

Revised Syllabus

B.Sc. Programme (Subject – Geology)

**Department of Applied Geology
Dr. Harisingh Gour Vishwavidyalaya
Sagar (M.P.)**

Session 2018-19

Syllabus – B. Sc. (Geology) 2018-19

I Semester

Course no.	Course Name	MM	L	T	P	C
GEO-CC 111	General Geology, Geomorphology and Geodynamics	100	4	0	0	4
GEO-CC 112	Geology Lab & Field Work	100	0	0	2	2
			Total Credits			06

II Semester

Course no.	Course Name	MM	L	T	P	C
GEO-CC 211	Crystallography, Crystal Optics and Mineralogy	100	4	0	0	4
GEO-CC 212	Geology Lab & Field Work	100	0	0	2	2
			Total Credits			06

III Semester

Course no.	Course Name	MM	L	T	P	C
GEO-CC 311	Igneous, Sedimentary and Metamorphic Petrology	100	4	0	0	4
GEO-CC 312	Geology Lab & Field Work	100	0	0	2	2
GEO-SEC 311	Photo Geology and Remote Sensing	100	2	0	0	2
			Total Credits			08

IV Semester

Course no.	Course Name	MM	L	T	P	C
GEO-CC 411	Structural Geology and Tectonics	100	4	0	0	4
GEO-CC 412	Geology Lab & Field Work	100	0	0	2	2
GEO-SEC 411	Geomorphology and Geotectonics	100	2	0	0	2
			Total Credits			08

V Semester

Course no.	Course Name	MM	L	T	P	C
GEO-EC 511*	Indian Stratigraphy	100	3	0	0	3
GEO-EC 512*	Palaeontology	100	3	0	0	3
GEO-EC 513	Geology Lab & Field Work	100	0	0	2	2
GEO-SEC511	Environmental Geology	100	2	0	0	2
			Total Credits			10

VI Semester

Course no.	Course Name	MM	L	T	P	C
GEO-EC611*	Earth Resources	100	3	0	0	3
GEO-EC 612	Geology Lab & Field Work	100	0	0	2	2
GEO-EC 613*	Applied Geology	100	3	0	0	3
GEO-SEC611	Geochemistry	100	2	0	0	2
L= Lecture, T= Tutorial, P= Practical, C= Credits			Total Credits			10

Total Credits - 48

*Because GEO EC 511 & GEO EC 512 in 5th Semester & GEO EC 611 & GEO EC 613 are essential for B. Sc. Geology studentd , the these electives are kept mendatory.

SEMESTER - I

Core Course: Geology I

Theory (Credits 4, Lectures: 60, M.M. 100= 60 end sem. + 40 sessional)

GEO-CC 111 General Geology, Geomorphology and Geodynamics

Unit 1

Introduction Geology and it's perspectives. Pure and applied branches of geology: scopes and applications. Earth- in the solar system. Size, shape, mass and density of the earth. Origin of the earth. Radioactivity. Age of the earth. Interior of the earth-crust, mantle and core. **(Lectures 12)**

Unit 2

Basic concepts of Geomorphology, Definition and scope, Geomorphic agents, processes and land forms, weathering - physical, chemical, biological. Soil- Formation, Types of soils. **(Lectures 12)**

Unit 3

Geological work of rivers and fluvial landforms, Geological work of wind and Aeolian landforms. Geological work of glaciers and Glacial landforms. Geological work of groundwater. Karst topography. Geological work of oceans and Coastal landforms. **(Lectures 12)**

Unit 4

Earthquakes-distribution causes and effects, Volcanoes- types and distribution, Concept and theories of Isostasy, Origin of oceans, continents and mountains, Concept of plate tectonics. **(Lectures 12)**

Unit 5

Continental drift, Nature and types of plate margins, Evidences of sea floor spreading, Mid-oceanic ridges and trenches, Origin and distribution of Island arcs, Concept of palaeomagnetism, Application of palaeomagnetism. Representation of landforms by various methods, volcanic landforms. **(Lectures 12)**

GEO CC 112 Geology Lab & Field Work

(Credits 2; 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs M.M. 100= 60 end sem. + 40 sessional)

Study of Physical models showing geomorphic features, (Configuration and Numbering of Topographic maps on various scales). Interpretation of various geomorphic landforms and drainage patterns map exercise; Plotting of major mountain ranges, lakes and rivers on the map of India. Plotting of seismic data on the map in India.

