIODS

TEXTS/REFERENCES

1. Rowland, S.M. and Duebendorfer, E.M. Structural Analysis and Synthesis, Pergamon, 1994.
2. D M Ragan. Structural geology - An Introduction to Geometrical Techniques, John Wiley, 1985.
3. Turner, F.J. and Weiss, L.E. Structural Analysis of Metamorphic Tectonites, Mc Graw Hill, 1963.
4. Paor, D. Structural Geology and Personal Computer, Pergamon, 1996.
5. Lahee. Field Geology, CBS Publishers, 1987.

AG8113 **SURVEY PRACTICAL** **L T P C**
0 0 6 3

OBJECTIVES:

- Practical training to the students on surveying techniques and instruments. Also to train them in handling modern and advanced surveying instruments and understand their application in geology.

OUTCOME:

- Students will be trained on professional aspects of surveying and leveling.

UNIT I CHAIN SURVEYING **12**

Ranging - Chaining – Traverse.

UNIT II COMPASS SURVEYING **6**

Traverse

UNIT III PLANE TABLE SURVEYING **18**

Intersection - Traverse - Three-point problem.

UNIT IV LEVELLING **18**

Fly leveling using Dumpy level - Fly leveling using Tilting level

UNIT V THEODOLITE SURVEYING **24**

Measurement of angles by reiteration and repetition – Measurement of vertical angles – Heights and Distances : Single plane method

UNIT VI DEMONSTRATION **12**

EDM instrument – Electronic theodolite – Total station instrument - GPS

TOTAL: 90 PERIODS

AG8201 **EXPLORATION GEOPHYSICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the physical properties of earth and application of physics in geology, to understand subsurface features and structures for better understanding of subsurface geology. It describes various geophysical techniques and their field setup, data processing and interpretation.

OUTCOME:

- Better understanding on geophysical anomalies, interpretation of subsurface features and modelling of geological structures.

UNIT I INTRODUCTION & ELECTRICAL METHODS **9**

Scope of exploration geophysics – physical properties of the earth – Electrical methods – SP, IP, EM and Resistivity - methods of electrode arrangement – field methods – interpretation – application

UNIT II GRAVITY METHODS **9**

Principle – field methods – gravimeters – corrections – interpretation of gravity data – determination of shape and depth of ore bodies –– corrections & applications – GRACE mission

UNIT III MAGNETIC METHODS 9

Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys

UNIT IV SEISMIC METHODS 9

Seismic waves – travel velocity in various geological formations – principles – field operation – refraction and reflection survey – correction of seismic data – methods of interpretation – determination of attitude and depth of formations – various types of shooting

UNIT V RADIOACTIVITY METHODS AND GEOPHYSICAL WELL LOGGING 9

Fundamentals of radioactivity – principle of radioactivity methods – types of counters – field methods and interpretation – Well logging - Self potential – resistivity – radioactivity logging methods – caliper and other miscellaneous logging methods – field procedure and interpretation of data

TOTAL: 45 PERIODS

REFERENCES:

1. Arnaud Gerkens, J. C. d'. Foundation of exploration geophysics. Amsterdam ; New York : Elsevier ; New York, NY, U.S.A, 1989.
2. Burger, H.R., Exploration Geophysics of the Shallow Subsurface, Prentice Hall, 1992.
3. Dobrin, M.B An introduction to geophysical prospecting, McGraw Hill, New Delhi,1984
4. Ramachandra Rao, M.B. Outline of geophysical prospecting. Wesley press, Mysore, 1975
5. Rama Rao, B.S and Murthy I.B.R Gravity and magnetic methods of prospecting. Arnold Heinmann Pub. New Delhi, 1978.
6. Robinson, Edwin S., Cahit Coruh, Basic exploration geophysics Wiley, New York : 1988.

AG8202 GEOCHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To study the chemical properties of earth and application of chemistry in geology, to understand rock chemistry and evolution of various rock types through geochemical differentiation. Also to understand various surface guides for exploration of economical ores and minerals.

OUTCOME:

- Better understanding on geochemistry of rocks and minerals and interpretation of geochemical path finders for economical minerals and ores.

UNIT I PRINCIPLES OF GEOCHEMISTRY 9

Introduction – Periodic table, Geochemistry of the Earth; Formation of the solar system and geochemical history of the earth. The geochemical cycle- Distribution of elements in rocks and soils.

UNIT II GEOCHEMISTRY OF MINERALS, ROCKS AND WATERS 9

Mineral stability, compositional changes in minerals. River water, Seawater, Seafloor hydrothermal systems; Groundwater and Lakes. Characteristics of Magma, Melting of rocks, Water in Magmas, eutectic and melting. Distribution of trace components between rocks and melts.

UNIT III ISIOTOPE GEOCHEMSIRTY 9

Radioactive Decay, Determining Isotope Decay time, Potassium-Argon Systematics, Uranium-Thorium-Lead Systematics. Types of Isotope- Fractionation, isotope Exchange between minerals and water, Carbon, Oxygen and Sulphur isotopes, First-order decay and growth equations.

UNIT IV EXPLORATION GEOCHEMISTRY 9

Introduction – Primary dispersion pattern, Secondary dispersion pattern – background values. Geochemical anomaly – geochemical sampling. Principles and techniques used in the design and implementation of an exploration geochemical survey.

UNIT V ENVIRONMENTAL GEOCHEMISTRY 9

Anthrosphere aquatic environment – Marine, fluvial, lacustral, aerosols. Perturbations caused by human activity.

TOTAL: 45 PERIODS

REFERENCES:

1. John V. Walther, Essentials of Geochemistry, Jones and Bartlett Publishers, 2005, Boston.
2. Girard, Principles of Environmental Chemistry, Jones and Bartlett Publishers, 2005, Boston.
3. Faure, G, Principles and applications of Geoche4msitry, Pearson Education, 1998, INC, Australia.
4. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., Australia, 1996.
5. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC, Australia, 1998.
6. Nelson EBY, G., Principles of Environmental Geochemistry, Thomson Brooks/Cole, UK,2004.
7. Criss, R.E. Principles of stable Isotope distributions. Oxford University Press, U.K., 1999.
8. Lajtha, J. and Michener, R. Stables isotopes in ecology and environmental Science, Blackwell, U.K., 1994.

AG8203 IGNEOUS AND METAMORPHIC PETROLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course is an introduction to the igneous processes, physical and chemical characteristics of magma, and various rock types. It describes occurrence and geological setting of igneous rocks, metamorphic agents and formation of metamorphic rocks.

OUTCOME:

- Student will be able to understand the Igneous and metamorphic processes and evolution of earth resources and rock types.

UNIT I IGNEOUS PETROLOGY 9

Structure of the earth and origin of magmas, .Characteristics of Magma. Intrusive and extrusive igneous rocks. Textures of igneous rocks. Magma differentiation. Crystallization of magma. Ascent and emplacement of magmas. General classification of Igneous rocks

UNIT II PHASE DIAGRAMS & IGNEOUS ROCKS OF DIFFERENT TECTONIC SETTINGS 9

Two component phase diagrams: Definitions – Phase Rule – Two component eutectic systems – Incongruent melting – Solid solution systems – Exsolution. Ternary phase diagrams: Crystallisation in ternary systems. Igneous rocks of Ocean basins. Igneous rocks of convergent margins – Igneous rocks of Continental Lithosphere.

UNIT III DESCRIPTIVE PETROLOGY 9

Geochemistry, Petrography and Field relations of Calc-Alkaline Volcanic Suits, Calc-Alkaline Plutonic suits, Sub alkaline Basaltic and ultramafic suits, and Alkaline Suits. Distribution and tectono magmatic setting of important igneous complexes of India.

UNIT IV METAMORPHIC PETROLOGY 9

Texture and structure of metamorphic rocks. Nomenclature and description of metamorphic rocks. Basic concepts of metamorphic reactions. Diagrammatic representations of mineral reactions and mineral paragenesis – ACF, AKF, AFM diagrams.

UNIT V METAMORPHIC FACIES & METASOMATISM 9

Facies classification and systematic description of regional and thermal metamorphism pelitic, basic-ultabasic and impure calcareous rocks. Metasomatism, ultametasomatism and anatexis. Metamorphism and plate tectonics. Paired metamorphic belts – EPMA Studies – PT Estimates – ITD.

TOTAL: 45 PERIODS

REFERENCES:

1. Barker A.J. Introduction to Metamorphic Textures and Microstructures. 1st ed., Blackie, Glasgow; 2nd ed., Stanley Thornes, Cheltenham, 1998.
2. Best M.G., Igneous and Metamorphic Petrology, 2nd ed. Blackwell. UK, 2002.
3. Hall, Anthony, Igneous Petrology. Longman, UK1996.
4. Mason R., Petrology of the Metamorphic Rocks, 2nd ed. Unwin Hyman, London, 1990.
5. Tony Philpotts Principles of Igneous and Metamorphic Petrology, Cambridge University Press, UK, 2006

AG8204 SEDIMENTOLOGY AND SEDMENTARY PETROLOGY L T P C

3 0 0 3

OBJECTIVES:

- To study the sedimentation process, its physical and chemical characteristics to understand the sedimentary basin history to review its potentiality of the basin for economic resources exploration and to understand the geological framework with time and space.

OUTCOME:

- Student will be prepared to address the sedimentary basins to look for economic resources evaluation and exploitation programme.

UNIT I ORIGIN AND CLASSIFICATION OF SEDIMENTS 9

Weathering and erosion process, products, principles of sedimentation process, scope, applications, classification of sedimentary rocks, Basin forming processes, sediment transport mechanisms.

UNIT II SEDIMENTOLOGY 9

Sedimentary textures, structures-primary, secondary and biological structures. Provenance studies, diagenesis of sediments, frame work matrix and cement of terrigenous sediments. Definition, measurement and interpretation of grain size, roundness and sphericity, paleocurrent analysis.

UNIT III SEDIMENTARY FACIES 9

Facies modelling for marine, non-marine and mixed sediments, tectonics and sedimentation, cyclic sediments. Structure contours and isopach map.

UNIT IV SEDIMENTARY BASINS 9

Description of sedimentary basins of India, classification, interpretation to the depositional environment.

UNIT V SEDIMENTARY PETROLOGY 9

Description of Siliciclastic, argillaceous and carbonate sedimentary rocks: classification, texture, structure, origin, diagenesis and depositional environment of sandstones, conglomerate, breccias, shale, limestone and dolomite. Carbonaceous sedimentary rocks: evaporates, cherts, phosphorites and iron bearing sedimentary rocks.

