Course Details: UG

Course Title	Course Type	Nature of Course		Credits	Semester
		Theory (T)	Lab (L)		
Physical Geology	DSC	T (03)	L (01)	4	1
Minerals and Gems	DSC	T (03)	L (01)	4	2
Petrology	DSC	T (03)	L (01)	4	3
Historical geology	DSC	T (03)	L (01)	4	4
Resource and Mining Geology	DSC	T (03)	L (01)	4	5
Photogeology and Engineering Geology	DSC	T (03)	L (01)	4	6
Introductory Geology	GE	T (04)	L (0)	4	1
Geological Processes	GE	T (04)	L (0)	4	2
Geohazard Management	GE	T (04)	L (0)	4	3
Geology of India	GE	T (04)	L (0)	4	4
Evolution of Life	GE	T (04)	L (0)	4	5
Mineral and Fuel Resources of India	GE	T (04)	L (0)	4	6
Geohazard Management	DSE	T (04)	L (0)	4	3
Geology of India	DSE	T (04)	L (0)	4	4
Evolution of Life	DSE	T (04)	L (0)	4	5
Mineral and Fuel Resources of India	DSE	T (04)	L (0)	4	6

PROGRAMME PREREQUISITES: -

Students who have completed intermediate Science with a Mathematics/Biology group or an equivalent examination can choose Geology as a subject in the **six-semester B.Sc.** program (undergraduate level). They should be intensely interested in comprehending the Earth's forming processes through time and possess a natural flair for geoscientific study and research.

PROGRAMME INTRODUCTION: -

Geology is an ever-evolving and most popular branch of pure and applied science amongst students having a keen interest and curiosity in understanding the origin, evolution, nature, composition, structure and processes of the Earth and its environs through time. The identification of minerals, rocks, and fossils provides insights into the age, composition, structure, and paleoenvironment of the Earth and the life that thrived on it through the geological ages. This leads to understanding the physical processes of the Earth’s spatiotemporal evolution and the availability of its natural resources and reserves. A thorough knowledge of various domains of geology is, thus, beneficial in not only enriching our understanding of different physical and historical aspects of the Earth’s evolution and dynamics but also in judiciously utilising its precious natural resources as well as efficiently preventing or mitigating disasters that could be caused as a result of the Earth’s powerful endogenic and exogenic processes.

The programme offers fundamental and advanced knowledge and technical skills in various domains of geology. Students would study core and applied aspects of recent technological advances in the subject field. The curriculum of the programme is designed in such a stepwise manner that the student can derive benefit at any stage of the programme, even if the entire course still needs to be completed; it begins with basic essential knowledge and gradually covers advanced aspects of the subject. At the end of every academic year, the student

will have a good understanding of some basic and applied aspects of the subject, which will keep growing as the student proceeds further with the subject course.

The geology program opens doors to a wide range of career opportunities in fields such as geoscience, disaster management, natural resource assessment and management, civil engineering and construction projects, natural environment conservation, and other allied fields. By choosing the courses offered in geology, candidates can pave the way to a rewarding career in these sectors.

PROGRAMME OUTCOMES (POs)

The curricula of the subject of geology are designed keeping in view the following programme.outcomes:

PO1	Enabling the students to understand the age, composition, structure, processes, and evolutionary history of the Earth.
PO2	Enabling the students to identify, locate, explore, judiciously exploit, and manage various earth resources like minerals, fossil fuel and natural gas, coal, building stones, weathered crust and soils, underground and surface water, etc.
PO3	Enabling the students to understand and assess the potential of natural processes in causing hazards and disasters.
PO4	Enabling the students to understand such geological conditions that make the terrain prone to natural and anthropogenic hazards.
PO5	Enabling the students to assess the suitability of terrain for various civil engineering constructions such as dams, reservoirs, bridges, tunnels, roads, railway lines, cable-cars, and buildings etc.
PO6	Enabling the students to formulate and execute guidelines for safe developmental activities in diverse geological terrains.
PO7	Motivating the students to take up higher studies and research to bring out new knowledge. Yet to be understood the geological aspects of the Earth.

Programme Specific Outcomes (PSOs) for *UG I Year/Certificate Course in Science*

Programme Specific Prerequisites: To acquire a *Certificate in Science*, with geology as one of the major subjects, a student should have passed 10+2 with science background having eitherMathematics/Biology group or equivalent subjects. The candidate may have keen interest inunderstanding the earth forming processes and its evolution through time.

PSOs: This programme pertains to basic and applied knowledge on the essential components ofgeology, in which the students will know the broad physical aspects of the earth and learn toidentify different minerals and gemstones. This programme will impart knowledge on diverse branches of the subject, as well as endogenic and exogenic processes, and geomorphic features of the earth.At the end of the programme the student will have basic knowledge about the rock forming minerals, characteristics properties of gemstones, and the subject domain of geology that are required for further academic progression as well as preparation for competitive examinations.

Programme Specific Outcomes (PSOs) for *UG II Year/Diploma Course in Science*

Programme Specific Prerequisites: To acquire *Diploma in Science*, with geology as one of the major subjects, a student should have obtained Certificate Course in Science from any recognized university.

PSOs: This programme provides broad understanding on various physical and historical aspects of the earth. Having understood the broad physical aspects of the Earth, its constituents, and rock-forming minerals in the two-semester Certificate of Science programme, the students will gain knowledge on rock-forming processes in one semester, and faunal and floral life of the geological past in another semester.
The programme will enable the students to identify different rocks and rock forming processes (petrogenesis) on the basis of minerals, structure, composition, megascopic, and microscopic characters by observing rocks at outcrops, in hand specimens and thin sections. It will also enable them to identify different types of animal and plant fossils, and to understand the origin and evolution of life on the earth.

Programme Specific Outcomes (PSOs) for *UG III Year/Bachelor of Science*

Programme Specific Prerequisites: To acquire a *Bachelor of Science* degree, with geology as one of the major subjects, a student should have obtained a Diploma Course in Science from any recognized university. Studentsshould have a learning aptitude towards rocks and ores.

PSOs: Having understood basic physical and historical aspects of the earth as *Diploma in Science* programme, the students of this programme will gain added knowledge on earth resources, environment, geological controls on the safety of civil engineering construction, and evolution of the earth through time. They will also learn the basics of the fast-growing remote sensing technology, and its application potential in geological investigations. The programme will enable the students to understand such aspects of the earth as its composition, structure, natural resources, terrain, and life evolution through time and space, geological process leading to environmental degradation and hazards, and endangering the safety of civil engineering constructions, as also the techniques of earth resource exploration and using remote sensing technique in geological investigations.