Field Work (3 to 4 days).

Essential Reading:

- 1- Thornbury W. D., (1958) **Principles of Geomorphology** John Wiley and Sons.
- 2- Mukherjee P. K., (1991) **A Text Book of Geology** CBS Publisher and Dist., New Delhi.
- 3- Homes A., (1993) Principle of **Physical Geology** 4th Ed., Chapman and Hall, London.
- 4- Datta A. K., An introduction to **Physical Geology** –Dastane Ramchandra and Co. Pune.

Suggested Reading:

1. Chiplonkar G.W. and Powar K.B. (1979) **Geological Maps**.
2. Lahee, (1961) **Field Geology** Frederic Henry, Mc-Graw Hill Book Comp., London, N. York.

SEMESTER - II**Core Course: Geology II****Theory (Credits 04, Lectures: 60 M.M. 100 = 60 end sem. + 40 sessional)****GEO-CC 211 Crystallography, Crystal Optics and Mineralogy*****Unit 1***

Concept of Crystallography. Definition of crystal, Elementary ideas about crystal structure, Crystal faces, edges and interfacial angles, Solid angle, zone and crystal forms, Crystallographic axes and axial angles, Parameters and indices of crystal notations, Crystal symmetry elements, Twinning in crystals, Chemical bonding, Silicate structures, Isomorphism, Polymorphism, Pseudomorphism and Solid solution, Physical properties of minerals- form, colour, streak, lusture, cleavage, fracture, and hardness. Specific gravity, electrical, magnetic and radioactive properties of minerals. **(Lecture 15)**

Unit 2

Classification of crystals into seven systems, Study of symmetry of normal classes of crystal systems, Study of forms of normal classes, Silicate structures and classification.

(Lectures 15)**Unit 3**

Wave Optics, Ordinary and polarized light, isotropic and anisotropic minerals, their wave surfaces and wave fronts, Reflection and refraction of light, Refractive index, critical angle, total internal reflection and Becke's effect, Double refraction, Nicol Prism its construction and working. Optical properties under microscope: Petrological microscope- its parts and functioning, Optical properties of minerals-twinkling, birefringence and pleochroism, Interference colours, Extinction angle and twinning.

(Lectures 10)

Unit 4

Definition of mineral. Classification of minerals, chemical composition, physical and optical properties of the following group of minerals: - Silica, Feldspar and Feldspathoid,

(Lectures 10)

Unit 5

Amphibole, Pyroxene and Olivine, Garnet and Mica, Tourmaline, Epidote, Zircon, Chlorite and Serpentine, Apatite, Sphene, Staurolite, Kyanite, Sillimanite and Zeolite. **(Lectures 10)**

GEO-CC 212 Geology Lab & Field work

(Credits 2; 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs M.M. 100= 60 end sem. + 40 sessional)

Study of symmetry elements in crystal models, Study of Fundamental forms of normal classes of all crystal systems, Verification of Euler's theorem, Study of Physical properties of rock forming minerals, Study of the optical properties of important rock forming minerals using polarizing microscope.

Field Work (3 to 4 days)

Essential Reading:

1. Read, H.H. (1962) Rutley's **Elements of Mineralogy** Reprint CBS Pub. & Dist., New Delhi
2. Ford W. E., (2006) Dana's Text Book of **Mineralogy** CBS Pub. & Dist., New Delhi

Suggested Reading:

3. Alexander P. O. (2008), Handbook of **Minerals, Crystals, Rocks and Ores**, New Age India.

SEMESTER - III**Core Course: Geology III****Theory (Credits 04, Lectures: 60 M.M. 100= 60 end sem. + 40 sessional)****GEO-CC 311 Igneous, Sedimentary and Metamorphic Petrology**

Unit I

Introduction: Scope of igneous petrology, Structures and textures of igneous rocks and their significance. Magma: Origin, composition and classification. Classification of igneous rocks; important IUGS classification, chemical and mineralogical classification. Bowen's reaction principles and its role in the crystallization of magma. **(Lectures 12)**

