KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY, BHUJ-KACHCHH

Year: 2023-2024

Master of Science in Geology

GEOLOGY

FACULTY OF SCIENCE

SYLLABUS

Curriculum as per UGC Guideline

With effect from June – 2023

Credit Structure

Semester	Core course	Elective course	Interdisciplinary course	Project/dissertation/ internship/Field	Total Credits
1	4 (5) = 20	NIL	1 (4) = 04	NIL	24
2	3 (5) = 15 1 (4) = 04	NIL	1 (4) = 04	(Field) 02	25
3	2 (5) = 10 1 (4) = 04	2 (4) = 08	NIL	(Field or internship) 02	24
4	1 (5) = 05	2 (5) = 10	NIL	(Dissertation) 10 (Field) 02	27
	58	18	08	16	100

(D. J. M. Patel)

C.D. J. Padia

(Dr. Gaurav Chauhan)

Approved by the Board of Studies (Geology)

Kranti Guru Shyamji Krishna Varma Kachchh University BHUJ-Kachchh 370001

DEAN
FACULTY OF SCIENCE
KSKV KACHCHH UNIVERSITY
BHUJ-KACHCHH-370001

Extended Course Structure
Semester-I

Course Category	Paper Code	Title of the Paper	Lab + field details	Credits (T+P)
Core Course (All are compulsory)	**CCGE-101**	**Structural Geology & Geotectonics**	***LAB*** *and field visit (Map Sections, Stereographic projection of the structural features etc.., Field Visit to structurally and tectonically important sites)*	**(3+2)**
	CCGE-102	**Crystallography, Mineralogy, Optics, and Instrumentation Techniques**	***LAB*** *(megascopic, microscopic minerals and elemental composition of minerals and rocks)*	**(3+2)**
	CCGE-103	**Paleontology and Stratigraphy**	***LAB*** *and Field Visit (fossils identification, micropalaeontology, ichnofacies, Stratigraphic reconstructions, Field Visit to stratigraphical and paleontological important sites)*	**(3+2)**
	CCGE-104	**Geomorphology, Remote Sensing and GIS (RS & GIS)**	***LAB*** *(Satellite Image Interpretation, GIS Software- QGIS, Global Mapper, Surfer etc.)*	**(3+2)**
Elective Course	**--**	**--**	**--**	
Interdisciplinary Course (Any one out of two courses)	**ICGE-105**	**Oceanography and Climatology**	*LAB (Analysis of Meteorological Data, Study of Ocean Sediments)*	**(3+1)**
	ICGE-106	**Natural Resource Management**	***LAB and Field visit*** *(Mapping of Natural Recourses sites, Field visits to the Natural Recourses sites)*	**(3+1)**
Project/dissertation/	**NIL**	**NIL**	**--**	**NIL**
Internship/Field	**NIL**	**NIL**	**--**	**NIL**
				(24)

Semester-II

Course Category	Paper Code	Title of the Paper	Lab + field details	Credits (T+P)
Core Course (All are compulsory)	**CCGE-207**	**Igneous Petrology**	***LAB and Field Visits*** *(Megascopic and microscopic rocks, Norms calculation, Field Visit to igneous terrain)*	**(3+2)**
	CCGE-208	**Metamorphic Petrology**	***LAB and Field Visits*** *(Megascopic and microscopic rocks, Field Visit to metamorphic terrain)*	**(3+2)**
	CCGE-209	**Economic and Mining Geology**	***LAB and Field Visits*** *(Megascopic and microscopic Ore, field visits to the mines sites)*	**(3+1)**
	CCGE-210	**Field Techniques in Geology**	***LAB and Field Visits*** *(Maps and Toposheet Study, Field Mapping, various types of sampling techniques, etc.)*	**(3+2)**
Elective Course	**--**	**--**	**--**	
Interdisciplinary Course (Any one out of two courses)	**ICGE-211**	**Environmental Geology and Disaster Management**	***LAB and Institutes/Industries Visits*** *(Water and Soil testing, Visits related to Disaster Management, Visit to the relevant sites)*	**(3+1)**
	ICGE-212	**Research Methodology, Statistics and Computer application**	*LAB (Statistical and Computer related practical)*	**(3+1)**
Project/dissertation		**NIL**	**---**	**NIL**
Internship/Field	**Field-001**	**Field Excursion**	*Over all 10 days Field studies in two semesters where basic field techniques are taught*	**(02)**
				(25)

Semester-III

Course Category	Paper Code	Title of the Paper	Lab + field details	Credits (T+P)
Core Course (All are compulsory)	**CCGE-313**	**Sedimentary Petrology and Sedimentology**	*LAB and Field Visits (Petrography, Grain size analysis, sieving for sedimentary environment, Field Visit to sedimentary terrain)*	**(3+2)**
	CCGE-314	**Geochemistry & Geochronology**	*LAB and Institutes/Industries Visits (Calculation of Atomic Wt %, Isotopes, K-Ar, Rb-Sr, Sm-Nd Radionuclide Decay, Visit to geochemical and geochronological institute/industries)*	**(3+1)**
	CCGE-315	**Engineering Geology and Surveying**	*LAB and Field Visits (Geotechnical Analysis, Surveying instruments, Interpretation of Surveying Data, Visits to Engineering Geological Sites)*	**(3+2)**
Elective Course (All courses are compulsory)	**ECGE-316**	**Geodesy, Geophysics and Geophysical Exploration Methods**	*LAB and Institutes/Industries Visits (Geophysical Surveys, Calculations, Academic Visits to the Geophysical and Seismic Institutes/ Industries)*	**(3+1)**
	ECGE-317	**Fuel Geology**	*LAB (Use of calorimeter for coal and petroleum, Interpretation of borehole and seismic data for the reservoir identification)*	**(3+1)**
Interdisciplinary Course	**NIL**	**NIL**	**---**	**NIL**
Project/dissertation	**NIL**	**NIL**	**---**	**NIL**
Internship	**INTR-002**	**Internship**	*Over all 1 week of internship with any one of the institutes or industry is compulsory*	**(02)**
				(26)

Semester-IV

Course Category	Paper Code	Title of the Paper	Lab + field details	Credits (T+P)
Core Course (All are compulsory)	**CCGE-418**	**Hydrogeology**	***LAB and Field Visits*** *(Water Quality Testing, Preparation of subsurface profiles, watershed mapping through GIS and RS, Visits for well monitoring and well data collections, visits to groundwater management institutes/NGOs)*	**(3+2)**
Elective Course (All are compulsory)	**ECGE-419**	**Quaternary Geology and Geoarchaeology**	*LAB and Field Visits (Preparation of Geomorphological maps through RS and GIS, Morphometric Analysis etc. Visits to geomorphologically, Quaternary and geoarchaeologically important sites)*	**(3+2)**
	ECGE-420	**Geoheritage, Geoconservation and Geotourism**	*LAB and Field Visits (TWOS and SWOT Assessment of Geoheritage Sites, Visits to geoheritage and geotourism sites)*	**(3+2)**
Interdisciplinary Course		**NIL**	**---**	**NIL**
Project/dissertation	**ECGE-421**	**Dissertation / Project**	*Dissertation with any of the faculties, research institutes, other universities, industry etc. are compulsory and carries 10 credits*	**(10)**
General Geological Field work	**Field-003**	**Field Excursion**	*A field excursion of minimum 10 days in igneous/ metamorphic/sedimentary/ Quaternary terrain is compulsory*	**(02)**
				(27)