Semester: I

Discipline Specific Core (DSC): Physical Geology

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Physical Geology (DSC)	04	03	0	01	Class X+II with Science	Basic Knowledge of the fundamental laws of physical sciences of 12th Standard.

Course Title: Physical Geology (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: After successful completion of this course students will understand the origin of solar system, and dynamics of earth's surface and interiors, plate tectonic processes, seismicity, and volcanism. They will be enhanced by the knowledge regarding formation of different landforms and the physical, chemical, and biological processes operating upon the earth. They will also be able to recognize and interpret the geological structures formed as a result of deformation.

Units	Course Contents	Teaching Hours
Unit-I	Introduction to geology Modern theory of origin of earth. Earth's size, shape, mass, density, and its atmosphere. Internal structure of the earth and its composition. Earth's gravity and magnetic fields, and geothermal gradient. Law of uniformitarianism.	11
Unit-II	Earth's internal and external processes: The rock cycle. Earthquakes: nature of seismic waves, their intensity and magnitude; Volcanoes: types, products and causes of volcanism. Weathering and its types; Erosion, transportation and deposition by rivers, wind, glaciers, and waves and underground water, and their related landforms. Mass wasting and their types.	12
Unit-III	Introduction to rock deformation; basic concept of stress and strain. Elementary idea of bed, dip and strike; Outcrop, effects of various structures on outcrop. Clinometer/Brunton compass and its use. Elementary idea of types of deformation.	11
Unit-IV	Products of rock deformation: Morphology and types of Folds, Faults and Joints. Unconformity and its types.	11

Course Title: Physical Geology (Lab and Field Training)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	PhysicalGeology:Studyofimportant geomorphological models; Reading topographical maps of The Survey of India; Identification of geomorphic features.Identification of different types of folds/faults from block models; Exercises on structural problems: preparation of cross-section profile from ageological map	**30**
Section-B	Geological Field Training: Students will be required to carry out one week field work in a suitable geological area to study the elementary aspects of field geology and submit a report there on.	

Suggested Reading:

- Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall,London.
- Miller (1949). An Introduction to Physical Geology. East West Press Ltd.
- Spencer, E.V. (1962). Basic concepts of Physical Geology. Oxford &IBH.
- Billings, M.P. (1972). Structural Geology. Prentice Hall.
- Davis, G.R. (1984). Structural Geology of Rocks and Region. John Wiley
- Hills, E.S. (1963). Elements of Structural Geology. Farrold and Sons, London.
- R.J Park (1998) Foundation of Structural Geology, III Edition, Routledge
- Singh, R.P. (1995). Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.
- https://www.mooc-list.com/course/mountains-101-coursera
- https://www.mooc-list.com/course/origins-formation-universe-solar-system-earth-and-lifecoursera
- https://www.mooc-list.com/course/science-solar-system-coursera
- https://www.mooc-list.com/course/planet-earth-and-you-coursera
- https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
- https://www.classcentral.com/course/swayam-structural-geology-14312

Semester II

Discipline Specific Core (DSC): Minerals and Gems

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Mineral and Gems (DSC)	04	03	0	01	Class X+II with Science	Basic Knowledge of the fundamental laws of physical sciences of 12th Standard.

Course Title: Mineral and Gems (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: After completing this course, student will gain basic and fundamental knowledge about the various mineral groups regarding their physical and optical properties along with an idea about crystal systems, their symmetry elements and notation systems. Apart from this, basic knowledge about the instruments such as physical tools and polarizing microscope etc. will also be imparted. Basic knowledge about gemstones will be given to train the students in recognizing and using these precious and semi-precious minerals and gemstones, which make them a professionalin geology and newly emerging medicinal gemology field of therapy.

Units	Course Contents	Teaching Hours
Unit-I	Crystals and their characters: Crystal form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles. Crystal parameters, Miller system of notations. Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems. Twinning and twin laws.	12
Unit-II	Definition and characters of mineral; Silicate structure and classification of silicates. Chemical composition and diagnostic physical properties of common rock forming minerals: quartz, feldspar, pyroxene, amphibole, garnet, Olivine, and mica families.	11
Unit-III	Polarizing microscope, its parts and functioning; Ordinary and polarized lights; Common optical properties of minerals observed under ordinary, polarized lights and crossed nicols. Optical properties of some common rock forming minerals	11

	(Quartz, Orthoclase, Microcline, Plagioclase, Olivine, Pyroxene, Hornblende, Muscovite, Biotite, Garnet).	
Unit-IV	Definition and scope of Gemology. Basic qualities of a gem, Physical properties, Optical properties & optical effects in gemstones. Theory of gem cutting techniques, & application crystallography in Gemology. Instruments used in gem identification. Techniques, limitation, and Precautions in gem identification.	**11**

Course Title: Minerals and Gems (Lab)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	Study of physical properties of minerals such as Olivine, Garnet, Muscovite, Biotite, Beryl, Tourmaline, Hornblende, Gypsum, Quartz, Feldspar Group, Chalcedony, Barite, Pyroxene, Agate, Jasper, Flint. Use of polarizing microscope. Study of optical properties of common rock forming minerals such as Olivine, Pyroxene, Garnet, Muscovite, Biotite, Amphiboles, Feldspars, Quartz, Calcite, Tourmaline, Zircon, opaque mineral.	**30**

Suggested Reading:

- Berry, L.G., Mason, B. and Dietrich, R.V. (1982). Mineralogy. CBS Publ.
- Nesse, D.W. (1986). Optical Mineralogy. Mc Graw Hill.
- Deer, W.A., Howie, R.A., and Zussman, J. (1996). An Introduction to Rock-Forming Minerals. Prentice Hall.
- Kerr, P.F. (1977) Optical Mineralogy. IV Edition. McGraw Hill
- Read, H.H. (1968). Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
- Berry and Mason (1961). Mineralogy. W.H. Freeman &Co.
- Sharma, R.S. and Sharma A. (2013). Crystallography and Mineralogy (Concepts and Methods). Geological Society of India, Bangalore.
- Hall, Cally (2000). Gemstones. Dorling Kindersley, London; New York.
- Liddicoat,RichardT. (1989) Handbookof Gem Identification.12th ed., rev., Gemological Institute of America, Santa Monica, CA.
- Nassau, Kurt (1994). Gemstone Enhancement: History, Science and State of the Art. 2nd ed. Butterworth-Heinemann, London.
- Anderson, Basil, W (1990). Gem Testing. Rev. by E.A. Jobbins.10th ed., Butterworth, London.
- Verma, P.K. (2010) Optical Mineralogy. CRC Press.
- Demanje, M.A. (2012) Mineralogy for petrologists. CRC Press

Suggested Online Link:

- https://www.classcentral.com/course/swayam-subject-geology-paper crystallography-mineralogy-17820

Semester III

Discipline Specific Core (DSC): Petrology

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Petrology (DSC)	04	03	0	01	Class X+II+I in Science	Knowledge about Minerals.