Unit II

Factors causing diversity in igneous rocks, assimilation and differentiation. Crystallization of the basaltic magma in relation to the following systems: Albite-Anorthite (b) Diopside-Anorthite (c) Forsterite-Fayalite (d) Diopside-Albite-Anorthite. **(Lectures 12)**

Unit III

Introduction: Physical and chemical weathering processes, Sedimentary origin, transportation and deposition in marine environments and continental environments. Concept of lithification, diagenesis and basic concept of sedimentary. Structure and classification: Structures and textures of sedimentary rocks and their significance. Classification of sedimentary rocks. **(Lectures 12)**

Unit IV

Introduction: Definition, variables/agents and types/kinds of metamorphism. Metamorphic grade; Structure and classification of metamorphic rocks. Concept of classification of metamorphic facies and facies series. Facies: Description of facies; Facies of low pressure and medium to high pressure, with special reference to characteristic minerals; subdivision into Zones/Subfacies and mineral assemblages, Regional metamorphism of pelitic rocks and thermal metamorphism of calcareous rocks. **(Lectures 12)**

Unit V

Distribution of igneous rocks in India, megascopic and microscopic studies of following rocks, Granite, Granodiorite, Syenite, Diorite, Pegmatite, Gabbro, Dolerite, Pyroxenite, Peridotite, Dunite, Basalt, Rhyolite and Nepheline syenite.

Study of different types of metamorphic rocks: slate, talc, phyllite, schist, gneiss, amphibolites, charnockite and granulite.

Study of different types of sedimentary rocks: Sandstone, Conglomerate, Shale, Clay and Breccia. **(Lectures 12)**

GEO-CC 312 Geology Lab & Field work

(Credits 2: 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs M.M. 100= 60 end sem. + 40 sessional)

Megascopic study of igneous, metamorphic and sedimentary lithotypes: Granite, Granodiorite, Syenite, Diorite, Pegmatite, Rhyolite, Gabbro, Dolerite, Basalt, Pyroxenite, Dunite and Peridotite Sandstone, Conglomerate, limestone, Shale, Clay, Breccia, and Slate, Phyllites, Schist, Gneiss, Marble, Amphibolite, Charnockite and Granulites. Identification of texture of igneous rocks: intergrowth, porphyritic, reaction rims, perthitic and their petrogenetic significance. Identification of textures in sedimentary rocks and their petrological significance and Identification of microstructure, textures in metamorphic rocks and their petrological significance. Microscopic study of igneous, metamorphic and sedimentary lithotypes: Granite, Granodiorite, Syenite, Diorite, Pegmatite, Gabbro, Dolerite, Pyroxenite, Dunite, Basalt, Rhyolite Sandstone, Conglomerate, Shale, Clay, Limestone, Breccia and Slate, Phyllites, Schist, Gneiss, Amphibolite, Charnockite and Marble.

Field Work (3 to 4 days)

Essential Reading:

1. Mason, R., (1978) **Petrology of Metamorphic Rocks** CBS Pub. & Dist., New Delhi
2. Blatt H., Middleton G. and Murray R. (1972), Origin of **Sedimentary rocks** Prentice Hall
3. Best M.G. (2002), **Igneous and Metamorphic Petrology** Wiley-Blackwell Science.
4. Bose, Mihir K., (1997), **Igneous Petrology** World Press Pvt. Ltd., Calcutta, p.568.
5. Winter John D (2012), **Principles of Igneous and Metamorphic Petrology** 2nd Edition, PHI Learning Private Limited New Delhi
6. Pettijohn, F. J. (1957.), **Sedimentary rocks** 3rd Ed Oxford and IBH Publishing Company, New Delhi

Suggested Reading:

7. Carmichael, I. S. E., Turner, F. J. and Verhoogen, J (1971): **Igneous Petrology** Mc Graw Hill
8. Winkler, H. G.F. (1967) **Pathogenesis of Metamorphic Rocks** Springer-Verlag. /Narosa publication, New Delhi
9. Tyrell, G. W., (1963) Principles of **Petrology**, [Methuen](#).
10. Blatt, H. and Tracy, R.J. W.H. (1996), **Petrology (Igneous, Sedimentary and, Metamorphic** Freeman and Co., New York.
11. Mason, R., (1978) **Petrology of Metamorphic Rocks** CBS Pub. & Dist., New Delhi
12. V.K. Verma and Prasad C (1981). A text book of **Sedimentary Petrology** Inter. Book Dist. New Delhi
13. Ehlers, E.G. and Blatt, (1982), **Igneous, Sedimentary and Metamorphic Petrology** CBS Pub. & Dist., New Delhi

14. Alexander, P.O., (2008) Handbook of **Minerals, Crystals, Rocks and Ores**. New Delhi.

15. E-content: Available at <http://cec.nic.in/e-content/Pages/default.aspx>

Skill Enhancement Course (SEC)

GEOC SEC-311 Photo Geology and Remote Sensing

(Credits 2: 30 Hrs, M.M. 100= 60 end sem. + 40 sessional)

Unit-I: Elementary idea about photogeology: electro-magnetic spectrum, types & geometry of aerial photographs; factors affecting aerial photography; types of camera, film and filters; factors affecting scale. **(Lectures 06)**

Unit-II: Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. **(Lectures 06)**

Unit-III: Application of remote sensing in geosciences and geomorphological studies.

(Lectures 06)

Unit-IV: Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification.

(Lectures 06)

Unit-V: Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing. **(Lectures 06)**

Books Recommended:

1. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.
2. Gupta, R.P., 1990. Remote Sensing Geology. Springer Verlag.
3. Lilleasand, T.M. and Kiffer, R.W., 1987. Remote Sensing and Image Interpretation. John Wiley.
4. Pandey, S.N., 1987. Principles and Application of Photogeology. Wiley Eastern, New Delhi.
5. Sabbins, F.F., 1985. Remote Sensing – Principles and Applications. Freeman.
6. Siegal, B.S. and Gillespie, A.R., 1980. Remote Sensing in Geology. John Wiley.
7. Rampal K.K. 1999. Hand book of aerial photography and interpretation. Concept publication.

SEMESTER – IV

Core Course: Geology IV

Theory Credit 4, Lectures: 60 M.M. 100= 60 end sem. + 40 sessional)

GEO-CC 411 - Structural Geology and Tectonics

Unit I

Introduction to Structural Geology, classification, Primary and Secondary structures of igneous, sedimentary and metamorphic rocks, Unconformity, classification and Recognition Joint morphology, geometric and genetic classification of joints. **(Lectures 12)**

Unit II

Elements of Fold, Classification. Effect on the various rock type and Criteria for recognition in map and in field. **(Lectures 12)**

Unit III

Elements of Fault, Classification, effect of fault on various strata and criteria for Recognition of fault. **(Lectures 12)**

Unit IV

Foliation and Lineation- descriptive terminology, kinds, origin and relation of foliation and lineation to major structures. Concept of rock deformation, Concept of stress and strain ellipsoids, Plastic deformation. **(Lectures 12)**

Unit V

Concept of tectonics, Elementary idea of mechanics of folding. Elementary idea of mechanics of faulting, Tectonic framework of Peninsular India, Tectonic framework of Extra-peninsular India, Tectonic framework of Indo-Gangetic plain. **(Lectures 12)**

GEO-CC 412 Geology Lab & Field work

(Credits 2; 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs

M.M. 100 = 60 end sem. + 40 sessional)

Study of geological maps and symbols Measurement of dip and strike using clinometer compass. Measurement of dip and strike using Brunton compass, Interpretation and drawing of sections of simple geological maps. Three point exercise and completion of outcrops, Study of primary sedimentary and igneous structures. Geological cross sections, and identification of structures, fault, dyke, unconformity etc. Structural in Hand specimen.