TOTAL: 45 PERIODS

REFERENCES:

1. Tucker, M.E., Sedimentary Petrology, Blackwell Science U.K., 2001.
2. F.J. Pettijohn., Sedimentary Rocks third edition, CBS Publishers & Distributors, Reprint 2002.
3. Sam Boggs, Principles of Sedimentology and Stratigraphy. Pearson, USA, 2000.
4. Donald R. Prothero, Frederic Schwab., Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy W H Freeman, USA, 2003.
5. A. Bhattacharyya, C. Chakraborty., Analysis of sedimentary Successions.,Oxford and IBH Publishing Co. Pvt Ltd, New Delhi,2000
6. Mike D Blum,Susan B. Marriot, Suzanne F.Leclair, Fluvial Sedimentology ,2005., Blackwell Publishing.,London
7. Kenneth J Hsu., Physics of Sedimentology, 2004, 2nd edition., Publisher: Springer Verlag, London
8. Michael McLane Sedimentology, 1995., Oxford University Press,London

AG8211 EXPLORATION GEOPHYSICS LAB L T P C
0 0 3 2

OBJECTIVES:

- Practical training to the students on various geophysical instruments and techniques, field setup and collection of geophysical data. Also to impart analytical and interpretational skills to the students on various geophysical anomalies of geological materials.

OUTCOME:

- Better understanding on rocks and soil properties and interpretation for exploration of groundwater, petroleum, minerals and other natural resources, using geophysics.

UNIT I ELECTRICAL METHODS 9

Resistivity surveys – Wenner and Schlumberger methods – electrical sounding and profiling – problems on these methods –methods –calculation of auxiliary point

UNIT II FIELD SURVEY USING RESISTIVITY METER 9

Filed survey – sounding and profiling – SP methods - Interpretation of data – curve matching use of standard computer packages in interpretation

UNIT III SEISMIC METHODS 9

Problems on refraction and reflection methods – 3 layer and inclined beds – calculation based on intercept time and cross over distance

UNIT IV MAGNETIC AND GRAVITY METHODS 9

Problems on magnetic and gravity methods – preparation of anomaly maps – methods of corrections

UNIT V RADIOACTIVE METHODS 9

Problems on well logging – interpretation of data

TOTAL: 45 PERIODS

AG8212 GEOCHEMISTRY LAB L T P C
0 0 3 2

OBJECTIVES:

- To develop analytical skill and practical exposure on geochemistry to the students to understand the chemical properties of water, sediments and minerals. Also training on sophisticated analytical instrument handling in geochemistry and their application in geology.

OUTCOME:

- Better understanding on geochemistry of rocks, soil, water and other earth materials.

UNIT I ANALYSIS OF ORES 16

Dolomite, Galena, Haematite by titrimetric / gravimetric methods

UNIT II ANALYSIS OF WATER 20

Acidity, alkalinity, hardness by titrimetry, total dissolved solids by gravimetry, iron by spectrophotometry, sodium and potassium by flame photometry

UNIT III DEMONSTRATION EXPERIMENTS 9

PH, conductometry, IR, UV-visible spectrophotometry, AAS

TOTAL: 45 PERIODS

REFERENCES:

1. Jeffery, G.H., Bassell, J.Mendham, J and Denney, R.C (1994) Vogel's text book of quantitative chemical analysis, ELBS 5th Edn. England

AG8213 IGNEOUS AND METAMORPHIC PETROLOGY LAB L T P C
0 0 2 1

OBJECTIVES:

- Practical training to the students to handle the igneous rocks and metamorphic rocks in order to understand the origin, evolution and changes in their, environment, energy, besides characterization of minerals to address their role in geological processes for understanding and exploration various rock types. The development of skills for interpretation of Thin sections, and norm calculations.

OUTCOME:

- Students will be able to address different rock types, their occurrence and distribution to look for economic exploration programme.

UNIT I IGNEOUS PETROGRAPHY 10

Study of textures and structures of igneous rocks. - Systematic megascopic and microscopic study of the following igneous rocks: granite, granodiorite, syenite, diorite, gabbro, dolerite, basalt and rhyolite.

UNIT II METAMORPHIC PETRGRAPHY 10

Study of textures and structures of important metamorphic rocks - Systematic megascopic and microscopic study of important and common metamorphic rocks: Microscopic study of hornblende schist, mica-granite-schist, marble, quartzite, amphibolite, Charnockites etc.

UNIT III PETROCHEMICAL CALCULATIONS 10

Norm calculation and interpretation of chemical analysis of representative rocks using variation diagrams – Niggli – Maniar Picolli – Harker's – Niggli basis – CIPW Norms.

TOTAL: 30 PERIODS

AG8214 SEDIMENTOLOGY AND PALEONTOLOGY LAB L T P C
0 0 2 1

OBJECTIVES:

- Practical training to the students to handle the sedimentary rocks and sediments in order to understand the origin, erosion, transportation, depositional environment, energy, besides characterization of sediments to address its role in sedimentary basins for exploration of oil, coal, limestone, gypsum, silica sands, clays, etc. The development of skills for interpretation of SEM, XRD, heavy mineral suites, S-S-C ratio, paleogeographic maps, chemical test, Paleobathymetry, stratigraphic boundary, formation dating results.

OUTCOME:

- Preparation of man power for oil, coal, cement, industry and research institutions

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	Duration	Name	Quantity
1.	Macroscopic and microscopic identification of sedimentary rocks and sedimentary structures.	9	Rock physical test kit, microscopes, rock thin sections and Rock specimens	30
2.	Sieving analysis-River, marine, dune sediment grain size analysis, interpretation-CM plotting, histogram, calculation of statistical parameters and interpretation of sediment depositional environment	9	Sieving machine, sieve plates	2
3.	Interpretation of SEM–Recognisition of physical and chemical etch marks-determination of transportation and porosity	3	Standard SEM images	60

4.	Determination of sand-silt-clay ratio, clay mineral separation from sedimentary mixture.	3	Glass wares	10
5.	Identification of clay minerals using XRD	2	XRD charts	30
6.	Sediment core logging	1	Sediment core	1
7.	Panel diagrams- lithofacies map	1		
8.	Preparation of paleocurrent map	1		
9	Staining technique- identification of Carbonate minerals.	2	Chemicals, bowls, sample holder	30
10	Identification and morphological description of Invertebrate fossils and its age	4	Fossil specimens	30
11.	Exercises on microfossil separation technique,	2	Chemicals, faunal slides	30
12.	Microfossil identification methods, method of preparation of taxonomic notes of fossils	2	Faunal identification catalogs	5
13.	Stratigraphy boundary demarcation based on Index foraminifera.	1	Work table	**-**
14.	Trilinear diagram- plotting of fossil abundance and determination of environment of deposition	1	Work table	**-**
15.	Preparation of biofacies map Preparation of spatial and temporal charts.	4	Work table	**-**

AG8306 **ECONOMIC GEOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide the knowledge on geological processes responsible for mineral and ore formation, weathering and other secondary mineralization processes, patterns and global distribution of economic minerals, Indian mineral deposits and mineral economics and laws governing exploration of economic minerals.

OUTCOME:

- Preparation of professional Geologist to address the exploration of economic minerals and their management.

UNIT I PRINCIPLES OF ECONOMIC GEOLOGY 9

Introduction –The importance and history of mining - The nature and morphology of the principal types of ore deposit- Textures and structures of ore and gangue minerals-Fluid inclusion studies-Wall rock alteration-Geothermometry, Geobarometry, Paragenitic Sequence, Zoning and dating of ore deposits-Classification of mineral deposits.

UNIT II INTERNAL PROCESSES 9

Oregenesis- Ore deposits and ore minerals. Magmatic processes of mineralisation. Porphyry, skarn and hydrothermal mineralisation. Mineralisation associated with (i) Ultramafic, mafic and acidic rocks, (ii) greenstone belts, (iii) komatiites, anorthosites and kimberlites and (iv) submarine volcanism. Magma-related mineralisation through geological time. Stratiform and stratabound ores. Ores and metamorphism — cause and effect relations.

UNIT III SURFACE PROCESSES 9

Introduction – Principles of chemical weathering – lateritic deposits- clay deposits – calcrete-hosted deposits – supergene enrichment of Cu and other metals in near surface deposits – clastic sedimentation and heavy mineral concentration – placer deposits – chemical sedimentation – banded iron formations – phosphorites and evaporates.

UNIT IV GLOBAL TECTONICS AND METALOGENY 9

Patterns in the distribution of mineral deposits – continental growth rates - crustal evaluation and metallogenesis – metallogeny through time – plate tectonics and ore deposits. Application of fluid inclusion study and stable isotope geochemistry in understanding ore forming processes. Ore textures and paragenesis

UNIT V INDIAN MINERAL DEPOSITS AND MINERAL ECONOMICS 9

Occurrence and distribution in India of metalliferous deposits — base metals, iron, manganese, aluminums, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals — mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries. Building stones. Phosphorite deposits. Placer deposits, rare earth minerals. Strategic, critical and essential minerals. India's status in mineral production. Changing patterns of mineral consumption. National Mineral Policy. Mineral Concession Rules. Marine mineral resources and Law of Sea.

TOTAL: 45 PERIODS

REFERENCES:

1. Bateman, A. M. and Jensen, M. L. Economic mineral deposits, John Wiley and sons, New York. 1981.
2. Gailbert, J.M., Park, C. P. Jr. and Freeman, W. H. The geology of ore deposits, John Wiley and sons, New York. 1986.
3. Krishnaswamy, S. India's mineral resources, Oxford and IBH publishing, New Delhi. 1979.
4. Edwards, R. and Atkinson, K. Ore deposit geology, Ist Edition, Chapman and Hall. New Delhi, 1986.
5. Robb, L. Introduction to ore-forming processes, Blackwell publishing, U.K., 2005.
6. Anthony Evans, Ore Geology and Industrial Mineral, Jhon Wiley & sons, USA, 1993
7. R.M. Umathay, Mineral Deposits of India, Dattsons, New Delhi, India, 2006

AG8307 **ENGINEERING GEOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide the knowledge of geological investigation for site selection for engineering projects. Rock type and their engineering properties, suitability of site conditions for dam, Tunnel, coastal structure constructions.

OUTCOME:

- Preparation of professional Geologist to address the site and construction material evaluation for safe construction of Civil engineering projects.

UNIT I SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS 9

Field investigations, electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, Description of discontinuities, bed rock attitudes, thickness, calculation of True thickness and vertical thickness of bed rock. Geological information for slope stabilization.

UNIT II ENGINEERING PROPERTIES OF ROCKS AND SOILS 9

Rock description and engineering classification of rocks – weathering and its significance in engineering site- Engineering properties of rocks and soils, RMR, RQD methods, determination of engineering properties in field and laboratory.