Course Title: Petrology (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: The prime aim of this course is to characterize, classify, and deduce the genesis of individual rocks and rocks in association, making a rock suite, complex, or succession. Students will characterize, identify, and name different types of rocks in the field, hand specimens, and rock-thin sections. Finally, they will propose rock-forming processes (petrogenesis). The most common criteria are structure, texture, mineral assemblage, and modes, which present a particular rock examined at megascopic and microscopic levels.

Units	Course Contents	Teaching Hours
Unit-I	Introduction to igneous petrology; Magma: definition, generation, composition, and evolution. Mode of formation of igneous rocks. Structure, texture, and classification of igneous rocks. Bowen's reaction series; Introduction to phase diagrams. Petrogenesis of common igneous rocks: granite, granodiorite, gabbro syenite, basalt, dacite, trachyte and rhyolite.	12
Unit-II	Introduction to metamorphic petrology; Definition, types, and agents of metamorphism: Structure, texture, and classification of metamorphic rocks; Metamorphic zones and isograd; Petrogenesis of common metamorphic rocks: slate, phyllite, schists, gneiss, quartzite, and marble.	11
Unit-III	Introduction to sediments and sedimentary rocks. Genesis of clastic and non-clastic sedimentary rocks. Udden-Wentworth grain size scale. Matrix and cement. Folk's Classification of sandstones and limestones. Sedimentary structures.	11
Unit-IV	Concept of provenance and basins. Paleocurrent and sedimentdispersal. Concept of sedimentary environments and facies.Petrographic details of important siliciclastic andcarbonate rocks: sandstone and limestone.	11

Course Title: Petrology (Lab and Field Training)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	Petrology: Study of common structures and textures of igneous, metamorphic and sedimentaryrocks in hand specimen and thin sections.	**30**
Section-B	Geological Field Training: Students will be required to carry out one week field work in a suitable geological area to study the elementary aspects of field geology and submit a report there on.	

Suggested Reading:

- Bose, M.K. (1997). Igneous petrology. World press.
- Ehlers, W.G. and Blatt, H. (1987). Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers.
- Friedman and Sanders, (1978). Principles of Sedimentology. John Wiley and Sons.
- Moorhouse, W.W. (1969). The study of rocks in thin sections. Harper and sons.
- Pettijohn, F.J. (1975). Sedimentary rocks, Harper & Bros. III Edition
- Prasad, C. (1980). A textbook of Sedimentology.
- Turner, F.J. (1980). Metamorphic petrology. McGraw Hill.
- Blatt, H. and Tracy, R.J. (1996). Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman & Co.,New York.
- Tucker, M.E. (1991) Sedimentary petrology: An introduction to the origin of sedimentary rocks. Blackwell Science
- Boggs Jr., S. (2009) Petrology of sedimentary rocks. II Edition, The Blackburn Press.
- Best, M.G. (2002) Igneous and Metamorphic Petrology. II Edition, Wiley- Blackwell
- Hibbard, M.J. (1995) Petrography to petrogenesis. Mac Millan USA
- Haldhar, S.K., Tišljar, J. (2014) Introduction to Mineralogy and Petrology, Elsevier

Suggested Online Link:

- https://www.classcentral.com/course/swayam-petrology-14084
- https://www.mooc-list.com/course/myths-and-facts-about-rocks-iversity.
- E-pathshala. https://epgp.inflibnet.ac.in/

Semester IV

Discipline Specific Core (DSC): Historical Geology

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Historical Geology (DSC)	04	03	0	01	Class X+II+I inScience	Basic Knowledge of Biological Science up to 10th standard.

Course Title: Historical Geology (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: This course intends to acquaint the students about origin and evolution of life through geological time and the major evolutionary break throughs, and to correlate the evolutionary history with other synchronous geological events. It would add to their knowledge regarding the basic concept of paleontology using mode and methods of fossil preservation and species identification, thereafter, suggesting the organic evolutionary path and paleo-environment. Also, they will know the causes of major events of mass extinctions in geological past including the glaciations periods.

Units	Course Contents	Teaching Hours
Unit-I	Definition and scope of Historical Geology. Geological Time scale. Principles of stratigraphy Fundamentals of litho-, bio, chrono-, and magneto-stratigraphy; Code of stratigraphic nomenclature. Normal and inverted stratigraphic sequences.	12
Unit-II	Concepts of paleogeographic reconstructions. Major stratigraphic events at Precambrian-Cambrian, Permian-Triassic, and Cretaceous-Tertiary boundaries.	11
Unit-III	Fossils and Ichno-fossils. Conditions and modes of fossilization. Binomial nomenclature. Biozones- significance, correlation, and Index fossils.	11
Unit-IV	Morphology, classification, evolutionary trends, and geological distribution of common Invertebrate fossils: Trilobite: Brachiopods, Lamellibranchs, Gastropods, Cephalopods, Graptolites and Echinoids. Origin of vertebrates and evolution of vertebrate. Evolutionary history of Equidae, Proboscidea andHominidae	11

Course Title: Historical Geology (Lab)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	Study of fossils showing various modes of preservation.Study of diagnostic morphological characters, systematic position, stratigraphic position, and age of various invertebrate and plant fossils.	**30**

Suggested Reading:

- Raup, D.M., Stanley, S.M., Freeman, W.H. (1971). Principles of Paleontology.
- Clarkson, E.N.K. (2012). Invertebrate paleontology and evolution 4th Edition by Black well Publishing.
- Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.
- Shukla, A.C. and Misra, S.P. (1975). Essentials of paleobotany. Vikas Publisher.
- Moore, R.C. Lalliker, C.G. and Fischer, A.G. (1952). Textbook of Invertebrate Palaeontology.
- Schrock, Twenhofel and Williams (1953). Principles of Invertebrate Paleontology. CBS, Delhi
- Bilal U. Haq and A. Boersome, Introduction to Marine Micropaleontology
- Wood, F. (1961) Invertebrate paleontology. Cambridge University Press.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.

Semester V

Discipline Specific Core (DSC): Resource and Mining Geology

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Resource and Mining Geology(DSC)	04	03	0	01	Class X+II+II in Science	Basic knowledge about Minerals and Ores.

Course Title: Resource and Mining Geology (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: The course is intended to impart basic knowledge about the occurrence and distribution of metallic and non-metallic ores and energy resources in India, and to understand ore-forming processes. The acquired knowledge of ore-formation indeed paved the way of developing methods of ore prospecting, exploration, mining, and beneficiation of economic deposits. This course will surely help the students for opting carrier in the field of mineral prospection, exploration, and mining industry.