Field Work (3 to 4 days)

Essential Reading:

1. Ghose S. K. (1985) **Structural Geology** (1985)
2. J. G. Ramsay, (1967) **Folding and Fracturing of Rocks**. (1967)Academic Press.
3. A.K. Jain, 2014, **An Introduction to structural Geology Geol. Soc. of India, Bangalore.** (2014)
4. K.S.Valding (1980) **Geology of Kumaun Himalaya** Himachal Times Press, Dehradun. (1980)
5. Billing,M.P. (1974) **Structural Geology** (3rd Ed.) Pranctice Hall

Suggested Reading

6. Ramsay J.G. and Hubg, M. (1983) **Modern Techniques of Structural Geology**, Academic Press London, New York.
7. **Sturctural Geology**, by D.Sitter (1950)

Skill Enhancement Course (SEC)
GEOC SEC-411: Geomorphology and Geotectonics
(Credits 2; 30 Hrs M.M. 100= 60 end sem. + 40 sessional)

Unit-I: Basic principles of Geomorphology, geomorphological cycles, weathering and erosion; geomorphic mapping- tools and techniques. **(Lectures 05)**

Unit-II: Epigene/exogenic processes: degradation and aggradation. Hypogene/endogenic processes; Extraterrestrial processes; Diastrophism and volcanism. **(Lectures 05)**

Unit-III: Geological work of wind, glacier, river, underground water and ocean. **(Lectures 05)**

Unit-IV: Plate Tectonics: the concept, plate margins, orogeny, deep sea trenches, island arcs and volcanic arcs. **(Lectures 07)**

Unit-V: Earth as a dynamic system. Elementary idea of continental drift, sea-floor spreading and mid-oceanic ridges. Paleomagnetism and its application. (**Lectures 08**)

Books Recommended:

1. Allen, P., 1997. Earth Surface Processes. Blackwell
2. Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition). Pearson Education, Inc.
3. Keary, P. and Vine, F.J., 1997. Global Tectonics. Blackwell and crustal evolution. Butterworth-Heinemann.
4. Kale, V.S. and Gupta, A., 2001. Introduction to Geomorphology. Orient Longman Ltd.
5. Moores, E and Twiss. R.J., 1995. Tectonics. Freeman.
6. Patwardhan, A. M., 1999. The Dynamic Earth System. Prentice Hall.
7. Summerfield, M.A., 2000. Geomorphology and Global tectonic. Springer Verlag.
8. Valdia, K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.
9. WD Thornbury, 2002. Principles of Geomorphology. CBS Publ. New Delhi.

SEMESTER – V

Discipline Specific Elective Course

Theory (Credits 3, Lectures: 45 M.M. 100= 60 end sem. + 40 sessional)

GEO-EC 511 Indian Stratigraphy

Unit - I

Laws of Stratigraphy; concept of uniformitarianism, law of order of superposition, law of faunal succession, law of original horizontality, law of cross-cutting relationship, physical and

biological criteria of correlation and homotaxis. Study of facies and Walther's law of facies succession. **(Lectures 09)**

Unit - II

Time scale; standard stratigraphic time scale. Indian geological time scale, imperfections in geological records- breaks in stratigraphic records, unconformity, diastems. Stratigraphic classification: Biostratigraphy, lithostratigraphy, chronostratigraphy. Physiographic divisions of India-major Stratigraphic divisions of India. Sargur supracrustals, Granulite succession of south India, Bundelkhand Granites and Supra-crustal sequence. Eastern Ghat Group. Bhilwara Super group. **(Lectures 09)**

Unit -III

Brief study of Singhbhum craton, Bastar Craton, Central India Craton, Sausar, Sakoli, Chilpi Groups. Dharwar Supergroup- Aravalli Supergroup. Late Precambrian Stratigraphy: Delhi Supergroup, Mahakoshal Supergroup Cudappah Supergroup, Bijawar, Gwalior, Kaladgi, Bhima, Kurnool, Indravati, Kolhan, Vindhyan Super group. Chattisgarh supergroup, Purana rocks of Pranhita -Godavari valley, and Marwar Supergroup of Rajasthan. **(Lectures 09)**

Unit - IV

Distribution of Paleozoic rocks in India, Cambrian of Salt Range, Age of Saline Series, Upper Carboniferous and Permian rocks of Salt Range, Paleozoic rocks of Kashmir Valley, Paleozoic rocks of Spiti Valley, Paleozoic rocks of Peninsular India, Mesozoic Stratigraphy: The Depositional Environment-distribution-life-classification and economic importance of Gondwana formations of India, Coastal Gondwana of India, Triassic of Spiti – The Lilang System. **(Lectures 09)**