UNIT III GEOLOGICAL INVESTIGATIONS FOR DAMS&TUNNELS 9

Dams -geological investigations- suitability of site, geological profile from catchment area to Dam site, lithology, structures, topography, slope, drainage system, water budget studies, Reservoir site investigations, siltation analysis, Geological investigations for soft rock and hard rock tunnels construction,

UNIT IV GEOLOGICAL INVESTIGATIONS FOR COASTAL DEVELOPMENT 9

Coastal erosion and accretion process and its impact. Geological investigations for harbor construction, Coastal protection structures-Sea walls, bulk heads, groins, jetties,

UNIT V GEOTECHNICAL STUDIES OF LANDSLIDES AND SUBSIDENCE 9

Landslide - Classification, causative factors, control measures. Land subsidence, factors, causes and remedial measures. Geological considerations for monitoring of landslides. geotechnical problems related to foundation for bridge and building site investigations

TOTAL: 45 PERIODS

REFERENCES:

1. Krynine and Judd. Principles of Engineering Geology and Geotechnology. McGraw Hill, New York, 1962.
2. Chandler. R.J. Slope Stability and Engineering Developments 1992.
3. Waltham, T. Foundations of Engineering Geology, SPON Press, London 2002, ISBN 0-415-25449-3,,.
4. Bell F G Engineering Geology, Second Edition by, 2007. Butterworth-Heinemann, Oxford
5. Sathya Narayanaswami. Engineering Geology. Dhanpat Rai and Co. 1710, Nai Sarak, Delhi-110006.. 2000
6. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub., I Ed.,UK,1994.

AG8308 **GEOLOGICAL REMOTE SENSING AND GIS** **L T P C**
3 0 0 3

OBJECTIVES:

- This course introduces principle and concepts of Remote Sensing and GIS, its applications for geology, natural hazards and environmental management.

OUTCOME:

- On completion of this course, student will be able to recognize geological and geomorphological features using image characteristics and will be able to perform image processing and can interpret satellite images for possible earth resources.

UNIT I REMOTE SENSING AND PHOTOGRAMMETRY 12

Introduction to remote sensing. Aerial and space borne platforms. Photogrammetry – principles and concepts. Image interpretation elements. Reflectance Properties of Geologic features in the various parts of EMR. Lithologic and structural mapping.

UNIT II GIS 9

Introduction to GIS. Type of data – spatial and non spatial data – data structure – vector and raster formats – hardware for GIS — scanner – digitizer – standard GIS packages - database concepts – data input – retrieval – Assigning rank and weightage for geologic studies, overlay analysis.

UNIT III GEOMORPHIC MAPPING 8

Introduction to Geomorphology, Significance of landforms - Image characters of landforms. Role of aerial photographs and satellite images in Geomorphic mapping.

UNIT IV GEOLOGICAL APPLICATIONS 8

Remote sensing and GIS for mineral exploration, ground water exploration and petroleum exploration. Case studies with methodology.

UNIT V REMOTE SENSING AND GIS FOR GEO HAZARDS AND ENVIRONMENTAL STUDIES 8

Integrated surveys using Remote sensing and GIS for mineral exploration, Groundwater studies, Coastal erosion and accretion, Landslides and Earthquake studies, Coastal Zone Management.

TOTAL: 45 PERIODS

REFERENCES:

1. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Private Limited, 2005 ISBN 8173715351, 9788173715358
2. Lillesand. TM.,Kiefer, R.W and Chipman, K.W. Remote sensing and image imterpretation Fifth Edition. Wiley. 2007.
3. Ravi P. Gupta, Remote Sensing Geology, Springer-Verlag New York, 2002.
4. Burrough, PA; and RA McDonnell. Principles of Geographic Information Systems. Oxford Press, U.K., 1998.
5. Wolf. P. R. Elements of Photogrammetry. Mc Graw Hill, Japan, 1993.
6. G. Rees. Physical Principles of Remote Sensing. Cambridge University Press, U.K., 2000.
7. SN Pandey, Principles and Applications of Photogeology: New Age International (P) Ltd., New Delhi. 1988.

AG8304 **HYDROGEOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- This course is an introduction to the hydrological process in the earth system, estimation of aquifer parameters and potential for groundwater development using geophysical approach and assessment of groundwater quality through hydro geochemical techniques.

OUTCOME:

- Student will gain knowledge on groundwater flow through earth system and skill to interpret potential for exploration of groundwater.

UNIT I INTRODUCTION **9**

Scope - Hydrologic cycle – hydrograph - origin and source - distribution of groundwater – aquifers – aquifer compressibility -porosity - rock properties – specific yield, storage coefficient – groundwater occurrence in various geological formations – geological structures – Hydrology of India.

UNIT II GROUNDWATER FLOW **9**

Darcy's law – validity of Darcy's law – hydraulic gradient - hydraulic conductivity – field mapping - flow nets – K estimation in lab and by tracer techniques - transmissivity – homogeneity and heterogeneity – isotropic and anisotropic formations – groundwater resources evaluation – unsaturated flow

UNIT III ESTIMATION OF AQUIFER PARAMETERS **9**

General groundwater flow equation – steady and unsteady radial flow towards wells – confined, unconfined and semi confined aquifers – impact of boundaries – multiple wells - estimation of aquifer parameters by pump tests – slug tests – well loss - groundwater recharge – groundwater modelling

UNIT IV GROUNDWATER DEVELOPMENT **9**

Advantage of groundwater use – Construction of wells – shallow and deep wells – methods of well completion and development – testing for yield - safe yield – horizontal wells – galleries - interference between wells and aquifer boundaries - aquifer response to pumping - land subsidence – Groundwater recharge.

UNIT V GROUNDWATER QUALITY **9**

Constituents in groundwater – dissolved ions – chemical analysis – reporting of results – groundwater quality for various uses - geochemical evolution of groundwater - sources of contaminants – solute and particle transport – remediation - seawater intrusion - Case studies.

TOTAL: 45 PERIODS

REFERENCES:

1 Domenico P.A. and F.W. Schwartz, Physical and chemical hydrogeology. John Wiley 1990.
2 Fetter,C. W.,Applied Hydrogeology,(3rd edition),New York,Macmillan,1994
3 Freeze, R.A and Cherry, J.A, Groundwater, Prentice Hall, 1979
4 Elango, L and Jayakumar, R (Eds.) Modelling in Hydrogeology, Unesco-IHP Publications, Allied Publ, 2001
5 Elango, L (Ed.) Hydraulic conductivity – Issues, Determinations and applications, Intech Open Acces Publishers, ISBN 978-953-307-288-3, 434 P. 2011.
6 Todd, D.K Groundwater Hydrology, John Wiley, 1979
7 Hiscock, K, Hydrogeology: Principles and Practice, Wiley-Blackwell, 2005

AG8305	PETROLEUM GEOLOGY	L T P C 3 0 0 3

OBJECTIVES:

- To provide the knowledge on exploration of Petroleum deposits in sedimentary basins, the method of basin analysis, application of sedimentology, geophysics and biostratigraphy in oil exploration, insight to the oil field development methods.

OUTCOME:

- Prepare the student for job in oil industries. To train in the concepts of oil exploration methods and to address the techniques in exploration of petroleum deposits

UNIT I PROCESS OF FORMATION OF HYDROCARBONS 9

Fundamental concepts of organic and inorganic theories of hydrocarbon. Sedimentary processes and accumulation of organic matter-diagenesis, catagenesis and metagenesis of organic matter. Generation, migration and accumulation of oil, examples of oil fields of India.

UNIT II BASIN ANALYSIS 9

Interpretation of surface and subsurface stratigraphic units. Characterization of sediments to its petrophysical nature, diagenesis signatures, porosity, fabric constituents, accommodation, rate of sedimentation, thickness, maturity, basin structure, tectonic history of the sedimentary basins.

UNIT III DEPOSITIONAL SYSTEMS 9

Seismic method of hydrocarbon reservoir exploration. Seismic profiles interpretation techniques, seismic reflection patterns and to decipher the depositional and structural features. Depositional systems, classification, significance in petroleum exploration. stratigraphic cycles

UNIT IV WELL-LOGGING, SOURCE ROCK GEOCHEMISTRY AND BIOSTRATIGRAPHY TECHNIQUES 9

Well logging techniques, interpretation of logs, geochemical parameters, determination of TOM, TOC, VRO,TTI, and TAMR. Biostratigraphy- study of planktic and benthic foraminifera, paleobathymetry analysis.

UNIT V OIL FIELD DEVELOPMENT 9

Well site geological operations, drilling methods, drilling fluids, formation testing, well completion, crude oil types, oil reservoir evaluation.

TOTAL: 45 PERIODS

REFERENCES:

1. A. T. Levorsen Geology of Petroleum CBS publishers and distributors, Delhi, II Edition 1999.
2. Tissor and D. H. Welte Petroleum formation and occurrence Springer Velag, Tokyo, 1984.
3. D. W. Lewis and Mc Conchie Analytical Sedimentology Chapman & Hall, New york, 1994.
4. JH Doveton Geological log interpretation Society of sedimentary geology, Tulsa 1994.
5 G. Henery Geophysics of sedimentary basins, Technip, Rue Ginoux, Paris 1994.

AG8312 GEOLOGICAL REMOTE SENSING AND GIS LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- Practical training to the students on aerial photos and satellite image interpretation, Digitization and generation of thematic maps in a GIS, Buffering and layer analysis for geologic applications.

OUTCOME:

- A thorough knowledge on image interpretation and GIS mapping for various earth resources and hazards mitigation and management.

Sl. No.	Details of Experiment		Details of Equipment / Instrument Required for a batch of 25 Students	
	Name	**Duration in hours**	**Name**	**Quantity**
1.	Elements of aerial photos, satellite images and topographic maps	2	Aerial photographs, satellite images, topographic maps	50 photos, 25 images, 25 maps
2.	Setting up of stereoscope, determination of stereoscopic acuity and orientation of aerial photographs under a stereoscope	2	Stereoscopes and aerial photographs	6 numbers
3.	Interpretation of aerial photographs and delineation of tonal and textural units.	2	Stereoscopes, tracing paper and aerial photographs	6 numbers
4.	Aerial photos: Lithologic interpretation	2	Stereoscopes, tracing paper and aerial photographs	6 numbers
5.	Aerial photos: Structural interpretation	2	Stereoscopes, tracing paper and aerial photographs	6 numbers
6.	Aerial photos: Geomorphic interpretation	2	Stereoscopes, tracing paper and aerial photographs	6 numbers
7.	Satellite imagery: Lithologic interpretation	2	Satellite images and tracing paper	25 numbers
8.	Satellite imagery: Structural interpretation	2	Satellite images and tracing paper	25 numbers
9.	Satellite imagery: Geomorphic interpretation	2	Satellite images and tracing paper	25 numbers

10.	Contrast Enhancement, Ratioing, PCA and fusion of digital images to extract geologic details	2	Computers, Image processing software and digital satellite images	12 numbers
11.	Unsuprvised classification of satellite images to extract geologic details	2	Computers, Image processing software and digital satellite images	12 numbers
12.	Supervised classification of satellite images to extract geologic details	2	Computers, Image processing software and digital satellite images	12 numbers
13.	Digitization and generation of thematic maps in a GIS	2	Computers,Image processing and GIS software	12 numbers
14.	Buffering and layer analysis for geologic applications – Groundwater and minerals	2	Computers, Image processing and GIS software	12 numbers
15.	Buffering and layer analysis for geologic applications – Landslide and coastal.	2	Computers,Image processing and GIS software	12 numbers

AG8313 HYDROGEOLOGY LAB L T P C
0 0 2 1

OBJECTIVES:

- Practical training to the students to understand the origin and characters of aquifers, determination of aquifer parameters using various tests, water budgeting and quality determination of groundwater.