Units	Course Contents	Teaching Hours
Unit-I	Mineral resources, ore and gangue minerals. Ore forming processes: magmatic, metamorphic, and sedimentary.	12
Unit-II	Study of important metallic (Cu, Pb, Zn, Mn, Fe, Au, Al) and non-metallic (industrial) minerals (gypsum, magnesite, mica, silica, phosphorite, talc, limestone). Hydrocarbon and coal resources: Basic knowledge about the genesis and localization of oil and natural gas and coal.	11
Unit-III	Water resources: surface and sub-surface. Hydrologic cycle and its components. Vertical distribution of sub surface water. Water bearing and yielding bodies. Aquifers and their types.	11
Unit-IV	Concepts of mineral exploration. Elementary idea of geological, geophysical, geochemical and geobotanical prospecting. Drilling and sampling. Surface and subsurface mining methods.	11

Course Title: Resource and Mining Geology (Lab and Field Training)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	Resource and Mining Geology: Study of common ores in hand specimen. Study of copper, lead, zinc, iron, gold, phosphorite, magnesite, oil and gas, and coal deposits of India. Ore microscopy.	**30**
Section-B	Geological Field Training: Students will be required to carry out one week field work in a suitable geological area to study the elementary aspects of field geology and submit a report there on.	

Suggested Reading:

- Robb, L (2020). Introduction to ore forming processes. Wiley
- Moon, C.J., Whateley, M.E.G. and Evans, A.M (2006) Introduction to mineral exploration. 2nd edition, Blackwell Publishing
- Evans, A.M (2013) Ore Geology and Industrial Minerals, An Introduction. Wiley- Blackwell (3rd edition)
- Brown, C. and Dey, A.K. (1955). Indian Mineral Wealth. Oxford University
- Gokhale, K.V.G.K. and Rao, T.C. (1983). Ore Deposits of India. East West Press Pvt. Ltd.
- Jensen, M.L. and Bateman A.M. (1981). Economic Mineral Deposits. John Wiley and Sons.
- Krishnnaswamy, S., 1979. India's Minerals Resources. Oxford and IBH Publ.
- Deb, S. (1980). Industrial minerals and Rocks of India. Allied Publishers Pvt. Ltd.
- Umeshwar Prasad (2003). Economic Geology. CBS Publishers and distributers.
- Sharma, N.L. and Ram, K.V.S. (1972). Introduction to India's Economic Minerals, Dhanbad.
- McKinstry, H.E. (1962). Mining Geology. II Ed. Asia Publishing House.
- Clark, G.B. (1967). Elements of Mining. III Ed. John Wiley
- Arogyaswami, R.P.N. (1996). Courses in Mining Geology. IV Ed. Oxford IBH.
- Haldar, S.K. (2018) Mineral Exploration: Principles and Applications. II Edition, Elsevier

Suggested Online Link:

- https://www.mooc-list.com/course/minerals-and-mining-business-edx
- https://www.classcentral.com/course/swayam-drilling-and-blasting-technology-58442
- https://www.classcentral.com/course/swayam-underground-mining-of-metalliferous-deposits-43673

Semester VI

Discipline Specific Core (DSC): Photogeology and Engineering Geology

No. of Teaching Hours (Theory + Lab): 75 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Photogeology and Engineering Geology (DSC)	04	03	0	01	Class X+II+II inScience	Knowledge of Petrology, Physical and Historical Geology.

Course Title: Photogeology and Engineering Geology (Theory)

Course Type: DSC	Total Credit: 03	Teaching Hours: 45

Course Outcome: This course introduces recent technique of remote sensing that has wide application potential in several fields of surveying such as geological, geographical, agricultural, forestry etc. In the present programme, the students will know about the interpretation of aerial remote sensing and its application potential in geological investigations. The students will also be introduced to geological aspects that must betaken care of for any safe and stable geo engineering activity such as construction, mining, and environmental conservation.

Units	Course Contents	Teaching Hours
Unit-I	Definition and scope of remote sensing. EM energy and its interaction with atmosphere and earth surface features. Film and digital aerial photography. Types of aerial photographs. Stereo-pair aerial photographs. Tilt in aerial photographs. Scale of aerial photographs. Relief distortions and vertical Exaggeration in aerial photographs. Ortho photographs.	12
Unit-II	Stereoscopic vision in aerial photographs. Pocket and Mirror Stereoscopes. Elements of visual image interpretation. Application potential of aerial, photographs in landform, rock type and structure recognition.	11
Unit-III	Engineering properties of rocks and Soils. Dams and their types. Geological conditions controlling the safety of dams. Causes of dam failure. Geological problem of reservoirs.	11
Unit-IV	Bridges and their types. Tunnels and their types. Geological conditions controlling the safety of tunnels. Seepage problem in tunnels and role of water table.	11

Course Title: Photogeology and Engineering Geology (Lab)		
Course Type: DSC	**Total Credit: 01**	**Teaching Hours: 30**
Sections	**Course Contents**	**Teaching Hours**
Section-A	Studying stereopairaerialPhotographs and using stereoscopes for identifying the photo-technical and geotechnical elements of different landforms, and land use / landcover classes.	**30**

Suggested Reading:

- Valdiya, K.S. (2013). Environmental Geology 2nd Edition. McGraw Hill Education
- Krynine D.P. and Judd W.R. (1957). Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
- Kesavulu, N.C. (2009). A textbook of engineering geology. Macmillan publishing India Ltd.
- Crozier. M.J. (1989). Landslides: causes, consequences and environment. Academic Press.
- Bell, F.G. (1983). Fundamentals of Engineering Geology. Butterworth and Co.
- Lillesand, T.M., Kiefer, R.W., and Chipman (2015). Remote Sensing and Image Interpretation. Wiley.
- Campbell, J.B. and Wynne R.H. (2011). Introduction to Remote Sensing. The Guilford Press, New York/London.
- Pandey, S.N. (1987). Principles and Application of Photogeology. Wiley Eastern, New Delhi.

Suggested Online Link:

- https://www.classcentral.com/course/swayam-rock-mechanics-and-tunneling-43654
- https://www.classcentral.com/course/swayam-introduction-to-engineering-seismology-43605
- https://www.mooc-list.com/course/reservoir-geomechanics-edx
- https://www.mooc-list.com/course/geology-and-engineering-geology-gongchengdezhixue-edx
- https://www.classcentral.com/course/swayam-photogeology-remote-sensing-45165

Semester I

Generic Elective (GE):
Introductory Geology

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Introductory Geology (GE)	04	04	0	0	Class X+II	NIL

Course Title: Introductory Geology (Theory)

Course Type: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: After successful completion of this course students will understand the origin of universe, solar system, and the earth. They will know about the internal structure of the earth. Common rocks and their mineral compositions, and deformation of rocks under stress. After completing this course, they will have basic knowledge of the origin and physical characteristics of the earth.