SEMESTER-1

STRUCTURAL GEOLOGY & GEOTECTONICS
CCGE-101

Paper Code	CCGE-101
Title	**STRUCTURAL GEOLOGY & GEOTECTONICS**
Unit – 1	• Mechanical principles and properties of rocks and their controlling factors • Theory of Rock Failure • Concept of Stress and Strain • Dynamic and Kinematic analysis of rocks in two dimensions • Types of strain ellipses and ellipsoids, their properties and geological significance • Strain markers in naturally deformed rocks • Concepts of petrofabrics and symmetry
Unit – 2	• Classification and Mechanisms of Folds and Faults • Distribution of Stress and Strain in folds and faults • Classification and genesis of ductile shear zones • Lineations, foliations, joints and fractures • Genesis of planar and linear structures (bedding, cleavage, schistosity, lineation) • Stereographic and stereo-net projection • Interpretation of geological maps
Unit – 3	• Plate Tectonics: Concepts and boundaries, mantle plumes. • Seafloor spreading, triple junctions • Case studies of the orogenic belts, • Paleomagnetism, hot spots, mantle plumes, convection and mechanism, • Tectonic Setting, Oceanic ridges, Ophiolites, • Cratons and passive margins, • Continental rifts, Arc systems, Orogens, • Tectonic framework of India, • Tectonic features of extensional, compressional, and strike-slip-terrains and relevance to plate boundaries.
Practical/ Laboratory work	❖ Structural Maps, ❖ Outcrop Maps,

	❖ Stereographic and Stereonet projection, ❖ Balanced cross sections, ❖ Structural Problems
Field component	**FIELD WORK FOR MAPPING AND OBSERVATION OF STRUCTURES**
Texts / References (Suggested Readings)	1. ***Ramsay, J.G.*** *Folding and fracturing of rocks, McGraw Hill, 1967.* 2. ***Ghosh, S.K.*** *Structural Geology – Fundamentals and modern development, Pergamon, 1993* 3. ***Hobbs, B.E., Means, W.D. and Williams, P.F.*** *An outline of structural geology, John Wiley,1976.* 4. ***Davis, G.H. & Reynolds, S.J.,*** *Structural Geology of Rocks and Regions, Wiley, 1996.* 5. ***M. P. Billings,*** *Structural Geology, Prentice Hall. 1972.* 6. ***Paor, D.*** *Structural Geology and Personal Computer, Pergamon, 1996.* 7. ***Rowland, S.M. and Duebendorfer, E.M.*** *Structural Analysis and Synthesis, Pergamon, 1994.* 8. ***D M Ragan*** *Structural geology - An Introduction to Geometrical Techniques, John Wiley, 1985.* 9. ***Kent C. Condie,*** *Plate Tectonics and Crustal Evolution, 4th Edition.* 10. ***Kearey P and F.J. Vine****, Global Tectonics. Blackwell scientific Publications* 11. ***Frisch, W., Meschede, M., Blakey, R.C.*** *Plate Tectonics: Continental Drift and Mountain Building. Springer. (2011).* 12. ***Kearey, P., Klepeis, K.A., Vine, F.J.*** *Global Tectonics. Wiley-Blackwell. (2009).*

SEMESTER-1

CRYSTALLOGRAPHY, MINERALOGY, OPTICS, AND INSTRUMENTATION TECHNIQUES

CCGE-102

Paper Code	CCGE-102
Title	**CRYSTALLOGRAPHY, MINERALOGY, OPTICS, AND INSTRUMENTATION TECHNIQUES**
Unit – 1	**Crystallography:** • Definition of Crystal - Classification of crystals into Crystal systems, • Concept of unit cell - Proper and improper symmetry operations, • Concept of Space lattice - Derivation of 14 Bravais lattices – HCP, • Lattice defects (point, line and planar), • Classification of crystals into 32 Point Groups, Concept of Space Group,Natural symmetry, • Transformation of minerals – polymorphism, polytypism, and polysomatism
Unit – 2	**Mineralogy and optics:** • Atomic structures and mineral/ crystal chemistry • Diagnostic properties of rock forming minerals including clay minerals techniques of mineral identification. • All silicates, sulphates, carbonates, native minerals, sulphides, oxides, sulfosalts, hydroxides, halides, nitrates, borates, chromates, phosphates. • Optics: Properties of light, polarization, interference of light waves, • Measurement of RI, Pleochroism, Birefringence, • Optic orientation in different crystallographic systems. • Determination of optic sign of uniaxial and biaxial minerals, • Determination of optic axial Angle, • Conoscopic or convergent polarized light - Generation of Uniaxial and Biaxial interference figures - Forms of interference figures related to sections • Optical accessories like mica, gypsum and quartz plates - Determination of Optic sign of uniaxial and biaxial minerals.
Unit – 3	• **Instrumentation and Analytical Techniques**: • Sampling and Sample preparation, thin section and polished section making

	• Techniques in photomicrography, • Principles and geological applications of Luminescence, • Atomic Absorption Spectroscopy • X-ray Fluorescence spectroscopy, • X-ray diffractometry
Practical/ Laboratory work	❖ Crystallography Practical (Elements of Symmetry, Miller Indices, HM symbols, stereographic projections; identification of forms with models), ❖ Megascopic and Microscopic identification of rock forming minerals. ❖ Identification of basic optical properties (uniaxial, biaxial, 2V etc.)
Field component	**FIELD WORK FOR MAPPING AND OBSERVATION OF STRUCTURES**
Texts / References (Suggested Readings)	1. ***Donald Bloss****, Crystallography and Crystal chemistry, Holt Rinehart and Winstar Jr., 1971.* 2. ***Klein, C****., Manual of Mineral Science. IInd edition, Wiley (2002).* 3. ***J. D. Dana,*** *Manual of Mineralogy, New Haven, 1871.* 4. ***Dana, E.D.,*** *Text Book of mineralogy: With an Extended Treatise on Crystallography and* 5. ***Physical Mineralogy,*** *Wiley, 1949.* 6. ***Deer, W.A,*** *Howie, R.A., and Zussman, J. An Introduction to rock forming minerals, Longman, 1966.* 7. ***Berry, L.G****. and Mason, B. Mineralogy, Freeman, 1957.* 8. ***Kerr, P. F****. and Rogers, A.F., Optical Mineralogy. McGraw-Hill, 1977.* 9. ***Read, H.H.*** *Rutley's Elements of Mineralogy, CBS Publisheres and Distributors. (1960).* 10. ***Hutchinson, C.S.*** *1974: Laboratory Handbook of Petrographic Techniques. John Wiley.*

SEMESTER-1

PALEONTOLOGY AND STRATIGRAPHY
CCGE-103

Paper Code	CCGE-103
Title	**PALEONTOLOGY AND STRATIGRAPHY**
Unit – 1	**Paleontology:** • Paleobiology - Diversity of life through time, • Taphonomy - processes of fossilization. Taxonomy, • Morphology and functional morphology of invertebrates (bivalves, brachiopods, gastropods, echinoids, ammonites); • Microfossils (foraminifera, ostracoda, conodonts, bryozoa); • Vertebrate paleonology (Equus, Human); • Paleobotany (plant, spores, pollens). • Basic concepts of ecology/paleoecology; classification - ecological and taxonomic schemes (diversity and richness). • Fossils and paleoenvironments, • Classification and environmental significance of trace fossils, • Animal sediment relationship. Applications of micropaleontology.
Unit – 2	**Stratigraphy:** • Introduction to stratigraphy, • Major global geological/stratigraphical events (viz. Glaciation, deglaciation, mass extinction, stromatolites, snow ball earth) • Standard stratigraphic scale. • Various techniques adopted for Stratigraphical analysis: Lithostratigraphy and Chronostratigraphy, Biostratigraphy, Sequence Stratigraphy, Magnetostratigraphy, Seismostratigraphy
Unit – 3	**Indian Stratigraphy:** • Tectonic Framework of India: • Tectonic divisions, Cratons (Dharwar, Aravalli, Bastor, Singhbhum, Bundelkhad), Mobile belts (Eastern Ghat, Delhi Fold Belt, Satpura and Precambrian of Himalaya),

