B.Sc., Geology

Syllabus

w.e.f. 2021 Onwards

Centre for Applied Geology

Gandhigram Rural Institute (Deemed to be University)

B.Sc., Geology

Geology, an earth science, is the study of earth, its physical structure, properties, and phenomena. It is branch of knowledge dealing with rocks, minerals, sediments and processes that shape and reshape the earth. The sub-disciplines in geology are numerous and interesting, such as engineering geology, structural geology, mining geology, petrology, hydrogeology and environmental geology. Studying geology as a special course equips the students to secure jobs in many government schemes as well as in private sector. Mining, petroleum industry, mineral prospecting, hydrogeology, are some of the industries hiring geologists. Ministry of Earth Sciences sponsors multiple research schemes with geological focus. Climate change research for instance, has gained worldwide attention and geology students are well poised to take advantage of the research opportunities. Students can enter into the fascinating research activity in geology. Geology involves other basic sciences like physics, thermodynamics, chemistry and mathematics. Therefore, the students get a well-grounded scientific approach to contemporary problem solving. The course offered by Gandhigram Rural Institute has a comprehensive syllabus, technical laboratory work and extensive field surveys as part of the course. The scope of the course is modern and has the potential to offer rewarding research and career to the students. The syllabus for Geology programme offered for undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC. The main objective of framing this syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Geology. The ultimate goal of the syllabus is that the students at the end are able to understand the subject and secure a job. Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques of mapping and understanding of the subject. The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase. While the syllabus is in compliance with UGC model curriculum, some changes have been made to ensure all topics are covered and any of the subjects don't become difficult to be completed in one semester.

CENTRE FOR APPLIED GEOLOGY

VISION: To create space, spatial and Geosciences based Rural Development Models and Plans

The branch of Geology is one of the vital disciplines for comprehensive, holistic and Sustainable Rural Development, the Centre for Applied Geology has been created to achieve this ambitions / goal.

MISSIONS:

Using the space and spatial technologies the following various Academic (B.Sc. Geology and M.Sc. Applied Geology and Geomatics), R&D and extension programs are envisaged independently and in interdependently with various Departments of GRI-DU.

MISSION:1 Rural Natural Resources Inventory and Management: Mineral, Water, Hydrocarbon and Geothermal Resources inventory and creation of natural resources based rural development plans.

MISSION:2 Rural Water Management: Specific Studies to bring out village wise / taluk wise water management plans including surface water potential, water quality pollution due to rock - water interaction and anthropogenic, rejuvenation of defunct water bodies inventory and modeling of Ground water, Artificial recharge etc.

MISSION:3 Rural Geo-Energy Management: Geo-Energy Resources inventory & Planning like Oil and Gas, Coal, radioactive and geothermal energy.

MISSION:4 Geological Eco system-based development plans: Creation of Rural development plans on the basis of geomorphic provinces like river systems and coastal systems, arid systems etc.

MISSION:5 Natural Disaster Vulnerability Mapping and Management Models: Earthquakes, Landslides, Floods, Tsunami and other disaster predictive and preventive development plans for rural areas.

MISSION:6 Creation of Spatial Decision Support Systems for the development of rural areas.

ELIGIBILITY: A pass in Higher Secondary examination with Physics, Chemistry, Mathematics and Botany /Zoology / Biology / Computer Science or any other subject.

THE GANDHIGRAM RURAL INSTITUTE- DEEMED TO BE UNIVERSITY, GANDHIGRAM - 624302

OBE ELEMENTS

Name :

Designation & Department/ Centre : Centre for Applied Geology

Academic Programme offered : B. Sc. Geology

OBE Elements for B. Sc., Geology

Programme Educational Objectives (PEO)

The students pursuing Under Graduation course in Geology programme will subsequently fulfill the basics and the outline of the emerging geological techniques.

PEO1: To make the students to understand the fundamentals of Geology and its branches

PEO2: To articulate the students in developing the geological field knowledge, laboratory studies and thereby increasing their problem- solving potential

PEO3: Exposing of updated practical technologies to enhance their capability in job competency

PEO4: To enable them to work with integrated team effort to understand the Earth System process

PEO5: To increase the potentiality of the candidate towards updated application - oriented studies.

Program Outcome (PO)

The graduates will be capable of sharing their knowledge in Geology to a higher level of research and improved professional skills.

PO1: To become familiar in the subject of Geology and apply the doctrine of the same to the needs of the Geological Society.