OUTCOME:

- On completion of this course, students will be able to explore for groundwater potential zones and management of groundwater quantity and quality.

UNIT I POROSITY AND HYDRAULIC CONDUCTIVITY 8

Groundwater prominence – Hydrological cycle-problems using porosity and specific yield-Hydraulic conductivity – vertical and horizontal-groundwater gradient and contour map preparation-flow velocity – properties of various geological formations-permeameter experiments

UNIT II AQUIFER PARAMETERS 8

Determination of hydraulic conductivity in lab – problems on groundwater flow to wells - steady and unsteady flow – estimation of transmissivity and storage coefficient of wells-aquifer compressibility.

UNIT III WATER BUDGETING 8

Unsteady flow - Theis recovery methods - Use of computer codes to understand groundwater flow in aquifers – slug tests-water budgeting

UNIT IV GROUNDWATER QUALITY 6

Determination of ion balance error – problems on hydrochemistry – preparation of water quality diagrams-drinking and irrigation water quality

AG8001 ADVANCED REMOTE SENSING TECHNIQUES AND GIS FOR GEOLOGIC APPLICATIONS L T P C 3 0 0 3

OBJECTIVES:

- This course introduces principle and concepts of Remote Sensing and GIS, its applications for geology, natural hazards and environmental management.

OUTCOME:

On completion of this course, student will be able to recognize geological and geomorphological features using image characteristics and will be able to perform image processing and can interpret satellite images for possible earth resources

UNIT I HIGH RESOLUTION SENSORS AND HYPERSPECTRAL IMAGING DEVICES 9

Introduction - need for high resolution data.- Characteristics, specifications and applications . Spectrographic imagers-hyperspectral sensors- airborne and space borne..

UNIT II IMAGE PROCESSING AND INFORMATION EXTRACTION 9

Concept of pure and mixed pixels, Hard and soft classification – Per-pixel and Sub-pixel classification techniques - spectral unmixing- linear and non-linear, Fuzzy logic - Fuzzy land cover boundaries, Fuzzy pattern classifiers and fuzzy classification techniques. Neural network - fundamentals- applications in improving classification accuracy. Feature extraction and selection.

UNIT III GEOGRAPHIC INFORMATION SYSTEM (GIS) 9

Introduction - map - characteristics - projection - Computer Assisted cartography. GIS - Components of GIS - Integration of GIS with remote sensing. Data Base Structures, Spatial, Non spatial, Raster - Vector - Arc Node, DIME, DLG, Polygon - Topology - Data base - Hierarchical, Network & Relational.

UNIT IV DATA ANALYSIS & MODELLING USING GIS 9

Analysis of Non-spatial data - SQL - Integrated analysis of spatial & Non-spatial data - Retrieval, Surface Topographic & connectivity operations - Modeling.

UNIT V APLICATIONS OF GIS 9

Application to groundwater / recharge studies - landslides - Mineral investigation - Petroleum exploration using GIS - GIS and ore- body modeling - coastal studies,

TOTAL: 45 PERIODS

REFERENCES:

1. Schowengerdt, R. A., Remote sensing - Models and methods for image processing. Academic press. London.1997.
2. Richards,J.A, Remote Sensing Digital Image Analysis.,Springer-Verlag, London 1986,
3. Duda R.O & Hart PE,Pattern classification & Scene Analysis.. Wiley,New York, 1973.
4. Morton Nadia & Eric Smith P, Pattern Recognition Engineering. John Wiley, New York, 1993.
5. Robert Laurini and Derek Thompson, Fundamentals of Spatial Information Systems, Academic Press. London. 1996.

AG8002 **APPLIED HYDROGEOCHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES:

- This course introduces processes in groundwater, their chemical parameters and evolution, flow and transport processes. It also describes methods of sample collection and hydro geochemical modelling.

OUTCOME:

- On completion of this course, student will be able to understand and model flow and transport pattern of groundwater system.

UNIT I GROUND WATER CHEMISTRY 9

Equilibrium and redox reaction – activity coefficients – solution – precipitation – saturation indices with respect to common minerals adsorption – ion exchange processes in ground water.

UNIT II SAMPLE COLLECTION AND PARAMETERS 9

Chemical parameters – sampling and influence of well conditions- sampling for environmental isotopes – pore water sampling – calculation of parameters – representation of results – hydrochemical sections – statistical diagrams and techniques.

UNIT III GROUND WATER CHEMICAL EVOLUTION 9

Hydrochemical sequences – major – ion evolution – groundwater in carbonate terrain – crystalline rocks – sedimentary deposit – interpretation of isotope data.

UNIT IV FLOW AND TRANSPORT 9

Transport processes – advection – dispersion – diffusion – hydrochemical processes during flow – influence of saline waters.

UNIT V HYDROGEOCHEMICAL STUDIES 9

Chemical processes in relation to hydrogeology – regional Hydro geochemical studies – mixing of waters – Hydro geochemical models – case studies.

TOTAL:45 PERIODS

REFERENCES:

1. Lloyd, J. W. and Heathcote, J. A. National inorganic hydrochemistry in relation to groundwater, Oxford University press, 1985.
2. Freeze, R. A. and Cherry, J. A. Groundwater, Prentice Hall, 1979.
3. Stumm, W. and Morgan, J. J. Aquatic chemistry, An introduction emphasizing chemical equilibria in natural waters, Wiley interscience, New York, 1981.
4. Garrels, R. M. and Christ, C. L. Solutions, minerals and equilibria, Harper and Row, New York. 1965.

AG8003 **COAL GEOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide the knowledge on geological processes responsible for coal formation, grading and exploration, reserve estimation and resource management with knowledge on Indian occurrence.

OUTCOME:

- Preparation of professional Geologist to address the exploration of coal and its management.

UNIT I CHARACTERISTICS 9

Coal as rock – types of coal – mode of occurrence – structure in coal streams – coals through ages – physical and chemical characteristics of coal – macropetrographics – microlithotypes.

UNIT II GENETICS AND EXPLORATION 9

Origin - classification of coal – Indian coal grading – exploration of coal – Modern techniques – drilling and logging- assessment of coal reserves - calculation of coal reserves.

UNIT III PREPARATION AND UTILISATION 9

Coal Preparation - cleaning – sizing – washing – supporting operations – Beneficiation of Indian coals – Coal utilization - combustion – carbonization – gasification – hydrogenation.

UNIT IV RESOURCES AND ENVIRONMENT 9

Resources – Production and consumption pattern – Energy policy, conservation – environment pollutant – reduce environmental hazards – mining hazard in India, world coal resources – principal coal fields of the world.

UNIT V INDIAN COALFIELDS 9

Occurrences – geological and geographical distribution – Gondwana coalfields – Tertiary coalfields – lignite deposits in India.

TOTAL: 45 PERIODS

REFERENCES:

1. Chandra, D., Singh, R. M. and Singh, M. P. Text book of coal (Indian context). Tara book agency, Varanasi. 2000.
2. Stach, E. Mackowsky, M. Th., Teichmuller, M., Taylor, G.H., Chandra, D. and Teichmuller, R. Stach's Text book of coal petrology, Gebnudar Borntraeger, Stuttgart, 1982.
3. Wilfrid Francis. Coal its formation and composition . Edward Arnold (Publishers)Ltd. London 1961.
4. Van Kreuelen. Coal – Typology – Chemistry – Physics Constitution. Elsievier publishing company, London 1961.

AG8004 **EARTHQUAKE DISASTER AND MITIGATIONS** **L T P C**
3 0 0 3

OBJECTIVES:

- This course introduces phenomena and characteristics of earthquakes, seismic waves, geodynamic processes and plate tectonics. Also it describes fault plane solution, vulnerability and risk management for seismic hazards, PGA based seismic micro zonation, prevention and capacity building for seismicity and enhancing public awareness.

OUTCOME:

- The student will be trained to prepare vulnerability analysis and risk assessment for seismic hazards, planning and execution of mitigation measures.

UNIT I FUNDAMENTALS OF SEISMICITY 9

Earth structure and plate tectonics – Strain accumulation – elastic rebound and faulting – energy release and seismic waves – physical parameters of earthquake source – magnitude – seismic moment and fault plane solution – geological and seismological input for Seismicity evaluation on magnitude – frequency relations.

UNIT II SEISMIC RISK ANALYSIS 9

Intensity and earthquake strong motion – seismic hazard analysis and estimation of design ground motions – seismic hazard mapping – seismic zonation and response – design codes – protective and reducing measures for infrastructures and structures – regulation of land use – risk assessment – vulnerability analysis.

UNIT III APPLIED SEISMIC HAZARD ASSESSMENT 9

Assessment of geological seismic hazards – site response and seismic microzonation – mapping of hazards de to liquefaction and earthquake – induced landslides – use of Geographical Information System for hazard mapping and seismic risk assessment.

UNIT IV CASE STUDIES 9

Case studies – National and International major events – dam failures – induced Seismicity – structural damage – lessons learnt – techniques for field investigations.

UNIT V SOCIO-ECONOMIC SYSTEM 9

Impact of disasters on national development – disaster legislation – public education – need, types of training – public awareness – information channels – organization of programs – sociology, psychology and economics of disasters – cost of mitigation measures – cost analysis.

TOTAL:45 PERIODS

REFERENCES:

1. Bell, F. G. Geological hazards: Their assessment, avoidance and mitigation. E and FN SPON, Routledge, London, 1999.
2. David Alexander. National disasters. UCL Press, London. Research press New Delhi, 1993.
3. Moores, E. M. and Twiss, R. J. Tectonics. W. H. Freeman and company, New York, 1995.
4. Nick Carter, W. Disaster management- A disaster manager's handbook. Asian Development Bank, Phillippines, 1991.
5. Penelis, G. G. and Kappos, A. J. Earthquake-resistant concrete structures, E and FN SPON, London, 1997.