	• Proterozoic Sedimentary basins: Paleoproterozoic (Bijawar, Gwaliar, Papaghni Sub-basin) and • Mesoproterozoic Basins (Vindhyan, Parinatha-Godavari, Cuddapah), • Quaternary Developments in India: Himalayas, Indo-Gangetic Plains, Peninsular India, • Important vertebrate fossils, plant fossils and microfossils in Indian stratigraphy
Practical/ Laboratory work	❖ Morphological descriptions and illustrations of representative fossils belonging to some foraminiferal genera (micropaleontology): ❖ Preparation of stratigraphic range charts and biostratigraphic zonation ❖ lithological and paleontological symbols
Field component	**FIELD WORK FOR FOSSIL IDENTIFICATION IN DIFFERENT STRATIGRAPHIC UNITS**
Texts / References (Suggested Readings)	1. ***Raup, D.M. and Stanley, S.M.*** *Principles of Paleontology, W.H. Freeman & Co. 1971.* 2. ***Clarkson, E.N.K.*** *Invertebrate Paleontology and Evolution, ELBS. 1987.* 3. ***Haynes, J.R.*** *Foraminifera, John Wiley. 1981.* 4. ***Shrock and Twenhoefells,*** *Invertebrate Paleontology, CBS publishers* 5. ***Woods, H.*** *Paleontology Invertebrate, International Book Bureau, 1966.* 6. ***Murray, J.W.*** *Atlas of Invertebrate Macrofossils, Longman. 1985.* 7. ***Benton, J.****B. Vertebrate Paleontology, Chapman & Hall, 1997.* 8. ***M. Ramakrishnana and R. Vaidyanathan:*** *Geology of India, (GSI), Bangalore* 9. ***Stratigraphic boundary problems of India:*** *Memoirs 16, GSI-Bangalore, 1990* 10. ***Krishnan, M. S.,*** *Geology of India and Burma, CBS Publisher, 2006.* 11. ***Valdiya, K.S.,*** *The making of India Geodynamic Evolution. MacMillan, 2010.*

SEMESTER-1

GEOMORPHOLOGY, REMOTE SENSING AND GIS
CCGE-104

Paper Code	CCGE-104
Title	GEOMORPHOLOGY, REMOTE SENSING AND GIS
Unit – 1	**Geomorphological Studies:** • Dynamics of Geomorphology, • Geomorphic processes and landforms – fluvial, glacial, eolian, coastal and karst (erosional and depositional landforms), Submarine relief, • Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition.
Unit – 2	**Quantitative geomorphology:** • Geomorphological mapping based on genesis of landforms, • Quantitative geomorphology: morphometric analysis, stream channel morphology changes, drainage modifications, • Application of geomorphology in engineering geology, and environmental studies, Geomorphology of India: Geomorphological features and zones
Unit – 3	**RS & GIS:** • Introduction and Principles of Remote Sensing: • Aerial Photographs and their Geometry, • Photogrammetry, Satellite Remote Sensing, • Image Interpretation and Digital Processing Techniques, • Geological Studies: Image Characters and their relations with ground objects based on tone, texture and pattern, • Evaluation of ground water potential, rock type identification, • Interpretation of topographic and tectonic features, • Principles and applications of Geographical Information System
Practical/ Laboratory work	❖ *Laboratory exercise for remote sensing and Photogeology:* ❖ *Topographical map, aerial photo and satellite imagery interpretation for geological and geomorphological applications,* ❖ *Basic photogrammetry exercises like parallax measurements for height*

	determination, ❖ *Introduction to digital image processing,* ❖ *Preparation and interpretation of Geomorphic map,* ❖ *morphometric analysis*
Field component	**FIELD WORK FOR LANDFORM IDENTIFICATION AND GROUND TRUTHING OF SATELLITE DATA ANALYSIS**
Texts / References (Suggested Readings)	1. ***Thornbury, W.D.*** *Principles of Geomorphology, Wiley Eastern, 1993.* 2. ***Bloom Arthur L****, Geomorphology: A Systematic analysis of late Cenozoic landforms.* 3. ***Geomorphic Mapping,*** *Developments in Earth Surface Processes 15, Elsevier, 2011* 4. ***Goudie, A.****, Geomorphic Techniques. Routledge, 1990.* 5. ***Sabnis, F.F.*** *Remote sensing - Principles and Interpretation, W.H. Freeman and Co., 1978.* 6. ***Lillesand, T.M. and Kiefer, R.W.*** *Remote sensing and Image Interpretation, John Wiley, 1987.* 7. ***S. A. Druary,*** *Image Interpretation in Geology,* 8. ***Pandey, S.N.*** *Principles and Applications of Photogeology, Wiley Eastern, 1987.* 9. ***Gupta, R. P.*** *Remote Sensing Geology. Springer. 1990.*

SEMESTER-1

OCEANOGRAPHY AND CLIMATOLOGY
ECGE-105

Paper Code	ECGE-105
Title	OCEANOGRAPHY AND CLIMATOLOGY
Unit – 1	**Oceanography:** • Morphologic and tectonic domains of the ocean floor and various topographical features; • Oceanic circulations, waves and currents, El Niño, Indian Ocean Dipole, • Thermohaline circulation, • Indian summer and winter monsoon and oceanic conveyor belt. • Formation of Bottom waters; major water masses of the world's oceans. • Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; Tectonic evolution of the ocean basins, • Opening and closing of ocean gateways and their effect on circulation, • Sea level processes and Sea level changes.
Unit – 2	**Climatology:** • Fundamental of climatology. • Earth's radiation balance; • Latitudinal and seasonal variation of insolation, • Temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance. • Air masses, air circulation, monsoon, Jet streams, tropical cyclones and anticyclones. • Classification of climates – Koppen's and Thornthwaite's scheme of classification. • Climate change.
Unit – 3	**Physical Meteorology**: • Thermal structure of the atmosphere and its composition. • Radiation: basic Laws - Rayleigh and Mie scattering, multiple scattering, • Radiation from the sun, solar constant, effect of clouds, surface and planetary albedo.

	• Emission and absorption of terrestrial radiation, radiation windows, radiative transfer, Greenhouse effect, • Vertical stability of the atmosphere.
Practical/ Laboratory work	❖ Oceanic circulations, illustrative diagrams of El-Nino and La-Nina, ❖ bathymetric diagrams and sea-floor topography
Field component	**FIELD WORK TO METEOROLOGICAL DEPARTMENT TO UNDERSTAND THE EQUIPMENTS USED FOR WEATHER FORECAST AND ITS DAY-TO-DAY APPLICATION.**
Texts / References (Suggested Readings)	1. ***Kennett, J.P****. (1982) Marine Geology. Prentice Hall.* 2. ***Seibold, E. And Berger, W. H.*** *(1982) The sea floor. Springer.* 3. ***Pipkin, B.W.,*** *and all (1972). Laboratory Exercieses in Oceanography. Freeman.* 4. ***C. Donald Ahrens*** *(2014) Essentials of Meteorology: An Invitation to the Atmosphere.Censage.* 5. ***Clift P.D. and Plumb R. A****. (2008) The Asian Monsoon. Cambridge.* 6. ***Kidder, S. Q. And Vonder HaarT. H****. (1995) Satellite Meteorology: An Introduction, Academic Press* 7. ***Louis J. Battan*** *(1984) Fundamentals of meteorology. Prentice Hall.* 8. ***Savindra Singh-*** *Physical Geography* 9. ***D.S. Lal-*** *Climatology and Oceanography*

SEMESTER-1

NATURAL RESOURCE MANAGEMENT
ECGE-106

Paper Code	**ECGE-106**
Title	**NATURAL RESOURCE MANAGEMENT**
Unit – 1	• Introduction to Natural Resources • Description of the Resources • Classification of the Natural Resources • Exhaustible resources – Minerals and Mining, • Energy Resources- Oil, Coal, Natural Gas, atomic minerals, • Soil as resource – types of soils, • Rivers resources, Coastal resources, Coastal Processes, • Renewable resources, • Water and Land resources, Function and values of the resource, • Human use and impact on the resource, Supply and demand of the resources
Unit – 2	• Development and Management of Natural Resources, • Management tools and techniques – Natural Resources Policy, • Watershed Management, Methods of soil Conservation, • Flood Control Measures, Coastal Zone Management
Unit – 3	• Application of Remote Sensing Techniques in resource management, • Environmental Impact Analysis, • Mineral Resources: Conservation and Management, • Policies and legislation concerning natural resources
Practical/ Laboratory work	❖ Introduction to the methods of Environmental Impact assessment, ❖ Assessment of Soil – Water – Energy Mineral Resources, ❖ Delineation of natural resources by using remote sensing techniques, ❖ Study of physical properties of Coal, Study of physical properties of Atomic Minerals
Field component	**VISITING THE MINING SITES, SAMPLE COLLECTION TECHNIQUES OF RESOURCES AND PRACTICAL IMPLICATION STRATEGIES FOR THE RESOURCE MANAGEMENT**
Texts / References	1. ***Keller:*** *Environmental Geology*