Units	Course Contents	Teaching Hours
Unit-I	Definition and branches of Geology. Age and Origin of the Universe: Big Bang Theory. Galaxies. Basic information about Milky way galaxy. Our Solar system: brief introduction to planets and their satellites, asteroid belt and kupier belt. Uniqueness of the earth in terms of its atmosphere and hydrosphere.	15
Unit-II	Modern theory of the origin of earth. Size, shape, mass, density, and atmosphere of the earth; Internal structure of the earth. Fossilization, fossils, and their uses. The geological time-scale.	15
Unit-III	Genesis and physical characters of Igneous, metamorphic, and sedimentary rocks.	15
Unit-IV	Elementary idea of bed, dip and strike. Rock deformation. Idea of types of deformation. Folds faults and joints.	15

Suggested Reading:

- Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall,London.
- Miller (1949). An Introduction to Physical Geology. East West Press Ltd.
- Spencer, E.V. (1962). Basic concepts of Physical Geology. Oxford &IBH.
- Billings, M.P. (1972). Structural Geology. Prentice Hall.
- Davis, G.R. (1984). Structural Geology of Rocks and Region. John Wiley
- Hills, E.S. (1963). Elements of Structural Geology. Farrold and Sons, London.
- R.J Park (1998) Foundation of Structural Geology, III Edition, Routledge
- Singh, R.P. (1995). Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.
- https://www.mooc-list.com/course/mountains-101-coursera
- https://www.mooc-list.com/course/origins-formation-universe-solar-system-earth-and-lifecoursera
- https://www.mooc-list.com/course/science-solar-system-coursera
- https://www.mooc-list.com/course/planet-earth-and-you-coursera
- https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
- https://www.classcentral.com/course/swayam-structural-geology-14312

Semester II

Generic Elective (GE):
Geological Processes

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Geological processes (GE)	04	04	0	0	Class X+II with Science	NIL

Course Title: Geological Processes (Theory)

Course Type: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: After successful completion of this course students will understand the formation of different landforms and the physical, chemical, and biological processes operating upon the earth. They will also have knowledge of earthquake, volcanic and landslide disasters, along with basic ideas of their management. After completing this course, they will be able to recognize the future changes in the landscape of any region, particularly its hazard proneness.

Units	Course Contents	Teaching Hours
Unit-I	Law of uniformitarianism. Internal and external processes of the earth. Sources of energy to derive Earth's processes: Internal and external sources of energy. Concept of plate tectonics.	15
Unit-II	Earthquakes: nature of seismic waves, their intensity and magnitude. Earthquake disasters. Volcanoes: types, products and causes of volcanism.	15
Unit-III	Weathering and its types; The rock cycle. Erosion, transportation and deposition by rivers, wind, glaciers and waves and their related landforms.	15
Unit-IV	Brief idea about mass wasting. Landslides: their types, and causative and triggering factors.	15

Suggested Reading:

- Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall,London.
- Miller (1949). An Introduction to Physical Geology. East West Press Ltd.
- Spencer, E.V. (1962). Basic concepts of Physical Geology. Oxford &IBH.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.
- https://www.mooc-list.com/course/mountains-101-coursera
- https://www.mooc-list.com/course/origins-formation-universe-solar-system-earth-and-lifecoursera
- https://www.mooc-list.com/course/science-solar-system-coursera
- https://www.mooc-list.com/course/planet-earth-and-you-coursera
- https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
- https://www.classcentral.com/course/swayam-structural-geology-14312

Semester III

Generic Elective (GE):
Geohazard Management

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Geohazard Management (GE)	04	04	0	0	Class X+II+I	NIL

Course Title: Geohazard Management (Theory)

Course Type: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: After successful completion of this course students will understand the genesis of major geohazards of the world, and the workings of the disaster management system of India. They will also have knowledge of earthquake, volcanic, landslide and flash-flood disasters, along with basic ideas of their management. After completing this course, they will be able to recognize the future changes in the landscape of any region, in particular its hazard proneness and the implementation of emergency plans related to that hazard.

Units	Course Contents	Teaching Hours
Unit-I	Concept of hazards and disasters. Proneness, Vulnerability and Risk Prediction of disasters. Concept of disaster mitigation: Pre-, During-, and Post-disaster management strategies. Geohazards: definition and their types.	15
Unit-II	Earthquakes, seismic waves and earthquake hazards. Reservoir-induced seismicity. Causes and characteristics of tsunamis and resulting hazards. Types of Landslides, their causative and triggering factors, and associated hazards. Volcanoes and volcanic hazards.	15
Unit-III	Causes and characteristics of floods and hazards caused by flash floods. Snow avalanches, Causes and characteristics, few case histories of snow avalanches in India.	15
Unit-IV	Geohazard proneness of India. Past major geohazards of India: Earthquake, Flood, Flash flood and Landslide hazards. Management and mitigation of geohazard related disasters: structural and non-structural strategies. Early warning of Geohazard.	15

Suggested Reading:

- Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall,London.
- Miller (1949). An Introduction to Physical Geology. East West Press Ltd.
- Spencer, E.V. (1962). Basic concepts of Physical Geology. Oxford &IBH.
- Edward Bryant (2005). Natural Hazards. Cambridge University Press
- Smith, Keith, (2013). Environmental hazards: assessing risk and reducing disaster: Routledge Taylor &Francis Group. London.
- Edward A. Keller; Duane E. DeVecchio (2014). Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes. Routledge.
- Bell, F.G., 1999. Geological Hazards, Routledge, London.
- David C. Alexander (1993). Natural Disasters. CRC Press

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.
- https://www.mooc-list.com/course/mountains-101-coursera
- https://www.mooc-list.com/course/origins-formation-universe-solar-systemearth-and- life coursera
- https://www.mooc-list.com/course/science-solar-system-coursera
- https://www.mooc-list.com/course/planet-earth-and-you-coursera
- https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
- https://www.classcentral.com/course/swayam-structural-geology-14312
- https://youtu.be/kt04JWZxoKQ?si=17tq1ApV0oFI9Xv1

Semester IV

Generic Elective (GE): Geology of India

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Geology of India (GE)	04	04	0	0	Class X+II+I	Matriculation in Science.