Unit - V

Jurassic of Kutch, Cretaceous of Tiruchirapalli – Pondicherry – Bagh Beds, Deccan traps: distribution, structure, Lameta beds Infratrapean and Intertrappean beds, age of the Deccan Traps. Cenozoic Stratigraphy: Comprehensive account of the geological events took place during Cenozoic Era in India, rise of Himalaya, Stratigraphy of Siwalik system, fauna and flora of Siwaliks, Tertiary rocks of Assam, Karewa Formation, and Tertiary rocks of the East coast of India. Tertiary rocks of West coast of India Pleistocene Glaciation – Cenozoic oil bearing formations of India. **(Lectures 09)**

SEMESTER – V

Discipline Specific Elective Course

Theory (Credits 3, Lectures: 45)

GEO-EC 512 Palaeontology

Unit - I

Introduction to Palaeontology, Elementary ideas about origin of life and fossil record, Modes of fossilization, Types and uses of fossils. **(Lectures 09)**

Unit - II

Morphology, classification and geological distribution of Graptolites, Lamellibranchia and Gastropoda. **(Lectures 09)**

Unit - III

Morphology, classification and geological distribution of Cephalopoda, and Trilobites. **(Lectures 09)**

Unit - IV

Morphology, classification and geological distribution of Brachiopoda and Rugose Corals. **(Lectures 09)**

Unit - V

A brief outline of Vertebrate Palaeontology. Micropalaeontology and Palaeobotany. Basic ideas about micropalaeontology and microfossils. Uses of Microfossils. Foraminifera, their wall composition, morphology. **(Lectures 09)**

GEO-EC 513 Geology Lab & Field Work
(Credits 2; 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs M.M. 100=
60 end sem. + 40 sessional)

Detailed study of the following fossils in hand specimens:

- Foraminifera : *Nummulites*.
- Coral : *Calceola, Zaphrentis*
- Lamellibranchia : *Gryphea, Pecten, Venus, Cardita, Arca, Trigonina, Cypraea, Ostrea*.
- Gastropoda : *Conus, Physa, Murex, Natica, Cypraea, Trochus, Turritella, Cerithium*.
- Cephalopoda : *Orthoceras, Nautilus, Perisphinctes, Goniatites, Ceratites, Belemnites, Hoplites, Hildoceras*.
- Brachiopoda : *Lingula, Rafinesquina, Chonetes, Productus, Spirifer, Terebratula, Rhynchonella, Rhynchotrema, Syringothyris*,
- Triobita : *Calymene, Paradoxides, Phacops, Trinucleus, Olenellus*
- Graptolites : *Monograptus, Diplograptus, Cyclograptus, Phyllograptus*.

Field Work (3 to 4 days)

Essential Reading:

1. Woods, H. (1963) **Palaeontology Invertebrate** CBS Pub. & Dist., (Low Price Edition) New Delhi. P.
2. Black, Rhona M. (1989) **Elements of paleontology** 2nd Ed. Cambridge University Press.

3. Kathal, P K (2012) **Applied Geological Micropaleontology** Scientific Publ., New Delhi, 203p.
4. Kathal, P. K. (1998) **Applications of Microfossils** CBS Publishers & Distributors, New Delhi, 198p.

Suggested Reading:

5. P.C. Jain and M.S. Anant Raman (2000). **An introduction to Invertebrate Palaeontology**, Vishal Pub.Jalandhar, 346P.

**Skill Enhancement Course (SEC)
GEO-SEC 511 Environmental Geology**

(Credits 2; 30 Hrs M.M. 100= 60 end sem. + 40 sessional)

Unit-I: Earth and its spheres: atmosphere, hydrosphere, lithosphere, biosphere and Man; Earth Material. **(Lectures 06)**

Unit-II: Energy budget: Solar radiation; Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change. **(Lectures 08)**

Unit-III: Geological hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation. **(Lectures 06)**

Unit IV: Resource Management: Energy resources (Conventional and non-conventional) **(Lectures 04)**

Unit V: Watershed management, landuse planning, management of water resources, land reclamation. **(Lectures 06)**

Books Recommended:

- 1.Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill.
- 2.Chorley, R. J., 1984. Geomorphology. Methuen.

3. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.
4. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.
5. Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.
6. Keller, E. A., 2000. Environmental Geology. Shales E. Merrill Publishing Co., Columbus, Ohio.
7. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.
8. Bird, Eric, 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.
9. Liu, B.C., 1981. Earthquake Risk and Damage, Westview.
10. Dutta, A.K., (1994) Introduction of Physical Geology, Kalyani Publishers, Delhi, 233 p.
11. Plummer, Charles, Carlson, Diane, Hammerstey, Lisa, (2013 Physical Geology, Mc Graw Hills comp, 635 p.)

SEMESTER – VI

Discipline Specific Elective Course: GEO-EC- 611 - Earth Resources

Theory (Credits 3, Lectures: 45 M.M. 100= 60 end sem. + 40 sessional)

Unit 1

Historical development of economic Geology. Geochemical distribution of elements. Materials of mineral deposits. ore minerals, gangue minerals, tenor & grade of ores, ore shoots & bonanzas. Classification of mineral deposits. Outline of Lindgren's & Bateman's classification. Syngenetic & epigenetic deposits. structural, stratigraphic, physical & chemical controls on ore localization: Metallogenic epochs & provinces. Geologic thermometers. **(Lectures 09)**

Unit 2

Mode of Formation of Mineral Deposits Magmatic processes: Mode of formation; Early magmatic processes & deposits, disseminations, segregations and injections; Late magmatic processes & deposits; Residual liquid segregation & injection; immiscible liquid segregation & injection; sublimation. Contact Metasomatic processes; process & effects; resulting mineral deposits. Hydrothermal processes; principles; Factors affecting deposition; wall rock alteration; minerals sequence; cavity filling deposits Fissure veins,

shear; zone, stock work, saddle reef, ladder vein, fold cracks, breccia filling, solution cavities, pore space & vesicular filling; replacement deposits; process & deposits; criteria of replacement. **(Lectures 09)**

Unit 3

Sedimentary processes & cycles; principles involved in sedimentation; cycles of Iron & manganese, weathering processes; principles; Residual concentration process & deposits; mechanical concentration principles; eluvial, alluvial, beach & eolian placers. Oxidation & supergene sulphide enrichment; solution and deposition in zone of oxidation; secondary sulphide enrichments; Gossans & capping. Metamorphic processes; Formation of Graphite, Asbestos, Talc, Soapstone & Sillimanite group of minerals. **(Lectures 09)**

Unit 4

Metallic Mineral Deposits of India with reference to their mode of occurrence, Diagnostic physical properties, chemical composition, uses, modes of occurrence & distribution in India of following: 1) Economic Minerals: Gold, Silver, Copper, Lead, Zinc, Iron, Manganese, Chromium, Tin, Aluminium; 2) Radioactive metals: Thorium, Uranium, Titanium; 3) Industrial Minerals: Asbestos, Barite, Graphite, Gypsum and Mica; 4) Abrasives: Diamond, Corundum, Emery garnet, Abrasive sand, Tripoli, Pumice, Sand feldspar, Limestone, Clay, Talc; 5) Refractories: fireclay, graphite, Dolomite & sillimanite group of minerals, diaspore, pyrophyllite, zircon; 6) Ceramic minerals: Clay, Feldspar, Wollastonite; 7) Gemstones; **(Lectures 09)**

Unit 5

Fossil fuels: coal and lignite, uses, classification, constitution, origin and distribution in India. Petroleum- composition, uses, theories of origin, oil traps, & important oil fields of India. A brief account of mineral deposits in Beach Sand of Kerala. Significance of minerals in National Economy. Strategic, critical & essential minerals. Mineral wealth of Madhya Pradesh Environmental impact of mineral exploration. **(Lectures 09)**

Essential Reading:

1. Gokhale and Rao **Ore deposits of India.**
2. Jensen and Bateman A.M. – **Economic Mineral Deposits,**
3. Krishnaswamy, S. **Indian Mineral Resources**

Suggested Reading:

4. Park and Macdiarmid **-Ore Deposits**
5. Umeshwer Prasad- **Economic geology**

GEO- EC 612 Geology Lab & Field work

(Credits 2: 30 Hrs Lab work + 30 Hrs Field work = 60 Hrs M.M. 100= 60 end sem. + 40 sessional)