AG8005 ENVIRONMENTAL GEOCHEMISTRY L T P C

3 0 0 3

OBJECTIVES:

- To study the chemical environment of earth in all its three spheres, and application of chemistry in geology. Also to understand various surface guides for exploration of economical ores and minerals.

OUTCOME:

- Better understanding on geochemistry of rocks and minerals in different environments and interpretation of geochemical pathfinders for economical minerals and ores.

UNIT I PRINCIPLES OF ENVIRONMENTAL GEOCHEMISTRY 9

The science of Geochemistry – Its OBJECTIVEs, its relationship to other geosciences and its methodology. The natural workings of the Earth: Natural distributions of chemicals in global and local environments. Geochemistry of the Earth: The birth of matter in our solar nebula, formation of the solar system and early geochemical history of the earth. The geochemical cycle – Distribution of elements in rocks

UNIT II THE CONTINENTAL ENVIRONMENT 9

Hydrologic cycle – Dissolution and precipitation of silica, aluminum and iron hydroxides - Geochemistry of surface and ground waters – Rivers, ground water and lakes. Complex formation and chelation. Metals and nonmetals. Radioactive isotopes and radioactive waste.

UNIT III MARINE ENVIRONMENT 9

Physical and chemical properties of open ocean seawater chemistry. Trace metals in sea waters. Types of metal distributions. Geochemistry of marine sediments. Marginal marine environments. Perturbations caused by humans: chemical distributions in anthropogenically "perturbed" systems.

UNIT IV ENVIRONMENTAL MINERALOGY 9

Basic mineralogy – Definition of a mineral – Types of minerals – Crystal chemistry – X – ray Crystallography. Basic silicate structures – zeolites – asbestos minerals – health effects of asbestos exposure. Mineral-microorganism interactions.

UNIT V GEOCHEMICAL EXPLORATION ENVIRONMENT 9

Introduction – Primary Dispersion pattern Secondary dispersion pattern. Background values – Geochemical anomaly – Geochemical sampling - Weathering – Soils.

TOTAL:45 PERIODS

REFERENCES:

1. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., 1996.
2. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC., 1998.
3. Nelson EBY, G., Principles of Environmental Geochemistry, Thomson Brooks/Cole, 2004.
4. Fraure, G, Principles of isotope geology, John Wiley, Second edition. 1986.

AG8006 ENVIRONMENTAL GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To teach the importance of impact of natural and anthropogenic activities on geological processes and ecosystem. This course describes the magnitude of geology in environmental impact assessment, natural hazards and their effects on environment.

OUTCOME:

- On completion of this course, students will have better understanding on the natural and anthropogenic processes and their impacts on environment.

UNIT I GEOLOGIC ENVIRONMENTS 12

Concept and scope of environmental geology – understanding earth processes and landforms; Geological characteristics of various environmental regimes – fluvial, coastal, marine, Aeolian, desert, and glacial. - Landforms as ecosystem units – Geomorphic controls on biodiversity and its conservation.

UNIT II TERRESTRIAL ENVIRONMENT 8

Environmental degradation due to mining and ore beneficiation – impact and management – Indian case studies - soil and mineral resources and their conservation

UNIT III AQUATIC ENVIRONMENT 8

Geological factors influencing the formation of surface, groundwater and marine Waters – geological basis of groundwater, surface and marine water pollution and management with Indian case studies

UNIT IV GEOLOGY IN ENVIRONMENTAL PLANNING AND MANAGEMENT 8

Environmental impact assessment – geological appraisal of waste disposal sites - geology in planning and siting of land fills - problems of deep well disposal, radioactive waste management - land use planning in EIA

UNIT V GEOLOGICAL HAZARDS AND GLOBAL ENVIRONMENTAL CHANGE 9

Causes, types, Mitigation and Management of earthquakes, landslides, tsunami and volcanoes. **;** Causes and Indicators of global environmental change

TOTAL: 45 PERIODS

REFERENCES:

1. Montgomery, C.W. Environmental Geology, Won. C. Brown, Publishers, Iowa, 1989.
2. Dorothy Merritts, Andrew de Wet, Kirsten Menking, Environmental Geology W. H. Freeman & Co. and Sumanas, Inc. USA, 1997
3. Valdiya, K. S, Geology, Environment and Society, Universities Press, India, 2004

AG8007 ENVIRONMENTAL HYDROGEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To teach importance of impact of natural and anthropogenic activities on the hydro geological processes and management of waste disposal and mitigation of groundwater contamination.

OUTCOME:

- On completion of this course, students will be capable of designing waste disposal sites by avoiding ground water contamination, protection of groundwater and management.

UNIT I INTRODUCTION 9

Hydrological cycle - geological formations as aquifers - aquifer parameters - their estimation - groundwater flow and recharge - environmental impacts related to hydrogeology

UNIT II HYDROGEOLOGICAL IMPACTS 9

Mass movements - land subsidence - causes - hydro compaction – sink holes – natural compaction - groundwater problems in mines and slopes

UNIT III GEOLOGICAL ASPECTS OF WASTE DISPOSAL SITES 9

Physiographic - nature of rock types - structure - hydrogeological considerations - data required - formation fluid tests - transport mechanisms of polluted groundwater

UNIT IV GROUNDWATER CONTAMINATION 9

Water quality standards – transport processes – sources of contamination – oil spills – deep well disposal site locations – sea water intrusion - hydrogeological systems and monitoring

UNIT V GROUNDWATER PROTECTION 9

Groundwater contamination - methods of assessment - application of groundwater modeling - damage prevention - remediation of aquifers – bio remediation of contaminated aquifers

TOTAL: 45 PERIODS

REFERENCES:

1. Soliman, M.M et al . Environmental Hydrogeology, Lewis Publ., 1997
2. Freeze, R.A and Cherry, J.A Groundwater, Prentice Hall, 1979
3. Coates,D.R. Environmental Geology, John Wiley, 1981
4. Keller, E.A, Environmental Geology, Columbus, 1985
5. Marcel van der Perk, Soil and Water Contamination: From Molecular to Catchment, Scale, Taylor and Francis, 2006
6. Appelo, C.A.J. and D. Postma, Geochemistry, Groundwater and Pollution, Taylor & Francis; 2 edition,, 2005.

AG8008 GEOPROSPECTING L T P C
3 0 0 3

OBJECTIVES:

- This course gives fundamental knowledge to the student on exploration of economic minerals and ores. It describes various techniques and methods used in exploration of minerals.

OUTCOME:

- This course gives additional knowledge to the student on prospecting of economic minerals and ores. The student will be having thorough knowledge on various geophysical and geochemical prospecting techniques.

UNIT I GEOLOGICAL PROSPECTING 9

Geological prospecting- field survey and mapping techniques - field equipments- methods of mapping- pits and trenches- sampling-geological map preparation.

UNIT II ELECTRICAL METHODS 9

Geophysical prospecting- electrical methods- resistivity, self potential methods- interpretation - application in mineral prospecting – groundwater targeting electrical logging methods in oil exploration.

UNIT III SEISMIC METHODS 9

Seismic methods- refraction and reflection method- interpretation of seismic data- application- identification of geological structures-oil fields location- analysis of 3-D seismic data in oil exploration.

UNIT IV MAGNETIC AND GRAVITY METHODS 9

Magnetic method - types of magnetometer-field survey- anomaly- interpretation and prospecting - gravity methods- gravimeter-identification of size and shape of bodies-correction of the data- application in mineral exploration.

UNIT V GEOCHEMICAL PROSPECTING 9

Geochemical prospecting- anomaly- background values- mobility of ions-associated elements-path finder elements-surface indicators - geobotanical methods – application in mineral exploration.

TOTAL: 45 PERIODS

REFERENCES:

1. Lahee, Field geology, CBS pub, New Delhi, 1987.
2. Dobrin, Geophysical prospecting, McGraw hill, New Delhi ,1981.
3. Mason, B., Introduction to geochemistry, John Wiley, USA, 1982.
4. Chaussier, J.B., and Mores, J Mineral Prospecting manual, North Oxford Academic press,1987.
5. Butler, B.C.M and Bell, J.D, interpretation of geological maps, Longman Scientific & technical Publ.,1st ED., New Delhi, 1988.

AG8009 GROUNDWATER CONTAMINATION L T P C
3 0 0 3

OBJECTIVES:

- To teach the significance of groundwater contamination and ecosystems. It also describes the importance of geology in understanding the causes for groundwater contamination and its effects on environment.

OUTCOME:

- On completion of this course, students will have better a understanding on the processes and causes of groundwater contamination.

UNIT I INTRODUCTION 9

Groundwater occurrence and flow – types of porosity – transmissivity and storage coefficient - significance in groundwater contamination - sources of contamination – landfills

UNIT II TYPES OF CONTAMINATION 9

Types – point and non point sources – natural and anthropogenic - organic and poly aromatic compounds – biological – other sources –gasoline spills on the water table - chlorinated solvent spills which sink

UNIT III IDENTIFICATION OF CONTAMINATION 9

Application of electrical conductivity measurement for soil and groundwater contamination - Application of Ground Penetration Radar and other methods

UNIT IV TRANSPORT PROCESS 9

Advection, dispassion and diffusion-sorption, biodegradation, transformation, retardation and attenuation of solutes – radionuclide transport

UNIT V REMEDIATION 9

Waste site characterization-Geochemical modelling-Modeling concepts -Thermodynamics - groundwater quality - Emerging remediation methods, including surfactant and co-solvent soil flushing

TOTAL:45 PERIODS

REFERENCES:

1. Philip B. Bedient, Hanadi S.Rifai and Charles J. Newll Ground Water Contamination: Transport and Remediation (2nd Edition) , 1999.
2. Fetter, C.W., Contaminant hydrogeology (2nd Edition), 2008.
3. Geophysics study committee., Groundwater Contamination:National Academy Press., Washington D.C ,1984.
4. Michael J. Barcelona., Contamination of Groundwater: prevention, assessment, restoration., Noyes data corp., 1990.
5. Reza M. Khanbilvardi., John Fillos., Groundwater hydrology, contamination and remediation., Science publication, 1986

AG8010 INDUSTRIAL GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course teaches the student on industrial aspects of exploration of economic minerals and ores. It describes various mineral economics and conservation of minerals, mineral policies and environmental impact assessment.

OUTCOME:

- This course gives additional knowledge to the student on prospecting of economic minerals and ores. The student will be having thorough knowledge on various legal aspects pertaining to exploration and exploitation of minerals and ores.

UNIT I ECONOMICS IN MINERAL EXPLORATION 9

Economic Considerations in Mineral Exploration; Systematic approach to Exploration Expenditure; In-situ and Mineable Reserves; Pit Optimization; Bulk Sampling; Pilot Plant Studies; Demand and Price Projections.