Course Title: Geology of India (Theory)

Course Type: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course on Geology of India is to provide students a comprehensive understanding about the overall geology of the Indian subcontinent through stratigraphic approach. Students will be taught about the geological history of the Indian subcontinent spanning from Archean to Quaternary times. They will be motivated to learn the role of tectonics, climate and sea level in framing the geological history of India through time.

Units	Course Contents	Teaching Hours
Unit-I	Introduction to geology of India: Physical and tectonic subdivisions of the Indian subcontinent. Distribution of important lithostratigraphic units in India: Stratigraphy, geographic distribution, lithological characteristics, fossil contents and economic importance.	15
Unit-II	Precambrian and Phanerozoic successions of India: Precambrian rocks of Dharwar, Aravalli-Bundelkhand, Bastar, Singhbhum, central provinces of northeastern India; Proterozoic mobile belts in northwestern, central, eastern and southern Indian peninsular regions and in the extra-peninsula; Proterozoic basins including: Vindhyan, Cuddapah, Kurnool, Bhima, and Kaladgi.	15
Unit-III	Marine Paleozoic formations of India: Tethyan regions, Lesser Himalayan region. Marine Mesozoic formations of India: Himalayan and Peninsular region. Gondwana sequences of India. Deccan Traps, Rajmahal Traps. Cenozoic formations of India	15
Unit-IV	Concept of Global Stratotype Section and Point (GSSP), Stratigraphic boundary problems: Precambrian-Cambrian boundary; Permian-Triassic boundary; Cretaceous-Tertiary boundary. A brief introduction to earth's climatic history, Major glacial events in the Earth's history, Sea Level changes in geological past, causes of eustatic and local sea level changes, stratigraphic implication of the sea-level changes in the Quaternary Period and their	15

	significance in Indian subcontinent.	

Suggested Reading:

- Wadia,D.(1973).Geology of India. Mc Graw Hill Book co.
- Krishnan, M.S. (1982). Geology of India and Burma,6th Edition. CBS Publ.
- Ravindra Kumar (1985). Fundamentals of Historical Geology &
- Stratigraphy of India. Wiley Eastern.
- Valdiya, K.S. (2010). The making of India, McMillan India Pvt ltd.

Suggested Online Link:

- https://learn.planet-geology.com/courses/stratigraphy-indian-geology

Semester V

Generic Elective (GE): Evolution of Life

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Evolution of Life (GE)	04	04	0	0	Class X+II+II	Matriculation in Science.

Course Title: Evolution of Life (Theory)

Course: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course on Evolution of life is to provide students a compelling introduction to evolution of early life and the role of early planetary conditions in evolution. After completion of the course, students will have a comprehensive understanding of the process of fossilization and mass extinction events and their causes. Students will also know about the effects and influence of various geological and climatic events on the evolution of early life and impact of origin and evolution of life on earth.

Units	Course Contents	Teaching Hours
Unit-I	Geobiology:Biosphere as a system, processes, and products; Biogeochemical cycles; Abundance and diversity of microbes, extremophiles; Microbes-mineral interactions, microbial mats.	15
Unit-II	Origin of life. Introduction to Life through Geological time. Archean life: Earth's oldest life, the Great Oxidation event and radiation of life. Proterozoic life: Evolution of Ediacara and metazoan life.	15
Unit-III	Palaeozoic Life: The Cambrian Explosion of Life; Biomineralization and the fossil record. Palaeozoic Marine Life; Origin and progression of vertebrates; Early adaptations of plants to terrestrial life.	15
Unit-IV	Mesozoic Life: Life after the largest (P/T) mass extinction, life in the Jurassic seas; Origin of mammals; Rise and fall of dinosaurs; Origin of birds; and spread of flowering plants. Cenozoic Life: Radiation of placental mammals following K/Pg mass extinction; Evolution of modern grasslands and co-evolution of hoofed grazers; Palaeocene-Eocene Thermal Maximum (PETM) deep time analogue for modern greenhouse state. The age of humans; Hominid dispersals and climate setting.	15

Suggested Reading:

- Stanley, S.M. &Luczaj, J.A. (2014). Earth System History (4th Edition), W.H. Freeman (Macmillan) Cowen, R. (2000). History of Life. Wiley-Blackwell.
- Benton, M.J. & Harper, D.A.T. (2016). Introduction to Paleobiology and the fossil record. Wiley
- Canfield, D.E. &Konhauser, K.O. (2012). Fundamentals of Geobiology, Blackwell.
- Cowen, R. (2000). History of Life. Wiley-Blackwell. Lumine, J.I. (1999). Earth-Evolution of a Habitable World, Cambridge University Press.
- Lieberman, B.S. &Kaesler, R. (2010). Prehistoric Life-Evolution and the Fossil Record, Wiley-Blackwell.
- Lieberman, B.S. &Kaesler, R. (2010). Prehistoric Life-Evolution and the Fossil Record. Wiley-Blackwell.
- Cockell, C., Corfield, R., Edwards, N. & Harris, N. (2007). An Introduction to the Earth-Life System Cambridge University Press.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.

Semester VI

Generic Elective (GE):
Mineral and Fuel Resources of India

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Mineral and Fuel Resources of India (GE)	04	04	0	0	Class X+II+II	NIL

Course Title: Mineral and Fuel Resources of India (Theory)

Course Type: GE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course is intended to impart basic knowledge about the occurrence and distribution of metallic and non-metallic ores and energy resources in India, and to understand ore-forming processes. After going through this course students will develop basic understanding and skill about the characteristics and distribution of mineral resources.

Units	Course Contents	Teaching Hours
Unit-I	Economic deposits of metallic minerals in India, their distribution and uses. Detailed study of Iron, copper, zinc, lead, gold, manganese, aluminum, uranium deposits of India.	15
Unit-II	Economic deposits of Non-metallic minerals in India, their distribution and uses and : Detailed study of gypsum, magnesite, mica, silica, phosphorite, talc, clay minerals, limestone, halite, barite deposits of India	15
Unit-III	Petroliferous basins of India: Offshore Oil petroliferous basins. Onshore petroliferous basins of Gujarat, Rajasthan, Maharashtra, Assam. Coal and lignite resources of India.	15
Unit-IV	Gas hydrates, coal bed methane and nuclear energy resources.	15

Suggested Reading:

- Evans, A.M., 1993: Ore Geology and Industrial Minerals-Blackwell
- Sawkins, F.J., 1984: Metal deposits in relation to plate tectonics-Springer Verlag
- Torling, D.H., 1981: Economic Geology and Geotectonics - blackwell Sci publ.
- Guibert, J.M. and Park, Jr. C.F., 1986: The Geology of Ore Deposits-Freeman
- Barker, C. (1996): Thermal Modeling of Petroleum Generation, Elsevier Science.