(Suggested Readings)	2. ***Tank :*** *Environmental Geology* 3. ***A.D.Howward and I. Remson :*** *Geology in Environmental Planning* 4. ***Strahler and Strahler:*** *Environmental Geology* 5. ***Ordway:*** *Earth Science and Environment* 6. ***Turk and Turk:*** *Environmental Geology* ***7. K.S.Valdiya :*** *Environmental Geology*

SEMESTER-2

IGNEOUS PETROLOGY
CCGE-207

Paper Code	CCGE-207
Title	IGNEOUS PETROLOGY
Unit – 1	• Evolution and formation of magma and magmatic systems, • Crystallization paths Phase rule and binary and ternary systems, • Magmatic differentiation, assimilation and partial melting, • Various rock suits, • Chemical and mineralogical classification, • IUGS classification of igneous rocks
Unit – 2	• Petrography, Structures and textures of the Calc-Alkaline, sub-alkaline and alkaline volcanic and plutonic rocks, • Field relations of volcanic and plutonic rock bodies (e.g. Plutons, pyroclastics, etc.) with major case studies
Unit – 3	• Magmatica and Petrotectonic association (MORB, Flood basalts, arc magmatism, ophiolites, Kimberlites, volcanic arcs, plutonic arcs, granite, lamprophyres etc. with major case studies)
Practical/ Laboratory work	❖ Megascopic and microscopic studies of igneous rock, NORM calculation and rock Classification
Field component	**FIELD WORK FOR MEGASCOPIC IDENTIFICATION OF COMMON IGNEOUS ROCKS AND THEIR VARIOUS TEXTURES**
Texts / References (Suggested Readings)	1.***Myron G. Best*** *Igneous and Metamorphic Petrology, CBS Publishers* 2.***Winter, J.D.*** *An introduction to Igneous and Metamorphic petrolog, Prentice Hall, 2010.* 3.***Anthony Hall*** *Igneous Petrology, Longman, 1987.* 4.***Carmichael,*** *I.S.E., J. Igneous Petrology, McGraw Hill 1974.* 5.***Cox, K.G. Bell, J.D. and Pankhurst, R.J.*** *Interpretation of Igneous Rocks. George Ullen & Unwin 1979.* 6.***Wilson, M.*** *Igneous Petrogenesis. Unwin Hyman 1990.* 7.***Blatt, H., Tracy, R.J. and Edwards, B.*** *Petrology: Igneous, Sedimentary and Metamorphic Freeman, 2006.* 8.***Phillpots A.,*** *Introduction to igneous and metamorphic petrology. Prentice Hall Pub., New Delhi.* 9.***Ehlers, E.G. and Blatt, H.,*** *Petrology: Igneous, Sedimentary and Metamorphic Freeman, 1982.*

SEMESTER-2

METAMORPHIC PETROLOGY
CCGE-208

Paper Code	CCGE-208
Title	METAMORPHIC PETROLOGY
Unit – 1	• Introduction to Metamorphism: Agents, changes, types of metamorphism, • Types of protolith, Classification of metamorphic rocks: • Metamorphism of Foliated, lineated; non-foliated and non-lineated rocks, • Famous case studies of the world
Unit – 2	• Structures and Textures of metamorphic rocks: • Process of deformation, recrystallization, • Textures of dynamic, regional, contact, non-foliated rocks, • Origin of fabrics in metamorphic system.
Unit – 3	• Metamorphic facies, Field relation of metamorphic bodies & metamorphic facies, • Metamorphism of pelites, mafic -ultramafic rocks, siliceous and dolomites • AFM, AKF, ACF diagrams, Migmatites. • Paired orogenic metamorphic belts, Regional burial metamorphism
Practical/ Laboratory work	• Megascopic and microscopic studies of igneous rock, Norms calculation and rock Classification
Field component	***FIELD WORK FOR MEGASCOPIC IDENTIFICATION OF COMMON METAMORPHIC ROCKS AND THEIR VARIOUS TEXTURES***
Texts / References (Suggested Readings)	1. ***Yardly, B. W.*** *An Introduction to Metamorphic petrology, Longman* 2. ***Myron G. Best,*** *Igneous and Metamorphic Petrology, CBS Publishers* 3. ***Winter, J.D.*** *An introduction to Igneous and Metamorphic petrolog, Prentice Hall, 2010.* 4. ***Phillpots A.,*** *Introduction to igneous and metamorphic petrology. Prentice Hall Pub., NewDelhi.* 5. ***Bhaskar Rao, B.*** *Metamorphic Petrology, IBH & Oxford, 1986.* 6. ***Blatt, H., Tracy, R.J. and Edwards, B.*** *Petrology: Igneous, Sedimentary and Metamorphic Freeman, 2006.* 7. ***Miyashiro Akiho.*** *Metamorphic Petrology. UCL Press, U.K.* 8. ***Miyashiro Akiho****. Metamorphism and metamorphic belts. George Allen & Unwin London.*

SEMESTER-2

ECONOMIC AND MINING GEOLOGY
CCGE-209

Paper Code	CCGE-209
Title	**ECONOMIC AND MINING GEOLOGY**
Unit – 1	**Ore Genesis**: • Concept of the term's ore, gangue, grade, tenor, resources, reserves • Mineral deposits as products of geochemical cycles in relation to igneous, sedimentary, metamorphic and weathering processes, • Resources and reserves and their classification, • Strategic, critical and essential minerals, National Mineral Policy
Unit – 2	**Indian ore deposits**: • Mode of occurrence, geological and geographic distribution, classification and genesis of the following mineral deposits: Chromium, Iron, Manganese, Copper, Skarn Deposits, Lead and Zinc, Gold, Aluminum (Bauxite), Barite, Uranium, precious and semi-precious stones
Unit – 3	**Mining Geology:** • Terminology in mining, Planning, exploration and exploratory mining of surface and underground mineral deposits, Open pit mining, Ocean bottom mining, • Mining Hazards: mine inundation, fire and rock burst, • Mine planning and environmental issues related to mining
Practical/ Laboratory work	❖ Megascopic study of ores, Indian occurrences of different economic minerals on map, illustrative representation of mining components
Field component	**FIELD WORK TO DIFFERENT MINES TO UNDERSTAND THE ON FIELD MINING TECHNIQUES AND EQUIPMENTS**
Texts / References (Suggested Readings)	1. ***Arogyaswamy, R.N. P*** *(1980). Course in mining Geology, Oxford & IBH Pub. Co* 2. ***Williams Peter J.*** *Exploration and mining geology. John Wiley & Sons, New York* 3. ***Chatterjee, K.K.*** *(1993) An Introduction to Mineral Economics. Wiley Eastern Ltd.* 4. ***Krishnaswamy, S. (1979)*** *India's Mineral Resources; Oxford and IBH Co.* 5. ***Asoke Mookherjee (1999)*** *Ore genesis: a holistic approach, Allied Publishers* 6. ***Evans, A.M. (1993)*** *Ore geology and industrial menerals, Blackwell.* 7. ***McKinstry, H.E. (1962)*** *Mining Geology. Asia Publishing House.* 8. ***Clark, G. B. (1967)*** *Elements of Mining. John Wiley.*