UNIT II MINERAL/MINE ECONOMICS AND FINANCE 9

Source of Mine Finance; Factors governing profitability; Concepts of Depreciation, Depletion, Present value, Cash Flow and DCF; Costs-Capital, Fixed / variable, Ownership; P & L Account; Balance Sheet.

UNIT III MINERAL PROJECT EVALUATION 9

Time Value of Money; Project Evaluation Technique-Pay Back, Discounted Pay Back, DCF,IRR; Project Ranking; Sensitivity analysis; Feasibility study-Prospect and Operating Mines; Preparation of Mine Plan under Mineral Concession Rules.

UNIT IV MINERAL CONSERVATION 9

Growth of the awareness; Means of conservation; Limitations in Scope; Wealth from Mineral waste; Co-products and By-products; Substitute for Minerals.

UNIT V MINERAL POLICIES AND ENVIRONMENT 9

National Mineral Policy; Prospecting License and Mining Lease; Mines Act, CMR, MMR, Mines Rules, MMRD Act and Rules, EMP, EIA.

TOTAL: 45 PERIODS

REFERENCES:

1. Gentry, D.W & O'Neill J.O 1984. Mine Investment Analysis, New York: Society of Mining Engineers of American Institute of Mining, Metallurgical and Petroleum Engineers.
2. Ian Runge, C. 1998 Mining Economics and Strategy, Littleton USA: Society of Mining, Metallurgy and Exploration, Inc.
3. Chatterjee, Kaulir Kishore, 2003, Introduction to Mineral Economics, Chennai, Wiley Eastern Limited and Lakshmi Publications.
4. Bruce, A.K. 1990 Surface Mining, Colorado, Society for Mining, Metallurgy and Exploration, Inc. Published Mines/Minerals Legislations
5. Ghosh A.K. & Bose, L.K. 2003, Mining in the 21st Century, New Delhi, Oxford & IBH Published Company Pvt Limited.

AG8011 MARINE GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To teach the Ocean geological resources exploration and exploiting methods, instrumentations, Ocean environment, Ocean geology.

OUTCOME:

- Preparation of man power to address the ocean resources and environment.

UNIT I PHYSICAL FEATURES OF THE OCEAN 9

Introduction and scope of Marine Geology; oceanic profile, oceanic features; beaches, coastal classification, erosion and accretion; waves, currents and tides, coastal protection structures

UNIT II OCEAN RESOURCES 9

Classification of marine mineral deposits. Origin and depositional system of marine resources; beach placers, shelf deposits, deep ocean Phosphatic, Polymetallic nodules, sulfate deposits, hydrocarbon deposits Sea water as a resource.

UNIT III OCEANOGRAPHIC INSTRUMENTATIONS 9

Descriptions of research vessels, cruise, position fixing in the sea; sampling devices – Grab samplers, bottom samplers, dredges, sediment traps, boomerang samplers, water samplers, Winches, temperature measurement instruments, tools for studying ocean floor topography. POD, COD, GOD and BOD tools kit.

UNIT IV SEA WATER AND MARINE POLLUTION 9

Concept of sea level changes, physical and chemical properties of seawater. Marine pollution-pathways, residence time, pollutants in the marine environment.

UNIT V OCEANIC CRUST, SEDIMENTS AND LAW OF THE SEA 9

Origin of oceanic crust, ocean sediments, classification, digenesis, Ocean tectonics. Law of the sea, EEZ. Fundamentals of Remote sensing applications to ocean science.

TOTAL: 45 PERIODS

REFRENCES:

1. J.J. Bhatt. Oceanography – Exploring the Planet Ocean. D. Van. Nostrand Company, New York, 1994.
2. Shepard, F. P. Submarine Geology, Harper and Row Publ. New York, 1994.
3. Kerth. S, Ocean Science, John Wiley and Sons. Inc. New York. 1996.
4. James, K, Marine geology Prentice Hall, Inc. Englewood Clifs. N. J. 07632.
5. Eric. C. Bird Coasts: an introduction to coastal geomorphology, III ed. Basil Black well Publ. 1984.

AG8012 MEDICAL GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To teach the significance of contaminants, pollutants and toxicants in altering the natural geochemical systems. It also describes the importance of geology in understanding human health.

OUTCOME:

- On completion of this course, students will have better a understanding on the processes and causes of human interference in geological environment and its impact on human health.

UNIT I INTRODUCTION 9

The Foundations of Medical Geology, Geochemical Classification of the Elements, Contributions to Medical Geology from Public Health and Environmental Medicine, Development of Medical Geology.

UNIT II PATHWAYS AND EXPOSURES 9

Volcanic Emissions and Health, Radon in Air and Water, Arsenic in Groundwater and the Environment, Fluoride in Natural Waters, Water Hardness and Health Effects, Bioavailability of Elements in Soil, Selenium Deficiency and Toxicity in the Environment, Soils and Iodine Deficiency.

UNIT III GEOLOGY HUMAN HEALTH 9

Natural Distribution and Abundance of Elements, Anthropogenic Sources, Uptake of Elements from a Chemical Point of View, Uptake of Elements from a Biological Point of View, Biological Functions of the Elements ,Geological Impacts on Nutrition, Biological Responses of Elements

UNIT IV GEOPATHOLOGY AND TOXICOLOGY, 9

Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Toxicology, Speciation of Trace Elements. Geophagy and the Involuntary Ingestion of Soil, Natural Aerosolic Mineral Dusts and Human Health, The Ecology of Soil-borne Human Pathogens, Animals and Medical Geology

UNIT V TECHNIQUES AND TOOLS 9

Mapping Geological factors for human health using RS and GIS - Investigating Vector-Borne and Zoonotic Diseases, Mineralogy of Bone, Inorganic and Organic Geochemistry Techniques, Histochemical and Microprobe Analysis in Medical Geology.

TOTAL:45 PERIODS

REFERENCES:

1. Miomir M. Komatina, Effects Of Geological Environments On Human Health, Burgess Publishers - 2004
2. Olle Selinus, B. J. Alloway, Essentials of medical geology: impacts of the natural environment on public health, Lewis Publishers, USA - 2005
3. C. B. Dissanayake, Rohana Chandrajith, Introduction to Medical Geology, Lewis Publishers, USA - 2009
4. Rolf O. Hallberg, Medical geology, Environmental geology – Burgess Publishers, 2007
5. Miomir Komatina, Base of medical geology, Lewis Publishers, 2007

AG8013 MICROPALAEONTOLOGY AND PALYNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To train the students on applications of micropaleontology for exploration of hydrocarbon and other minerals, and interpretation of stratigraphic architecture. The Paleontology knowledge equips the students to understand paleoenvironment of sedimentary system.

OUTCOME:

- Students will develop the knowledge on sedimentary basin history and environment to review it's potentially for resource evaluation

UNIT I INTRODUCTION 9

Introduction to Micropaleontology-scope, use and its applications in oil industries and Paleo-ecology studies, Methodology – separation of microfossils from matrix; mounting technique; identification and classification procedures.

UNIT II MICROFOSSILS AND ITS APPLICATIONS 9

Study of microfossils from Precambrian- Quaternary; applications – age determination, paleofacies; Interpretation of tectonics from micro faunal evidence.

UNIT III FORAMINIFERA 9

Foraminifera – Diamorphism, structure and test, classification of foraminifera; distribution through geological ages; ecology of foraminifera. Uses in sequence biostratigraphic studies.

UNIT IV OSTRACODA **9**

Ostracoda-classification, ornamentation, orientation of carapace, microfossiles utility-environment significance; marine, non-marine environments and mixed environments.

UNIT V PALYNOLOGY **9**

Introduction–definition, concept, potential and prospects; Palynofossils classification; affinity of spore, pollen, diatoms and dinoflagellate. Maceration technique; general morphology of acritarchs, fungi, stratigraphic importance Palynology in coal and oil exploration.

TOTAL: 45 PERIODS

REFERENCES:

1. G. Bignot. Elements of Micro paleontology, Graham and Trotman International Student edition. Bordas Dunod Paris. 1992.
2. Tschudy, R. H. & Scott, R. A. Aspects of Palynology, wiley interscience, New York. 1999.
3. N.K.N. Aiyengar, K. N. Prasad, An Introduction to Invertebrate Paleontology, New Delhi. 1996.
4. Jones, D. J., Introduction to microfossils, Harper & Brothers, New York. 1997.
5. Headly, R. H., Adams, C. S. (Eds) Foraminifera Vols., Academic press, London. 1984.

AG8014 MINERAL EVALUATION AND MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To provide information on exploration of mineral and ore petroleum deposits, methods of ore reserve estimations, mineral economics and feasibility studies, identification of suitable and profitable evaluation techniques, mineral processing and beneficiation and national mineral policies.

OUTCOME:

- Preparing students for professional employment in mineral mining and beneficiation industries. To train in the concepts of mineral exploration methods and address the techniques in exploration of economical deposits.

UNIT I PRE FEASIBILITY STUDIES **9**

Application of Geo Statistics Variogram Range, Kriging -Ore body Optimisation- Bulk Sampling, pilot Plant Saturation Prospecting, Categorisation curve-Block Recovery -grade Vis-à-vis In-situ grade

UNIT II MINE MINERAL ECONOMICS **9**

Source of Capital Funds-Factors Governing Profitability -Time Value of Money -Evaluating Net Profit-Capital Cost Owning Cost, Operating Cost, Amortisation -Concepts of Depreciation, Cash Flow, DCF, PV, NPV-Project and Loss Account, -Balance sheet

UNIT III MINERAL PROJECT FEASIBILITY **9**

Project Evaluation Techniques – Pay Back Discounted Pay Back, DCF, NPV, IRR Sensitivity Analysis WRT Grade, Price, Cut off grade, Recovery, Cost of Production -Feasibility Studies for Prospects and Operating Mines

UNIT IV MINERAL PROCESSING/BENEFICIATION **9**

Scope, Application, Brief Description of Concentrating/ Processing Methods Viz Gravity, Electrostatic, Electromagnetic, Flotation, Chemical, Ion Exchange, Roasting, Smelting-Mineral/Metal Recovery, Ratio of Concentration Selectivity Index-Flow Sheets of Important ore Minerals, Strategic Minerals

UNIT V MINERAL POLICIES 9

Synopsis of Mineral Related Acts, Rules, Regulations - Mining Plan under MCR1961, EMP, EIA, National Mineral Policy, Mineral Conservation, PL&ML -Wealth from waste, Co Products, By-Products - Turnaround Strategy for Sick Mineral Based Industries from Geologists Perspective.