- Jahn, F., Cook, M. andGraham, M. (1998):HydrocarbonExplorationand Production, Elsevier Science.
- Makhous, M. (2000): The Formation of Hydrocarbon Deposits in North African Basins, Geological and Geochemical Conditions, Springer-Verlag.
- North, F.K. (1985): Petroleum Geology, Allen Unwin. Selley, R.C. (1998): Elements of petroleum geology, Academic Press.
- Tissot, B.P. and Welte, D.H. (1984): Petroleum formation and occurrence, Springer– Verlag.
- Chandra, D., Singh, R.M. and Singh M.P., (2000): Textbook of coal (Indian context), Tara Book Agency, Varanasi.
- Scott, A.C., (1987): Coal and coal bearing strata: Recent Advances, Blackwell Scientifics Publications.
- Isabel Suárez Ruiz John Crelling. (2008). Applied Coal Petrology: The Role of Petrology in Coal Utilization, Academic Press.
- Singh, M.P. (1998). Coal and organic Petrology. Hindustan Publishing Corporation, NewDelhi.
- Holson, G.D. and Tiratso, E.N. (1985). Introduction to Petroleum Geology. Gulf Publishing, Houston, Texas.
- Tissot, B.P. and Welte, D.H. (1984). Petroleum Formation and Occurrence, Springer–Verlalg.
- North, F.K. (1985). Petroleum Geology. Allen Unwin.
- Selley, R.C. (1998). Elements of Petroleum Geology. Academic press.

Suggested Online Link:

- https://www.my-mooc.com/en/mooc/geoscience-earth-its-resources-delftx-geo101x/.
- https://www.mooc-list.com/course/oil-gas-industry-operations-and-markets-coursera

Semester III

Discipline Specific Elective (DSE):
Geohazard Management

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Geohazard Management (DSE)	04	04	0	0	Class X+II+I	NIL

Course Title: Geohazard Management (Theory)

Course Type: DSE	Total Credit: 04	Teaching Hours: 60

Course Outcome: After successful completion of this course students will understand the genesis of major geohazards of the world, and the workings of the disaster management system of India. They will also have knowledge of earthquake, volcanic, landslide and flash-flood disasters, along with basic ideas of their management. After completing this course, they will be able to recognize the future changes in the landscape of any region, in particular its hazard proneness and the implementation of emergency plans related to that hazard.

Units	Course Contents	Teaching Hours
Unit-I	Concept of hazards and disasters. Proneness, Vulnerability and Risk Prediction of disasters. Concept of disaster mitigation: Pre-, During-, and Post-disaster management strategies. Geohazards: definition and their types.	15
Unit-II	Earthquakes, seismic waves and earthquake hazards. Reservoir-induced seismicity. Causes and characteristics of tsunamis and resulting hazards. Types of Landslides, their causative and triggering factors, and associated hazards. Volcanoes and volcanic hazards.	15
Unit-III	Causes and characteristics of floods and hazards caused by flash floods. Snow avalanches, Causes and characteristics, few case histories of snow avalanches in India.	15
Unit-IV	Geohazard proneness of India. Past major geohazards of India: Earthquake, Flood, Flash flood and Landslide hazards. Management and mitigation of geohazard related disasters: structural and non-structural strategies. Early warning of Geohazard.	15

Suggested Reading:

- Arthur Holmes (1992). Principles of Physical Geology. Chapman and Hall,London.
- Miller (1949). An Introduction to Physical Geology. East West Press Ltd.
- Spencer, E.V. (1962). Basic concepts of Physical Geology. Oxford &IBH.
- Edward Bryant (2005). Natural Hazards. Cambridge University Press
- Smith, Keith, (2013). Environmental hazards: assessing risk and reducing disaster: Routledge Taylor &Francis Group. London.
- Edward A. Keller; Duane E. DeVecchio (2014). Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes. Routledge.
- Bell, F.G., 1999. Geological Hazards, Routledge, London.
- David C. Alexander (1993). Natural Disasters. CRC Press

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.
- https://www.mooc-list.com/course/mountains-101-coursera
- https://www.mooc-list.com/course/origins-formation-universe-solar-systemearth-and- life coursera
- https://www.mooc-list.com/course/science-solar-system-coursera
- https://www.mooc-list.com/course/planet-earth-and-you-coursera
- https://www.mooc-list.com/course/dynamic-earth-course-educators-coursera
- https://www.classcentral.com/course/swayam-structural-geology-14312
- https://youtu.be/kt04JWZxoKQ?si=17tq1ApV0oFI9Xv1

Semester IV

Discipline Specific Elective (DSE): Geology of India

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Geology of India (DSE)	04	04	0	0	Class X+II+I	Matriculation in Science.

Course Title: Geology of India (Theory) (Theory)

Course Type: DSE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course on Geology of India is to provide students a comprehensive understanding about the overall geology of the Indian subcontinent through stratigraphic approach. Students will be taught about the geological history of the Indian subcontinent spanning from Archean to Quaternary times. They will be motivated to learn the role of tectonics, climate and sea level in framing the geological history of India through time.

Units	Course Contents	Teaching Hours
Unit-I	Introduction to geology of India: Physical and tectonic subdivisions of the Indian subcontinent. Distribution of important lithostratigraphic units in India: Stratigraphy, geographic distribution, lithological characteristics, fossil contents and economic importance.	15
Unit-II	Precambrian and Phanerozoic successions of India: Precambrian rocks of Dharwar, Aravalli-Bundelkhand, Bastar, Singhbhum, central provinces of northeastern India; Proterozoic mobile belts in northwestern, central, eastern and southern Indian peninsular regions and in the extra-peninsula; Proterozoic basins including: Vindhyan, Cuddapah, Kurnool, Bhima, and Kaladgi.	15
Unit-III	Marine Paleozoic formations of India: Tethyan regions, Lesser Himalayan region. Marine Mesozoic formations of India: Himalayan and Peninsular region. Gondwana sequences of India. Deccan Traps, Rajmahal Traps. Cenozoic formations of India	15
Unit-IV	Concept of Global Stratotype Section and Point (GSSP), Stratigraphic boundary problems: Precambrian-Cambrian boundary; Permian-Triassic boundary; Cretaceous-Tertiary boundary. A brief introduction to earth's climatic history, Major glacial events in the Earth's history, Sea Level changes in geological past, causes of eustatic and local sea level changes, stratigraphic implication of the sea-level changes in the Quaternary Period and their	15

	significance in Indian subcontinent.	