SEMESTER-2

FIELD TECHNIQUES IN GEOLOGY
CCGE-210

Paper Code	CCGE-210
Title	**FIELD TECHNIQUES IN GEOLOGY**
Unit – 1	• Introduction to field techniques in geology, • Field equipment and Safety, • Introduction to field observations at different scales, • Field notebook and its method for preparing the field diary
Unit – 2	• Field observation and documentation of igneous rocks, metamorphic rocks, sedimentary rocks, • Structural information and paleontological information, • Construction of graphical logs and geomorphological evidences
Unit – 3	• Making of geological maps and interpretation of numerical Data and Use of various instruments in the field, • Photography, Sampling- fossils, minerals, rocks, structures etc., • Concluding Remarks.
Practical/ Laboratory work	❖ Use of Brunton and its demonstration, clinometer and its demonstration, ❖ Strike and dip demonstration, ❖ Use of geophysical instruments, ❖ Rosette diagrams plotting, ❖ Preparation and digitization of maps, Interpretation etc.
Field component	**FIELDWORK - FOR UNDERSTANDING THE PRACTICALITY AND APPLICATIONS IN THE FIELD**
Texts / References (Suggested Readings)	1. **Angela L. Coe:** Geological Field Techniques 2. **S.M. Mathur:** Guide to Field Geology 3. **Frederic H. Lahee:** Field Geology *4.* **Compton and Robert R.:** Manual of Field Geology

SEMESTER-2

ENVIRONMENTAL GEOLOGY AND DISASTER MANAGEMENT

ICGE-211

Paper Code	CCGE-211
Title	ENVIRONMENTAL GEOLOGY AND DISASTER MANAGEMENT
Unit – 1	**Environmental Geology:** • Concepts of Environmental Geology, • Geologic and Natural Hazards and hostile environment: Volcanism, earthquakes, landslide and mass movements, floods, water logging, • Mineral and Water resource exploration and environmental impact, • Waste disposal, Geology and urbanization, • Mineral resources and future of mankind, • Environmental Problems related to Geology: Indian Perspective
Unit – 2	**Disaster:** • Introduction to disasters, Theoretical Concepts and Case study • Coastal development and Disaster, • Increasing frequency of disaster and their reversal, • The politics of disaster, • Different approach to disaster recovery, • Debris disposal and Recycling from disaster.
Unit – 3	**Disaster Management:** • Human, Personal and International issues: Disaster Management and population with special needs, • Disaster Psychology: A Dual perspective, Managing the spontaneous volunteer, First responder and workforce protection, • The role of coordination in Disaster Management. • Disaster rehabilitation: towards a new perspective Planning, Prevention and Preparedness: • The role of training in disaster management, • Disaster management and intergovernmental relations, • Issues in hospital preparedness, Strategic planning for emergency manager.

Practical/ Laboratory work	❖ Laboratory exercises on mapping of seismic zones of India, ❖ Active and Passive Volcanoes in world and mapping of earthquake zones in world. ❖ Field Training with the State / District Level Disaster Management Authority, ❖ Training to use various rescue equipment, instruments, First Aid etc.
Field component	**FIELD WORK TO DISASTER MANAGEMENT DEPARTMENT FOR TRAINNING DURING NATURAL CALAMITIES**
Texts / References (Suggested Readings)	1. ***Bell, F.G.*** *Fundamentals of Engineering Geology, Butterworths, 1983.* 2. ***Krynine, D.P. Judd, W.P.*** *Principles of Engineering Geology, McGraw Hill, 1957.* 3. ***Ronald W. Tank,*** *Environmental Geology, Oxford, 1983.* 4. ***Keller, E. A.,*** *Environmental Geology, Printice Hall, 2010.* 5. ***K. S. Valdiya,*** *Environmental Geology: Indian Context, McGraw-Hill, 1987.* 6. ***Harsh Gupta (2003)****, Disaster Management, Universities Press.* 7. ***Thomas D. Schneid and Larry Collins (2001)****, Disaster management and preparedness: Occupational safety and health guide series, CRC Press.*

SEMESTER-2

RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATION

ICGE-212

Paper Code	**CCGE-212**
Title	**RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATION**
Unit – 1	• Introduction to Research and Scientific Writing: • Characteristics and Types of Scientific Research, • Organizing Scientific Research: Experimental Design, • Research Methodology, Sampling designs. • Research proposals, Paper, Reviews, thesis, conference reports, book reviews, project reports, reference writing and scientific abbreviations. • Preparation and delivery of Scientific Presentations
Unit – 2	• Introduction to Biometry and Parametric Tests: Statistics, Definition and scope, Sampling and sample designs, • Presentation of data (tabular, graphical and diagrammatic presentation), • Measures of central tendency, dispersion and standard error; • Probability distributions: binomial, Poisson and normal distribution, • Statistical significance (Hypothesis testing, types of error, level of significance), Student's t distribution, Analysis of variance, $\chi 2$ test and goodness of fit, Regression and Correlation Analysis
Unit – 3	• Computer Applications: History, development and types of computers; • Computer hardware, software and peripheral devices; • Basic working on DOS, Windows and Linux, • General awareness and use of popular software and packages, Microsoft office, Internet- Browsing
Practical/ Laboratory work	❖ Hands on practice of Statistics, ❖ Hands on practice on Computer related practical
Field component	**FIELD WORK TO DISASTER MANAGEMENT DEPARTMENT FOR TRAINNING DURING NATURAL CALAMITIES**
Texts / References (Suggested Readings)	1. **C R Kothari (2008)** Research Methodology: Methods and Techniques, New Age International. 2. **Wayne Goddard, Stuart Melville (2004)**: Research Methodology: An Introduction, Juta and Company Ltd. 3. **Allan G. Bluman (2005)**: Elementary statistics: a step-by-step approach, McGraw Hill Publ. 4. **Preben Blæsild, Jorgen Granfeldt (2003):** Statistics with applications in biology and geology, CRC Press. 5. **T. V. Loudon (1979)**, Computer methods in geology, Academic Press.

SEMESTER-3

SEDIMENTARY PETROLOGY AND SEDIMENTOLOGY
CCGE-313

Paper Code	CCGE-313
Title	SEDIMENTARY PETROLOGY AND SEDIMENTOLOGY
Unit – 1	**Sedimentology and processes:** • Introduction to Sedimentology, • Earth surface system: rock weathering, source of sediments, • Liberation and flux of sediments, processes of transport and generation of sedimentary structures; • Kinds of sedimentary particles; Hydraulics, sediment transportation and structures; • sedimentary texture - shape, size, fabric and surface textures, methods of textural analysis, textural parameters and their significance
Unit – 2	**Sedimentary Petrology:** • Rocks of mechanical origin, Gravels, Rudaceous sedimentary rocks (Conglomerates & Breccias); Sands & Sandstones; Shales, Argillites & Siltstones; • Rocks of chemical and biochemical origin: Limestones & Dolomites; • Diagenesis and fluid flow, • Lithification; Provenance
Unit – 3	**Sedimentary Basin and environment:** • Sedimentary environments and facies • Physical and chemical parameters of depositional environments; • Classification of environments; • Structures and vertical sequences formed in alluvial, deltaic, coastal, deep sea, Aeolian & carbonate environments, • Evolution of Sedimentary basins. • Sequence Stratigraphy
Practical/ Laboratory work	❖ Microscopic and megascopic petrography of common sedimentary rocks, grain size analysis, ❖ Determination of roundness and sphericity.
Field component	**FIELD WORK FOR IDENTIFICATION AND OBSERVATION OF COMMON SEDIMENTARY ROCKS AND STRUCTURES**