TOTAL: 45 PERIODS

REFERENCES:

1. McKinstry, H.E. Mining Geology, Newyork: Prentice-Hall, Inc. 1970.
2. Deshmukh, D.J.. Elements of Mining Technology, Dhanbad: Vidyaprakshan, 1998.
3. Bruce, A.K.. Surface Mining, Colarodo: Society for Mining, Metallurgy and Exploration Inc. 1990.
4. Hustrulid, H.V and Mark Kuchta, Open Pit Mine Planning and Design Fundamentals, Brookfield USA: A.A Balkema, 1995.
5. Hartman. Howard L,. Introduction to Mining Engineering, New York: John Wiley and Sons, 1987

AG8015 MINING GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course is fundamental to a geologist who is aspiring to explore economic minerals and ores. It provides the knowledge on various mining methods for minerals and metallic ores, reserve estimation, mine mapping and 3D modeling of ore body.

OUTCOME:

- The student will be able to understand various nuances pertaining to mining industry and can prepare himself to serve the industry.

UNIT I MINERAL EXPLORATION 9

Triangulation, Establishment of Local Base from National Grid Base-Review of Surface Mapping, Underground Mapping, Different Plans and Sections-Search for ore–Surface and Concealed Guides to ore - Persistence of ore in depth– Preliminary Investigations–Trenching, pitting, Data Interpretation – Drilling from pits.

UNIT II MINERAL PROSPECTING 9

Macro/Micro Economic Considerations-Sampling – Types, Sampling Quantity, Spacing, Sampling error of Mean, Sample Data Processing, Interpretation. Surface/underground Definition Drilling – Core, Diamond Drilling arrangement, Core logging, Compositing, Preparation of Slice Plan, Maximising Drill Data Vis-à-vis Cost of Drilling-Preparation of Assay Plans/Sections - Cut off Grade, Determination of Mineable Limits

UNIT III MINERAL RESERVE ESTIMATION 9

Reserves and Resource – Types and Classification -Geological / Techno economic Considerations in Reserve Classification-Reserve Estimation Methods – Surface and Underground Deposits

UNIT IV OREBODY MODELLING 9

Integrating Surface/ Underground mapping Drilling Sampling to evolve a 3D Model - Fold/Fault Interpretation from Maps and Bore hole Data - GIS Applications in mining and Mineral Projects.

UNIT V SURFACE AND UNDERGROUND MINING 9

Surface Mining – Development of Bench Mining Concept, Height/Width/Slope of Benches, Manual and Mechanised Strip/Terrace/Open pit Mining, Initial Mine Cut, Production per Blast, Blasting Ratio, Stripping Ratio, Breakeven Stripping Ratio, Ultimate depth, Pit Limit for Different cut-off Typical Opencast Layout. Placer, Alluvial Mining, Delineation of Pay Streak, Estimation of Grade Coal Mining Methods. Underground Mining – Stoping/Development activities, Typical Stoping Block, General idea of Important Stoping Methods

TOTAL: 45 PERIODS

REFERENCES:

1. McKinstry, H.E. Mining Geology, Newyork: Prentice-Hall, Inc. 1970.
2. Deshmukh, D.J.. Elements of Mining Technology, Dhanbad: Vidyaprakshan, 1998.
3. Bruce, A.K.. Surface Mining, Colarodo: Society for Mining, Metallurgy and Exploration Inc. 1990.
4. Hustrulid, H.V and Mark Kuchta, Open Pit Mine Planning and Design Fundamentals, Brookfield USA: A.A Balkema, 1995.
5. Hartman. Howard L,. Introduction to Mining Engineering, New York: John Wiley and Sons, 1987.

AG8016 NATURAL HAZARDS AND MITIGATIONS L T P C
3 0 0 3

OBJECTIVES:

- To teach characteristics and phenomena of various geological processes and how they become as hazard and threat to lives on earth, vulnerability and risk management for various hazards, prevention and capacity building for natural hazards and enhancing public awareness.

OUTCOME:

- The student will be trained to prepare vulnerability analysis and risk assessment for different disasters and planning of mitigation measures.

UNIT I DISASTER PHENOMENON 9

Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, cyclones flood, drought and epidemics.

UNIT II MITIGATION 9

Geological and hydrological hazards - Reduction of hazard proneness – reducing structural vulnerability – changing the functional characteristics of settlement – building code provisions.

UNIT III ASSESSMENT 9

Elements of risk – vulnerability analysis on dam and other infrastructures – risk assessment – plan area – organizational aspects, planning and mapping levels – socio-economic aspects – cost of risk reducing measures.

UNIT IV MANAGEMENT 9

Prevention – preparedness – response – recovery – resource utilization – international assistance – policy and legislation – training – public awareness.

UNIT V CASE STUDIES AND ADVANCED TOOLS 9

Post disaster review – role of remote sensing and GIS – sequence of activities for global, national and state level case studies on various disasters

TOTAL: 45 PERIODS

REFERENCES:

1. Nick Carter, W. Disaster management, A Disaster manager's Handbook, Publisher: Asian development bank, Manila, 1992.
2. Mitigating natural disasters: Phenomena, effects and options, Publisher: United Nations, Hew York, 1991.

AG8017 NUCLEAR ISOTOPE GEOLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course introduces applications of isotopes in geology, especially in understanding earth origin, geological and geodynamical processes, and applications of isotopes in paleoclimate studies..

OUTCOME:

- The student will be able to understand subtleties of geochronological studies.

UNIT I INTRODUCTION AND THE PHYSICS OF THE NUCLEUS 9

Radioactive Decay - Nucleosynthesis Geochronology, Basics of Radiogenic Isotope Geochemistry, The K-Ca-Ar system - The K-Ar and Rb-Sr systems - The Sm-Nd system - The U-Th-Pb system - The U-Th-Pb system: Zircon dating - U-Th decay series dating - Other decay systems.

UNIT II ISOTOPOES IN GEOCHRONOLOGY 9

Fission Track Dating **-** analytical Methods**,** Radiogenic isotope geochemistry - The Mantle the Pb Picture. Mantle Models Mantle Plumes. Subcontinental lithosphere. The continental crust. Isotope Geochemistry of subduction zone Magmas - isotope cosmochemistry. Evolution of the atmosphere and cosmogenic radionuclides.

UNIT III STABLE ISOTOPE GEOCHEMISTRY 9

Stable Isotope Theory: Equilibrium fractionations - kinetic fractionations Hydrologic system, biological system. Fractionations of stable isotopes. Stable isotope applications. Assimilations fractional crystallization - Assimilation and subduction - hydrothermal Activity, metamorphism and ore deposits.

UNIT IV STABLE ISOTOPES AND APPLICATIONS IN PALAEOCLIMATE STUDY 9

Paleontology and Archaeology, application to paleoclimatology-deep sea, continental records. The Carbon Cycle. Isotopes, and climate Tree ring studies

UNIT V CARBON ISOTOPE AND PETROLEUM GEOCHEMISTRY 9

Sulphur isotopes, diffusion experiments in isotope geology with case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. Fraure, G, Principles of isotope geology, John Wiley, Second edition. 1986.
2. Bradely, R.S, Quaternary paleoclimatology, methods of paleoclimatic reconstruction, Allen and Unwin Inc., US, 1985.
3. Criss, R.E. Pricinciples of stable Isotope distributions. Oxford University press, 1999.
4. Lajtha, J. and Michener, R. Stable isotopes in ecology and environmental Science, Blackwell, 1994.
5. Griffiths, K., Stable Isotopes: Interpretation of biological, ecological and geochemical processes, 1998.

AG8018 OIL EXPLORATION AND PRODUCTION L T P C
3 0 0 3

OBJECTIVES:

- To provide the knowledge on seismic prospecting of Petroleum deposits in sedimentary basins, reserve estimation and drilling operation, characteristics of drilling fluid, well completion and logging activities during oil exploration, insight to the oil field development methods.

OUTCOME:

- Prepare students for jobs in oil industries. To train the concepts of oil exploration methods and to address the techniques in exploration of petroleum deposits

UNIT I SEISMIC PROSPECTING 9

Seismic reflection prospecting – data acquisition – receiver design and characteristics – Energy source– seismic instrumentation - survey positioning–establishment of field parameters; Seismic processing–processing steps and associated pitfalls– signal migration–improving the signal – to noise ratio – velocity stacking and verification – displaying seismic data-Interpretation–structural–stratigraphy – facies, sequence and depositional environment – hot spots for oil and gas; 3 D surveying.

UNIT II RESERVE ESTIMATION AND DRILLING OPERATION 9

Volumetric oil and gas reserve estimation – proved, probable and possible reserves – Deterministic methods, Three point estimates- Expressing uncertain in the input to volumetric estimation - Rotary Drilling rig components – Basic operations – operational practices and procedures – Drill stem and assembly – descriptions, care, maintenance and handling practices - Drill stem Design – installation of blowout prevention

UNIT III DRILLING MUD 9

Drilling mud – function, composition, properties, classification of drilling mud – Foam drilling – Packer fluids – solid removal – drilling complications and importance of mud - heaving shale , plastic flow shale – lost circulation, blowouts, Procedure for designing hydraulic program – Minimum annular velocity , circulation rate, pump characteristics calculation of system pressure losses –Equations used in hydraulic calculation – Hydraulics worksheet

UNIT IV CASING AND CEMENTATION 9

Casing–types, policy, specifications , forces acting–Casing design – preparation of casing to be lowered. Cementation–composition, properties, types, cementation-procedures applications.

UNIT V WELL LOGGING RESERVOIR ENGINEERING AND PRODUCTION 9

Well logging – basic concepts – well bore environments – Logging Methods- Interpretation - calculation of saturation, gas saturation, water saturation porosity, permeability- finding oil, gas and water. Perforation techniques - well completion – fittings of well head, casing head housings, casing test, - transportation of oil, Reservoir engineering - principles- Oil recovery – primary, secondary enhanced oil recovery techniques – chemical methods – miscible methods - thermal method – Petroleum management and economics.

TOTAL:45 PERIODS

REFERENCES:

1. Brian J. Evans A Hand book for seismic data acquisition in exploration. Geophysical Monograph Series Publisher:
2. Society of Exploration Geophysics, Tulsa, U.S.A., 1997.
3. Robert E. Sheriff. Seismic stratigraphy, Publisher: International Human Resources Development Corporation, Boston 1980.
4. Bhagwan Shtay, Petroleum Exploration and Exploration practices, Allied Publishers Ltd., 2001.

5. Frank John, Mark Cook &Mark Gratan. Hydrocarbon exploration and production, Elsevier 2003.
6. Drilling: The mannal of methods, application & management. Australian Drilling Industry Training Committee Ltd., Publisher : Lewis publishes, 1997.

AG8019 ORE GEOLOGY AND MINERAL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course introduces ore microscopy, fluid inclusion, dressing and beneficiation of ore and minerals.

OUTCOME:

- Student will be able to identify ores and minerals using ore microscopy and will be trained on various aspects of mineral benefication.