Megascopic identification and description of Indian occurrences and uses of the ore and industrial Minerals: Sulphides: Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Chalcophyrite, Pyrite, Arsenopyrite, Marcasite. Sulphates: Barite, Celestite, Gypsum, Oxides: Cuprite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Cassiterite, Rutile, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite, Carbonates: Calcite, Dolomite, Magnesite, Siderite, Aragonite, Witherite, Strontianite, Cerussite, Azurite, Malachite, Industrial Minerals: Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varieties, Asbestos.

(Field work 3-4 days)

Discipline Specific Elective Course:

GEO-EC 613 - Applied Geology

Theory (Credits 3, Lectures: 45 M.M. 100= 60 end sem. + 40 sessional)

Unit 1

Engineering Geology and its importance, Elementary ideas about engineering properties of soils and rocks, Geological conditions for constructions of dams, tunnel, canals, highways, buildings and bridges. **(Lectures 09)**

Unit 2

Geohydrologic cycle and occurrence of groundwater, geohydrological properties of rocks, Classification of aquifers, Types of wells, Quality of groundwater. **(Lectures 09)**

Unit 3

Introduction to mineral exploration, Surface and sub-surface exploration methods. Elementary ideas about gravity, electrical and magnetic, methods of exploration.

(Lectures 09)

Unit 4

Elementary ideas of methods of drilling, Elementary ideas of mining, Surface mining methods, Under-ground mining methods, Environmental impact of mining. **(Lectures 09)**

Unit 5

Introduction to Aerial Photography, Types of aerial photographs, Basic elements of aerial photo interpretation, Basics of Remote sensing. Elementary idea of Geographical Information System (GIS) and Global Positioning System (GPS). **(Lectures 09)**

Essential Reading:

1. Krynine and Judd Principles of **Engineering geology and geotechniques**. CBS, Publisher and distributor, Pvt. Ltd., N. Delhi.
2. Todd D.K. **Groundwater hydrology**
3. N.C. Kesavulu Textbook of **Engineering Geology**, Maemillan India Ltd.,
4. Arogyaswami R.N.P. **Conrse in mining geology**
5. Pandey, S.N. **Principles and Applications of Photogeology**, John Wiley and Sons.
6. R.M. Raghunath Groundwater

Suggested Reading:

7. Jenson M and Bateman A M 'Economic Mineral Deposits. John Wiley and Sons, New York.
8. Gokhle KV and GK Rao 'Ore Deposits of India,. Thomson Press
9. Lillesand Thomas M. and Kiefer Ralph., 3rd Ed. John Wiley and Sons. Remote Sensing and Image interpretation

Skill Enhancement Course (SEC)
GEO-SEC 611 Geochemistry
(Credits 2; 30 Hrs M.M. 100= 60 end sem. + 40 sessional)

Unit-I: Introduction to geochemistry: basic knowledge about crystal chemistry. Types of chemical bonds, coordination number; Elementary idea of Periodic Table. **(Lectures 06)**

Unit-II: Cosmic abundance of elements; Composition of the planets and meteorites; Geochemical evolution of the earth. **(Lectures 06)**

Unit-III: Gold Schmidt's geochemical classification of elements; Distribution of major, minor and trace elements in igneous, metamorphic and sedimentary rocks. **(Lectures 06)**

Unit-IV: Elements of geochemical thermodynamics; Isomorphism and polymorphism; Isotope geochemistry. **(Lectures 06)**

Unit-V: Colloids in geological systems, ion exchanges and geological evidence for earlier colloids. geochemical cycles; **(Lectures 06)**

Books Recommended:

1. Hoefs, J., 1980. Stable Isotope Geochemistry. Springer-Verlag.
2. Klein, C. and Hurlbut, C.S., 1993. Manual of Mineralogy. John Wiley and Sons, New York.
3. Krauskopf, K.B., 1967. Introduction to Geochemistry. McGraw Hill.
4. Mason, B. and Moore, C.B., 1991. Introduction to Geochemistry. Wiley Eastern.
5. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and Interpretatio.