Texts / References (Suggested Readings)	1. ***Blatt, H., Middleton, G.V. and Murray, R.C.*** *(1980): Origin of Sedimentary Rocks, Prentice-Hall Inc.* 2. ***Collins, J.D., and Thompson, D.B.*** *(1982): Sedimentary Structures, George Allen and Unwin, London.* 3. ***Lindholm, R.C.*** *(1987) A Practical Approach to Sedimentology, Allen and Unwin, London.* 4. ***Miall, A.D.*** *(2000): Principles of Basin Analysis, Sjpringer-Verlag.* 5. ***Pettijohn, F.J.*** *(1975): Sedimentary Rocks (3rd Ed.), Harper and Row Publ., New Delhi.* 6. ***Reading, H.G.*** *(1997): Sedimentary Environments and facies, Blackwell Scientific Publication.* 7. ***Reineck, H.E. and Singh, I.B.*** *(1973): Depositional Sedimentary Environments, Springer- Verlag.* 8. ***Selley, R. C.*** *(2000) Applied Sedimentology, Academic Press.* 9. ***Tucker, M.E.*** *(1981): Sedimentary Petrology: An Introduction, Wiley and Sons, New York.* 10. ***Tucker, M.E.*** *(1990): Carbonate Sedimentolgy, Blackwell Scientific Publication.*

SEMESTER-3

GEOCHEMISTRY & GEOCHRONOLOGY
CCGE-314

Paper Code	CCGE-314
Title	GEOCHEMISTRY & GEOCHRONOLOGY
Unit – 1	**Basics of Geochemistry:** • Origin and abundance of elements in the solar system and in the Earth and its constituents, • Cosmic abundance of elements, composition of planets and meteorites. • Atomic structures and properties of elements in the Periodic Table, • Special properties of transition and rare earth elements, • Geochemistry of hydrosphere, lithosphere, biosphere and atmosphere.
Unit – 2	**Geochronology:** • Introduction and physics of nucleus, radioactive decay, low of radioactive decay, half-life period. • Stable isotopes of oxygen and hydrogen, • Geochemistry of Radioactive Isotopes: Rb, Sr, K, Ar, Sm, Nd, U,Th, Pb; • Radiogenic Isotope Geochronometers: Sm-Nd method, Rb-Sr method, U-Pb, Th-Pb, Pb-Pb method, • Other dating methods e.g. Thermoluminiscence, OSL
Unit – 3	**Application of Geochemistry:** • Stable Isotopes: nature, abundance and fractionation; • Laws of thermodynamics; • Mineral stability in Eh-pH diagram; rock weathering and soil formation; • Geochemistry and distribution of radiogenic minerals in rocks, minerals and sediments special reference to U-Th in India
Practical/ Laboratory work	❖ Calculations of atomic weight of elements with reference to isotopes; Calculation and ❖ Plotting of binding energy and neutron/proton ratios of various isotopes; ❖ Problems related to radioactive decay of nuclides; ❖ Determination of K-Ar ages; Ages, initial ratios and plotting of isochrones using Rb-Sr and Sm-Nd isotope data

Field component	***FIELD WORK FOR SAMPLE COLLECTION AND VISIT TO DIFFERENT LABORATORIES FOR THEIR GEOCHEMICAL ANALYSIS AND UNDERSTANDING DATING TECHNIQUES***
Texts / References (Suggested Readings)	1. ***Mason, B.*** *Principles of Geochemistry, Wiley Eastern, 1982* 2. ***Krauskopf, K.B.*** *Introduction to Geochemistry, Mc Graw Hill, 1994* 3. ***Faure, G.*** *Inorganic Geochemistry, Prentice Hall, 1991.* 4. ***Aswathnarayana, U.*** *Principles of Nuclear Geology, Oxford Press, 1985.* 5. ***Faul, H.*** *(Ed.), Nuclear Geology, Wiley 1954.*

SEMESTER-3

ENGINEERING GEOLOGY AND SURVEYING
CCGE-315

Paper Code	CCGE-315
Title	**ENGINEERING GEOLOGY AND SURVEYING**
Unit – 1	**Engineering Geology:** • Role of geology in civil construction, in planning, location, design, construction and performance of major civil engineering structures; • Tunnels, Buildings: Site Exploration and Foundation, • Bridges and Pavements; • Dams and Reservoirs, • Structures in earthquake prone regions, rocks as construction materials
Unit – 2	**Geotechnical studies:** • Physico-mechanical properties of rocks and soils; rock index tests; • Rock failure criteria (Mohr-Coulomb, Griffith and Hoek-Brown criteria); • Shear strength of rock discontinuities; • Rock mass classifications (RMR and Q Systems); • In-situ stresses; Analysis of slope stability
Unit – 3	**Surveying:** • Introduction to Surveying and various types of surveying methods, • Principles, techniques and use of Total Station (digital theodolite), chain and plane table survey, • Prismatic Compass, Abney Level, • Remote Sensing survey and there use in geological and geomorphic mapping
Practical/ Laboratory work	❖ Illustrative diagrams of different dams with its terminology, ❖ Hands on practice of plane table survey, ❖ Total station and remote sensing surveying
Field component	***FIELD WORK INCLUDES GEOLOGICAL MAPPING OF THE AREA, APPLICATION OF TOTAL STATION, PLANE TABLE SURVEY AND VISIT TO DIFFERENT CONSTRUCTION SITES TO UNDERSTAND THE FIELD CONCEPTS OF ENGINEERING GEOLOGY***
Texts / References (Suggested Readings)	1. ***Krynine D P & Judd W R (1998)*** *Principles of engineering geology & geotechniques; McGraw Hill,NY* 2. ***Bell F G (1980)*** *Engineering geology and geotechniques; Butterworths, London.* 3. ***Bell F G (1983)*** *Fundamentals of engineering geology; Butterworths, London.* 4. ***Zaruba, Q. and Mencl, V. (1976)*** *Engineering geology; Scientific publishing Amsterdam.*

SEMESTER-3

GEODESY, GEOPHYSICS AND GEOPHYSICAL EXPLORATION METHODS

ECGE-316

Paper Code	ECGE-316
Title	**GEODESY, GEOPHYSICS AND GEOPHYSICAL EXPLORATION METHODS**
Unit – 1	**Geodesy:** • History and introduction of Geodesy, Principles and techniques in Geodesy, • Physical and mathematical Geodesy, • Satellite Geodesy, Datum, coordinate system, geodetic instrumentation, • Principles of gravity of the earth, gravity survey, • Geomagnetism, magnetism of the earth, rock magnetism, • Paleomagnetism, eustasy and isostasy
Unit – 2	**Geophysics:** • Density distribution, Density Vs. depth profile, • Seismology and interior of the Earth, Seismic waves and their propagation, Study of Seismograms, • Composition and evolution of the crust, mantle and core, Geoelectricity
Unit – 3	**Geophysics and Geophysical Exploration:** • Introduction, Principles and Limitations of Geophysics: Earth through geophysics, • Data Acquisition and Processing; • Gravity method; Geomagnetic methods; Electrical Methods; Resistivity Methods; Seismic Methods; Radiometric Methods; GPR, Magnetic Methods
Practical/ Laboratory work	• Hands-on practice of different geophysical instruments.
Field component	***FIELD WORK APPLICATION OF DIFFERENT GEOPHYSICAL EQUIPMENTS AND ITS DATA INTERPRETATION***
Texts / References (Suggested Readings)	1. ***Milsom, J.,*** *(2003) Field Geophysics, Wiley.* 2. ***Lowrie, W.*** *(2007) Fundamentals of Geophysics, Cambridge.* 3. ***Howell, B.F.*** *(1959) Introduction to Geophysics. McGraw-Hill.* 4. ***Mussett, A. E. & Khan, M.A.,*** *(2000) Looking into the Earth: An introduction to Geological Geophysics. Cambridge.* 5. ***Bristow, C.S. & Jol, H.M.*** *(2003) Ground Penetration Radar in Sediments. Geol. Soc. of America sp. Publ*