UNIT I ORE MICROSCOPY 9

Introduction to ore microscopy – preparation of samples and specimen - mineral identification – examination of optical properties – under reflected light – reflectance measurement of microindentation hardness.

UNIT II ORE FABRICS 9

Ore textures – fabric property on geometry pattern on minerals – texture of primary precipitation – transformation textures – schngiderhom's classification of ore textures and structures – magnetic sedimentary – metamorphic paragenesis.

UNIT III FLUID INCLUSION 9

Ore mineral assemblages in igneous rocks and metamorphic rocks – fluid inclusion studies – nature and location of fluid inclusion – preparation of samples – observation – composition and changes since trapping – fluid inclusion geothermo-metry – application of fluid inclusion studies.

UNIT IV MINERAL TECHNOLOGY 9

Ore microscopy usage in mineral technology – information from mineralogical studies – mineral dressing processes.

UNIT V MINERAL BENEFICATION 9

Ore microscopy in mineral beneficiation of copper ores – gold ores – chromium ores – iron ores – titanium oxides – manganese ores.

TOTAL: 45 PERIODS

REFERENCES:

1. Craig, J. R. and Vaughan, D. J. Ore microscopy and ore petrography. Wiley interscience publication, New York. 1981.
2. Ramdohr, P. The ore minerals and their intergrowth, II ed. Vol. I and Vol. II, Pergamon press, New York, 1980.

AG8020	PLANETARY GEOLOGY	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the concepts of planetary science and geology, which will form a basis to understand planetary remote sensing.

OUTCOME:

- At the end of the course, the students will have a sound knowledge of planetary science in general and about the inner planets in particular. In addition, the role of remote sensing in improving our understanding of planetary science will also be appreciated by the students.

UNIT I INTRODUCTION TO PLANETARY SCIENCE 9

The sun- vital statistics of the sun- -Solar system - origin - physics, chemistry, and the surface features of the solid bodies in the solar system; Solar system. -Celestial sphere- the growth of the geocentric system- physical properties of objects in the solar system.

UNIT II PLANETS 9

Physical properties- optical properties- rotation and magnetic field-surface temperature. Surface features of the terrestrial planets; Inner planets- Geological phenomena- tectonic, volcanic, impact cratering, eolian, fluvial, glacial and possibly lacustrine and marine processes; Outer planets – formation and evolution processes –satellite-characteristic features.

UNIT III EARTH AND MOON 9

The earth: Planetary evolution- gross properties – solar terrestrial relations- earth in space-interior-geologic process; Moon-origin- basic facts- telescopic studies - internal structure-surface features-environment- surface composition and mineralogy and atmospheric conditions

UNIT IV ASTEROIDS-METEORITES- COMETS 9

Classification-physical and chemical properties, difference between asteroids-comets- meteors-geochemistry- relationship between earth and meteorite geochemistry; satellites- medium, small and tiny their- geology, interior, surface properties, atmosphere and potential for life.

UNIT V PLANETARY REMOTE SENSING 9

Study of planetary images, and construction of geological maps from orbital images and Rover (insitu); planetary data formats-Missions to - Moon- Mars-Venus- for geological exploration; Lunar return samples – Apollo-Luna.

TOTAL:45 PERIODS

REFERENCES:

1. Gunter Faure & Teresa M. Mensing. 2007. Introduction to planetary science: the Geological perspective, Publisher Springer-Verlag New York.
2. Imke de Pater and Jack J. Lissauer. 2001. Planetary Sciences, Published by Cambridge University press.
3. A.M. Davis 2003. Meteorites, Comets, And Planets, Published by University of Chicago, IL, USA.
4. Grant H. Hieken, David T. Vaniman, Bevan M. Frech. 1991**.** Lunar Sourcebook: A User's Guide to the Moon, ***Cambridge University Press.***
5. Nadine Barlow. 2008. Mars: An Introduction to its Interior, Surface and Atmosphere. Cambridge Planetary Science (No. 8)
6. Mary Chapman. 2007. The Geology of Mars .Cambridge Planetary Science (No. 5)
7. K D Abhyankar. 1999. Astrophysics of the Solar system, Universities Press, Hyderabad, India.
8. A.N. Rencz, 1999. Manual of Remote Sensing, Third Edition, Volume 3, John Wiley & Sons, USA.
9. Encrenaz, T.; Kallenbach, R.; Owen, T.; Sotin, C. 2005. The Outer Planets and their Moons. Springer Space Science Reviews.

AG8021 **QUATERNARY GEOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To teach recent history of earth through this subject. It describes emergence of man, change in earth climate system, and recent tectonics.

OUTCOME:

- The student will be able to understand global warming, climate modeling, can understand paleoclimate and prediction of future climate.

UNIT I INTRODUCTION **9**

Introduction to Quaternary period and types of Quaternary deposits. End of the Tertiary period and prologue to the Quaternary period, tectonic movements, magnetic polarity reversals, global sea level, and littoral sedimentation, Quarternary soil types, shallow water reserves and sediments used in human activities.

UNIT II QUATERNARY STUDY TECHNIQUES **9**

Relative chronologies and correlation, use of flora and fauna, non radioactive techniques, radioactive techniques. dating methods- radiocarbon, U/Th, Pb-Pb with case studies and dendrochronology

UNIT III QUATERNARY PERIOD AND EMERGENCE OF HOMINIDS **9**

Causes of Quaternary climate change, manifestation of Quaternary climate change and current issues in climate change, Human and Quaternary climate change, fauna at the Pliocene-Quaternary transition, emergence of hominids and evolution of Man.

UNIT IV QUATERNARY CLIMATE CHANGE **9**

The climate between 2.5 yr and 130,000 yr, ice ages, glaciations, last glaciations and the last glacial maximum, the deglaciation and the Holocene, Ocean and deep sea environments, terrestrial environments, lake and desert environments, soils. Humid tropical environments, subtropical arid zones and warm deserts, fluctuation in the polar region and Mediterranean environments.

UNIT V NEOTECTONICS AND DEFORMATION DURING THE QUATERNARY PERIOD **9**

Recent crustal movements and young magmatism, post glacial crustal uplift, analysis of Quaternary sediments from borehole data, climate modeling and prediction of climate change.

REFERENCES:

1. Bradley, R.S. Quaternary paleoclimatology, methods of paleoclimate reconstruction, Allen and Unwin, US 1985.
2. Riser, J.A.M., Quaternary Geology and the Environment, Springer, Praxis Publishing, Chichister, UK. 2001.

AG8022 **SEQUENCE STRATIGRAPHY** **L T P C**
3 0 0 3

OBJECTIVES:

- To train the students to address the exposed and subsurface rock layers, its description with respect to tectonics, rock type, structures and geological frame work. Interpretation of stratigraphic architecture. The Paleontology knowledge equips the students to understand paleoenvironment of sedimentary system.

OUTCOME:

- Students will develop the knowledge on sedimentary basin history and environment to review it's potentially for resource evaluation

UNIT I INTRODUCTION 9

Introduction to sequence stratigraphy, scope, applications in exploration of hydrocarbons, stratigraphic terminology, problems and research trends, stratigraphic architecture, facies and sea level cycles.

UNIT II METHODS FOR STUDYING SEQUENCE STRATIGRAPHY 9

Construction of sequence framework, importance of unconformities, assessing regional and global changes in sea level, areas and volumes of stratigraphic units, hypsometric curves, backstripping, integrated tectonic stratigraphic analysis.

UNIT III SEQUENCE DEPOSITIONAL MODEL 9

Depositional systems and systems tracts, sequence boundaries, litho-log analysis, sedimentary facies, fossil assemblages, counts and their controls, paleoecology & Milankovitch processes.

UNIT IV STRATIGRAPHIC CYCLES 9

Types of stratigraphic cycles, tectno-stratigraphic model, Eustasy, epiorogeny, global cycle chart, tectonic mechanisms.

UNIT V SEQUENCE BIOSTRATIGRAPHY, CHRONOSTRATIGRAPHY AND CORRELATION 9

Determination of the biostratigraphic framework, diachroneity of the biostratigraphic record, dating and correlation of stratigraphic events, time in sequence stratigraphy. Applications of sequence bio stratigraphy.

TOTAL:45 PERIODS

REFERENCES:

1. Andrew D. M. Geology of stratigraphic sequences Springer Publications, New York 1997.
2. Weimer and Posmentier, Sedimentary Geology, Elsevier Publications, Netherlands 1993.
3. Emery, D., and Myers, K, Sequence Stratigraphy, Blackwell Science, Publ. 1996.
4. Seismic stratigraphy – Applications to hydrocarbon exploration, AAPG Memoir No. 26. 1977.
5. Van Wagonar., P. R. Vail an overview of the fundamentals of sequence stratigraphy and key definitions. Sea level changes – an integrated approach. SEPM Publ. No. 42, 1988.

AG8023 SOIL SCIENCE L T P C
3 0 0 3

OBJECTIVES:

- To study the formation of soils, their physical and chemical characteristics, types of soils, soil and water relation, soil management and conservation.

OUTCOME:

- Better understanding on soil genesis, soil water relationship and soil conservation.

UNIT I INTRODUCTION TO SOIL SCIENCE 9

Nature and importance of soil, soil formation, soil survey, physical chemical and biological characters of soil. Relationship between Soil plants and animal.

UNIT II SOIL TYPES 9

Soil types and classification, soil genesis, Soil mineralogy and geochemistry of soil types: laterites, bauxites, ardisols, vertisols, camborthids. Application of soil micro morphology and landscape evolution. Radiometric age determination of soils

UNIT III SOIL AND CROP PRODUCTION 9

Elements essential for plants and animals, soil nutrients, nitrogen, phosphorus, potassium, calcium, magnesium and sulphur in soil and their and its significance in plant growth, micronutrients.

UNIT IV SOIL QUALITY AND LANDSCAPE 9

Soil and water relation, organic matter in soil, functions of organic matter, organic matter and soil structure, organic matter and essential elements, tillage, cropping systems and fertility and case studies.

UNIT V SOIL MANAGEMENT AND CONSERVATION 9

Introduction, irrigation, drainage soil management for field crops, gardens, lawns, pastures, rangelands and forests. Conservation factors and implementation methods.

REFERENCES:

1. Nyle C. Brady, Ray R. Weil, The Nature and Properties of Soils (13th Edition) Prentice Hall 2002.
2. Donald L. Sparks, Environmental Soil Chemistry, 2002.
3. Raymond B. Daniels, Richard D. Hammer., Soil Geomorphology, John Wiley & Sons, 2000.
4. M.E. Sumner, Hand book of soil Science, 1992.
5. Donald Sparks, Donald L. Sparks D, Environmental Geochemistry, Academic Press, 2002.