Suggested Reading:

- Wadia,D.(1973).Geology of India. Mc Graw Hill Book co.
- Krishnan, M.S. (1982). Geology of India and Burma,6th Edition. CBS Publ.
- Ravindra Kumar (1985). Fundamentals of Historical Geology &
- Stratigraphy of India. Wiley Eastern.
- Valdiya, K.S. (2010). The making of India, McMillan India Pvt ltd.

Suggested Online Link:

- https://learn.planet-geology.com/courses/stratigraphy-indian-geology

Semester V

Discipline Specific Elective (DSE): Evolution of Life

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Evolution of Life (DSE)	04	04	0	0	Class X+II+II	Matriculation in Science.

Course Title: Evolution of Life (Theory)

Course: DSE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course on Evolution of life is to provide students a compelling introduction to evolution of early life and the role of early planetary conditions in evolution. After completion of the course, students will have a comprehensive understanding of the process of fossilization and mass extinction events and their causes. Students will also know about the effects and influence of various geological and climatic events on the evolution of early life and impact of origin and evolution of life on earth.

Units	Course Contents	Teaching Hours
Unit-I	Geobiology:Biosphere as a system, processes, and products; Biogeochemical cycles; Abundance and diversity of microbes, extremophiles; Microbes-mineral interactions, microbial mats.	15
Unit-II	Origin of life. Introduction to Life through Geological time. Archean life: Earth's oldest life, the Great Oxidation event and radiation of life. Proterozoic life: Evolution of Ediacara and metazoan life.	15
Unit-III	Palaeozoic Life: The Cambrian Explosion of Life; Biomineralization and the fossil record. Palaeozoic Marine Life; Origin and progression of vertebrates; Early adaptations of plants to terrestrial life.	15
Unit-IV	Mesozoic Life: Life after the largest (P/T) mass extinction, life in the Jurassic seas; Origin of mammals; Rise and fall of dinosaurs; Origin of birds; and spread of flowering plants. Cenozoic Life: Radiation of placental mammals following K/Pg mass extinction; Evolution of modern grasslands and co-evolution of hoofed grazers; Palaeocene-Eocene Thermal Maximum (PETM) deep time analogue for modern greenhouse state. The age of humans; Hominid dispersals and climate setting.	15

Suggested Reading:

- Stanley, S.M. &Luczaj, J.A. (2014). Earth System History (4th Edition), W.H. Freeman (Macmillan) Cowen, R. (2000). History of Life. Wiley-Blackwell.
- Benton, M.J. & Harper, D.A.T. (2016). Introduction to Paleobiology and the fossil record. Wiley
- Canfield, D.E. &Konhauser, K.O. (2012). Fundamentals of Geobiology, Blackwell.
- Cowen, R. (2000). History of Life. Wiley-Blackwell. Lumine, J.I. (1999). Earth-Evolution of a Habitable World, Cambridge University Press.
- Lieberman, B.S. &Kaesler, R. (2010). Prehistoric Life-Evolution and the Fossil Record, Wiley-Blackwell.
- Lieberman, B.S. &Kaesler, R. (2010). Prehistoric Life-Evolution and the Fossil Record. Wiley-Blackwell.
- Cockell, C., Corfield, R., Edwards, N. & Harris, N. (2007). An Introduction to the Earth-Life System Cambridge University Press.

Suggested Online Link:

- https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906.

Semester VI

Discipline Specific Elective (DSE):
Mineral and Fuel Resources of India

No. of Teaching Hours (Theory): 60 Hours

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course Title	Credits	Credit Distribution of the Course			Eligibility Criteria	Pre-requisite (if any)
		Lecture	Tutorial	Practical/ Lab		
Mineral and Fuel Resources of India (DSE)	04	04	0	0	Class X+II+II	NIL

Course Title: Mineral and Fuel Resources of India (Theory) (Theory)

Course Type: DSE	Total Credit: 04	Teaching Hours: 60

Course Outcome: The course is intended to impart basic knowledge about the occurrence and distribution of metallic and non-metallic ores and energy resources in India, and to understand ore-forming processes. After going through this course students will develop basic understanding and skill about the characteristics and distribution of mineral resources.

Units	Course Contents	Teaching Hours
Unit-I	Economic deposits of metallic minerals in India, their distribution and uses.Detailed study of Iron, copper, zinc, lead, gold, manganese, aluminium, uranium deposits of India.	15
Unit-II	Economic deposits of Non-metallic minerals in India, their distribution and uses and : Detailed study of gypsum, magnesite, mica, silica, phosphorite, talc, clay minerals, limestone, halite, barite deposits of India	15
Unit-III	Petroliferous basins of India: Offshore Oil petroliferous basins. Onshore petroliferous basins of Gujarat, Rajasthan, Maharashtra, Assam. Coal and lignite resources of India.	15
Unit-IV	Gas hydrates, coal bed methane and nuclear energy resources.	15

Suggested Reading:

- Evans, A.M., 1993: Ore Geology and Industrial Minerals-Blackwell
- Sawkins, F.J., 1984: Metal deposits in relation to plate tectonics-Springer Verlag
- Torling, D.H., 1981: Economic Geology and Geotectonics - blackwell Sci publ.
- Guibert, J.M. and Park, Jr. C.F., 1986: The Geology of Ore Deposits-Freeman
- Barker, C. (1996): Thermal Modeling of Petroleum Generation, Elsevier Science.

- Jahn, F., Cook, M. andGraham, M. (1998):HydrocarbonExplorationand Production, Elsevier Science.
- Makhous, M. (2000): The Formation of Hydrocarbon Deposits in North African Basins, Geological and Geochemical Conditions, Springer-Verlag.
- North, F.K. (1985): Petroleum Geology, Allen Unwin. Selley, R.C. (1998): Elements of petroleum geology, Academic Press.
- Tissot, B.P. and Welte, D.H. (1984): Petroleum formation and occurrence, Springer– Verlag.
- Chandra, D., Singh, R.M. and Singh M.P., (2000): Textbook of coal (Indian context), Tara Book Agency, Varanasi.
- Scott, A.C., (1987): Coal and coal bearing strata: Recent Advances, Blackwell Scientifics Publications.
- Isabel Suárez Ruiz John Crelling. (2008). Applied Coal Petrology: The Role of Petrology in Coal Utilization, Academic Press.
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- Tissot, B.P. and Welte, D.H. (1984). Petroleum Formation and Occurrence, Springer–Verlalg.
- North, F.K. (1985). Petroleum Geology. Allen Unwin.
- Selley, R.C. (1998). Elements of Petroleum Geology. Academic press.

Suggested Online Link:

- https://www.my-mooc.com/en/mooc/geoscience-earth-its-resources-delftx-geo101x/.
- https://www.mooc-list.com/course/oil-gas-industry-operations-and-markets-coursera