SEMESTER-3

FUEL GEOLOGY
ECGE-317

Paper Code	ECGE-317
Title	**FUEL GEOLOGY**
Unit – 1	**Coal as fuel:** • Origin of Coal (peat, lignite, bitumen and anthracite); • Classification, Ranks and Grading of coal; • Chemical Characterization; Coal Petrology and its application; • Coal Bed Methane (CBM) – An unconventional petroleum system; • Methods of coal prospecting and production in India.
Unit – 2	**Petroleum as fuel:** • Petroleum – Composition, Origin, Occurrence, Migration and Accumulation of Hydrocarbons; Petroleum traps; Reservoir rocks, • Conditions & mechanisms. Petroleum exploration - Geological, geophysical and geochemical methods of petroleum exploration; • Drilling rigs, Drill holes, Different methods of drilling, • Coring; Casing and Cementation and Drilling fluids; • Functions of Petroleum Geologist; Well Completion and Stimulation.
Unit – 3	**Atomic Fuel:** • Mode of occurrence and association of atomic minerals in nature. • Atomic minerals as source of energy, • Methods of prospecting and productive geological horizons in India; • Nuclear power stations of the country and future prospects, atomic fuels and environment
Practical/ Laboratory work	❖ Identification of coal and petroleum basins on India Map
Field component	***FIELD WORK TO COAL MINES FOR ON-FIELD UNDERSTANDING OF TECHNIQUES USED FOR ITS EXPLORATION***
Texts / References (Suggested Readings)	1. ***Bhagwan Sahay.*** *(1994) Petroleum exploration and exploitation practices. Allied Pub* 2. ***Deshpande B. G.*** *The world of petroleum.* 3. ***Levorson A. I.,*** *Geology of Petroleum. CBS Pub.* 4. ***North F. K.*** *(1985) Petroleum Geology.* 5. ***Selley R. C.*** *(1985) Elements of Petroleum Geology. Academic Press. London*

6. ***Chandra, D., Singh, R.M. Singh, M.P.*** *(2000): Textbook of Coal (Indian context), Tara Book Agency, Varanasi.*
7. ***Scott, A.C.*** *(1987): Coal and Coal-bearing strata: Recent Advances, Blackwell Scientific Publications.*
8. ***Singh, M.P.*** *(1998): Coal and organic Petrology, Hindustan Publishing Corporation, NewDelhi.*
9. ***Stach;, E., Mackowsky, M-Th., Taylor, G.H., Chandra, D., Teichumullelr, M. and***
10. ***Teichmuller R.*** *(1982): Stach Texbook of Coal petrology, Gebruder Borntraeger,Stuttgart.*
11. ***Thomas, Larry*** *(2002): Coal Geology, John Wiley and Sons Ltd., England.*
12. ***Van Krevelen, D. W.*** *(1993): Coal: Typology-Physics-Chemistry-Constitution),Elsevier Science, Netherlands.*
13. ***Dahlkamp, F.J.*** *(1993) Uranium Ore Deposits. Springer.*
14. ***Boyle, R.****W. (1982). Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier.*

SEMESTER-4

HYDROGEOLOGY
CCGE-418

Paper Code	CCGE-418
Title	**HYDROGEOLOGY**
Unit – 1	**Groundwater:** • Groundwater Origin, types, importance, precipitation, evaporation, transpiration, evapotranspiration, infiltration, • Hydrologic properties of rocks; Runoff, • Elementary theory of groundwater flow; Darcy's law and its range of validity, • Pumping tests – principles – types of pumping tests, procedures, • Determination of aquifer properties and well characteristics by simple graphical methods – significance of transmissivity and storability data.
Unit – 2	• Ground water quality, estimation and methods of treatment for various uses, • Water contaminants and pollutants, • Well hydraulics: confined, unconfined, steady and unsteady and radial flows
Unit – 3	• Groundwater levels and fluctuations: • Various causes of water level fluctuations. • Fresh and salt water relationship in coastal areas; Ghyben-Herzberg principle and its modification, • Prevention and control of sea water intrusion, • Groundwater provinces of India. • Basin wise groundwater development: • Groundwater inventory. • Basic ideas of groundwater management, • Artificial recharge and water logging. • Quality and geochemistry of groundwater
Practical/ Laboratory work	❖ Calculations and illustrative representation of well-inventory data, ❖ Calculations of numerical on porosity, hydraulic conductivity, transmissivity, storativity, Salt and freshwater interface, contour map preparation. ❖ Piper-plot, Wilcox plot and USSL Salinity Chart, Watershed demarcation.
Field component	***FIELD WORK FOR GEOHYDROLOGICAL INVESTIGATION, VARIOUS***

	DRILLING METHODS (DR/ DTH), VISIT TO ARTIFICIAL RECHARGE SITE, BORE-HOLE LOGGING
Texts / References (Suggested Readings)	1. ***Davies, S.N. and De Wiest, R.J.M. (1966)*** *Hydrology, John Wiley, N.Y.* 2. ***Fetter, C.W. (1990)*** *Applied Hydrology, Prentice Hall* 3. ***Todd, D.K. (1980)*** *Groundwater Hydrology. John Wiley& Sons, N.Y.*

SEMESTER-4

QUATERNARY GEOLOGY AND GEOARCHAEOLOGY
ECGE-419

Paper Code	ECGE-419
Title	QUATERNARY GEOLOGY AND GEOARCHAEOLOGY
Unit – 1	**Quaternary Geology:** • Basics of Quaternary Geology; Quaternary Stratigraphy: • Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. • Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, • Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary, Late Quaternary Sea level, • Neotectonics and active tectonics, landforms geomorphology, Geomorphic markers/ indices, • Quaternary dating methods: Radiocarbon, Uranium series, Luminescence, Amino-acid, relative dating methods
Unit – 2	**Paleoseismology:** • Introduction to paleoseismology, Prehistoric earthquakes and dating, recurrence and dating, Co-seismic event horizon, co-seismic uplift, • Field techniques in paleoseismology, mapping paleoseimic landforms, Prehistoric stratigraphy. • Paleoseismology of extensional and compressional/ subduction zone tectonic environments
Unit – 3	• **Geoarchaeology**: • Introduction to Geoarchaeology: • Definition and scope of geoarchaeology, History of geoarchaeology, • Role of geoarchaeology in archaeological research, • stratigraphy and site formation processes and their effects on the archaeological record, Methods for identifying and interpreting stratigraphic sequences, • Paleoenvironmental reconstruction, proxy data and their interpretation: important case studies of paleoenvironmental reconstruction in archaeology. • Dating Geoarchaeological Material:

	• Evolution of man and Stone Age cultures • Landscape Evolution and Human Impact: The role of environmental change in human evolution, • Human impact on landscapes over time: some important case studies
Practical/ Laboratory work	❖ Morphometric exercise, TL, OSL, C14 Laboratory visit
Field component	***FIELD WORK TO IDENTIFY QUATERNARY STRUCTURES AND GEOMORPHIC MARKERS OF NEOTECTONICS, FIELD VISIT TO GEOARCHAEOLOGICAL SITES***
Texts / References (Suggested Readings)	1. ***Bull W. D. (1991)*** *Geomorphic Responses to Climatic Change, Oxford Uni. Press New York* 2. ***Keller E. A. (1986)*** *Active Tectonics National Academic Press, New York* 3. ***Bull and Mc Fadden****, Tectonic Geomorphology* 4. ***James P. McCalpin (2009),*** *Paleoseismology, Academic Press* 5. ***Schumm, S. A. (1977),*** *The Fluvial System Wiley New York* 6. ***Williams, M.A.J. et al.,*** *Quaternary Environments, Edward Arnolds (1993).* 7. ***Lowe, J.J. & Walker, M.J.C.*** *Reconstructing Quaternary Environments, Longman (1984).* 8. ***N. Tiwari; V. Singh; S. B. Mehra****: Quaternary Geoarchaeology of India, 2023* 9. **Christopher L. Hill, Jr. Rapp, George**: Geoarchaeology: The Earth-Science Approach to Archaeological Interpretation (2006)

SEMESTER-4

GEOHERITAGE, GEOCONSERVATION AND GEOTOURISM

ECGE-420

Paper Code	ECGE-420
Title	GEOHERITAGE, GEOCONSERVATION AND GEOTOURISM
Unit – 1	**Geoheritage:** • Introduction to Geoheritage: Definition and scope of geoheritage, • Importance and challenges of geoheritage conservation, • The role of geologists in geoheritage management. • Geological Features and Landscapes for geoheritage perspective, • Case studies of iconic geological features around the world, • UNESCO guidelines on Geoheritage and conservation, assessment and valuation of geoheritage resources: • Methods for assessing and mapping geoheritage resources,
Unit – 2	**Geoconservation:** • Principles of Geoconservation, geodiversity and its importance for geoconservation, • Strategies for sustainable geoconservation and management of geoheritage sites. • Geoconservation techniques and tools, techniques for site assessment, monitoring, and management, • Geotechnical methods for stabilization and restoration of geological features, • Use of geospatial tools and technologies in geoconservation
Unit – 3	**Geotourism:** • Geotourism and Interpretation: Definition and principles of geotourism, • Education for geoheritage and geotourism, • Global case studies of successful geotourism initiatives, • Geoheritage Policy and Management: Stakeholder engagement and participation in geoheritage management, current issues and future directions in Geoheritage: • Emerging challenges and opportunities in geoheritage conservation and management, • Concept of Geopark, Geopark through Geotourism, Employment opportunities and economic developments through Geotourism.

Practical/ Laboratory work	❖ SWOT and TWOS Analysis of Geoheritage sites. Geopark Evaluation of geoheritage Sites
Field component	• **FIELD WORK TO GEOHEROTAGE AND GEOTOURISM SITES**
Texts / References (Suggested Readings)	1. ***F. Wolfgang Eder, Peter T. Bobrowsky, Jesus Martinez-Frias:*** *Geoheritage, Geoparks and Geotourism (2023)* 2. ***Emmanuel Reynard, José Brilha:*** *Geoheritage,- Assessment, Protection, and Management (2017)* 3. ***R.B. Singh, Dongying Wei, Subhash Anand: lobal*** *Geographical Heritage, Geoparks and Geotourism: Geoconservation and Development (Advances in Geographical and Environmental Sciences) (2021)* 4. ***Thomas A. Hose, Boydell & Brewer:*** *Geoheritage and Geotourism: A European Perspective (2016)*

SEMESTER-4

DISSERTATION
ECGE-421

Paper Code	ECGE-421
Title	***DISSERTATION*** ***(10 Credits for Entire Project/ Dissertation, Preparation of report, Internal Evaluation through Presentation, Laboratory work etc.)*** ***(Dissertation equal to two course work)***

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

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

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

The outline must include the following:

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

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

Structure of the Question Paper for the University Exam

KSKV Kachchh University: BHUJ

M.Sc. (Geology) Semester: I to IV

Total Marks: 70, Duration: 3 hours

Passing standard: 28 Marks

FOR SEMESTER-END EXAMS (Sem I to IV) All papers

Subject: **Geology**

Total Marks: **70 (Total Units: Three)**

Time: **Three Hours**

PATTERN OF QUESTION PAPER

Question No.	Question type	Marks
	Section - I	
1	Descriptive question with internal option. Short notes or explanatory note can also be asked (From Unit : I) Example: Q-1 or Q-1	12
2	Descriptive question with internal option. Short notes or explanatory note can also be asked (From Unit : II) Example: Q-2 or Q-2	12
3	Descriptive question with internal option. Short notes or explanatory note can also be asked (From Unit : III) Example: Q-3 or Q-3	12
4	Descriptive question. Short notes or explanatory note can also be asked Total no. of short notes/ questions : 4 (Attempt any three - Each question carries four marks) (3X4) (From Unit I to III)	12
	Section : II	
5	Short questions – No option No. of Questions : 11 Each carries 2 marks (From Unit I to III)	22

- The examination pattern of the university is 70% external and 30% internal.
- Types of questions for section A and Question 5 may be varied like: one line answers / two line answers / definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice question/ one word answer / match the pairs etc.
- Excursion/ Project work/ Visit/ Tour/ report and submission of specimens / Charts/ Model/ Fresh Material/ other activity (Given by teacher or as a part of Syllabus) will be mandatory for all the students.

Distribution of Credits and Marks for Each Semester of M.Sc. Geology

Semester – I				
Core Papers				
Paper No.	**Title**	**Credits**		**Marks**
	Core Papers (All are compulsory)	**Theory**	**Practical**	(U+C)
CCGE-101	***Structural Geology & Geotectonics***	03	02	100 (70+30)
CCGE-102	***Crystallography, Mineralogy, Optics, and Instrumentation Techniques***	03	02	100 (70+30)
CCGE-103	***Paleontology and Stratigraphy***	03	02	100 (70+30)
CCGE-104	***Geomorphology, Remote Sensing and GIS (RS & GIS)***	03	02	100 (70+30)
Interdisciplinary papers (Any one out of two papers)				
ICGE-105	***Oceanography and Climatology***	03	01	100 (70+30)
ICGE-106	***Natural Resource Management***	03	01	100 (70+30)
	Total Credits	**15**	**09**	
	Total Credits for Semester I	**24**		
				Total Marks (Theory) **500 (350+150)**
				Practical **150 (105+45)**
				Viva **50**
				Total Marks (Practical + Viva) **200**
				Grand Total for Sem. I **700**

Semester – II				
Paper	**Title**	**Credits**		**Marks**
		Theory	**Practical**	
	Core Papers (All are compulsory)			(U+C)
CCGE-207	***Igneous Petrology***	03	02	100 (70+30)
CCGE-208	***Metamorphic Petrology***	03	02	100 (70+30)
CCGE-209	***Economic and Mining Geology***	03	01	100 (70+30)
CCGE-210	***Field Techniques in Geology***	03	03	100 (70+30)
Interdisciplinary papers (Any one out of two papers)				
ICGE-211	***Environmental Geology and Disaster Management***	03	01	100 (70+30)
ICGE-212	***Research Methodology, Statistics and Computer application***	03	01	100 (70+30)
FIELD-001	***Field Excursion***		02	**100 (Departmental Assessment)***
	Total Credits	**15**	**11**	
	Total Credits for Sem. II	**26**		
			Total Marks (Theory)	**500 (350+150)**
			Practical	**150 (105+45)**
			Viva	**50**
			Total Marks (Practical+ Field excursion + Viva)	**300**
			Grand Total for Sem. II	**800**

- *Departmental Assessment consists of field performance, Field Report and Field Excursion examination*

Semester – III				
Core Papers				
Paper No.	**Title**	**Credits**		**Marks**
	Core Papers (All are compulsory)	**Theory**	**Practical**	(U+C)
CCGE-313	***Sedimentary Petrology and Sedimentology***	03	02	100 (70+30)
CCGE-314	***Geochemistry & Geochronology***	03	01	100 (70+30)
CCGE-315	***Engineering Geology and Surveying***	03	02	100 (70+30)
Elective papers (All are compulsory)				
ECGE-316	***Geodesy, Geophysics and Geophysical Exploration Methods***	03	01	100 (70+30)
ECGE-317	***Fuel Geology***	03	01	100 (70+30)
INTR-002	***Internship***		02	**100 (Departmental Assessment)***
	Total Credits	**15**	**09**	
	Total Credits for Sem. I	**24**		
				Total Marks (Theory) **500 (350+150)**
				Practical **150 (105+45)**
				Viva **50**
				Total Marks (Practical + Internship + Viva) **300**
				Grand Total for Sem. I **800**

- *Departmental Assessment consists of field performance, Field Report and Field Excursion examination*

Semester – IV				
Paper	**Title**	**Credits**		**Marks**
		Theory	**Practical**	
Core Papers (All are compulsory)				(U+C)
CCGE-418	***Hydrogeology***	03	02	100 (70+30)
	Elective papers (All are compulsory)			
ECGE-419	***Quaternary Geology and Geoarchaeology***	03	02	100 (70+30)
ECGE-420	***Geoheritage, Geoconservation and Geotourism***	03	02	100 (70+30)
ECGE-421	***Project/dissertation***		10	**200** (140+60)
FIELD-003	***Field Excursion***		02	**100**
	Total Credits	**09**	**18**	
	Total Credits for Semester IV	**27**		
	Total Marks (Theory)			**500 (350+150)**
	Practical			**150 (105+45)**
	Viva			**50**
	Total Marks (Practical + Field excursion + Viva)			**300**
	Grand Total for Sem. II			**800**