PO2: Gain diagnostic skills in the field/area of Geology

PO3: Understand and appreciate professional ethics and Nation Building initiatives

PO4: Able to identify, analyze, and interpret geological data in multiple perspectives

PO5: Able to identify and utilize recent updated skills in the field of Geology

PO6: Able to work as an individual and as teams with cross culture perspective with potential become leader with effective communication skills.

PO7: Identify, formulate and analyze complex problems for substantiated conclusions

PROGRAMME SPECIFIC OUTCOME (PSO)

The graduates will be able to ensure themselves in a position for their enhancement in the field of Geology with precise qualification.

PSO1: Apply the knowledge of Geology in exploring the natural resources and to assess the natural disaster and ecosystem studies.

PSO2: Solve the complex problems in the field of Geology with an understanding of the interior features of the Earth and its impacts upon the surface layers

PSO3: Use accurate practical techniques to interpret the estimation of the resources in the field with appropriate results

PSO4: Ensure the Environmental safety extraction of the resources and enhance sustainable development

PSO5: Assures the candidate to be a precise in professional qualities for the fundamental positions in the field of Geology with adequate efficiency.

Semester - I

COURSE SYLLABUS

Course Code &Title	**21GEOU0101 GENERAL GEOLOGY**		
Class	B. Sc Geology	Semester	I
Cognitive Level	K-1 K-2 K-3		
Course Objectives	The Course aims • To Know the basic principles of Geology and the solar system and its components • To Describe the various processes of the Earth • To Illustrate the period-based history and its formations. • To Describe the geological processes of weathering. • To Summarize the concept of Plate tectonics		

Unit	Content	Lectures
I	**Geology:** Earth Sciences, Subdivisions of Geology, Allied Sciences, ***Scope of Geology***. **The Stellar System – The Solar System –** Grouping of planets – The terrestrial and extra- terrestrial Planets. **Planets:** Description and details of terrestrial planets (Mercury, Venus, Earth and Mars), and extra- terrestrial (Jupiter, Saturn, Uranus, Neptune and Pluto) – **Physical data of planets**. **The Atmosphere:** Troposphere, Stratosphere, Mesosphere, Thermosphere, **Lithosphere and Hydrosphere** - **Rock Cycle** – Outline of the geological history of the Earth	12
II	***Origin of the Earth*****: Description of the origin, Fundamental Regularities, Theories of Origin –** The Nebular hypothesis – The Tidal Hypothesis – The Gas-Dust cloud hypothesis – Weizascker's Hypothesis – Schmidit's Hypothesis – Hoyle's Magnetic Theory. ***Age of Earth*****:** Indirect Methods**(MP)-** Old Methods, **New Methods** – Radioactivity, Disintegration constant, Half Life – Uranium-Lead Method, Thorium – Lead Method, Rubidium-Strontium Method, Lead-Lead Method, Meteoric Lead Method. Concept of Geoid and, spheroid; Isostasy.	12
III	**Geological Time Scale.** ***Internal Structure of the Earth:*** Description, Seismological Evidence – Basic facts, Interpretation. **The Crust:** Mountainous Areas, Continental Areas, Oceanic Areas, Continental Crustal Layers, Oceanic Crust– Diagrammatic representation of structure of earth crust. **The Mantle, The Core:** Inner and Outer core. Outline of Meteorites. **Isostasy** – Pratt's and Airy's Hypothesis, Evidence of Isostasy.	12
IV	**Rock Weathering:** Introduction, weathering, erosion, Denudation. ***Mechanical (Physical) Weathering****:* Frost Action, Exudation, Thermal Effects (Insolation), Exfoliation, Unloading - ***Chemical weathering***: Description, Solution, Hydration and Hydrolysis, Oxidation and Reduction, Carbonation, Colloid Formation, Spheroidal weathering. ***Biological weathering -*** **Role of Plants and Organisms. Factors Affecting Weathering, Resistance to Weathering.** ***Products of Weathering:*** Eluvium, Deluvium**-** Regolith, Soil Profile, Mineral and Rock formation.	12
	Continental Drift – Paleomagnetism - **Sea Floor Spreading –** ***Theory of Plate Tectonics*** **Evidences. The lithosphere Plates. Movement of Plates:** Divergent Boundaries, Convergent Boundaries.	12

V	Transform Boundaries. **Global Effects. *Earthquakes*:** Description, Seismology, Isoseismal, Classification, Causes, Effects of Earthquake, **Recording of an Earthquake:** Seismographs, Determination of Magnitude and energy, Travel-Time Record, Location of Epicenter **– Distribution of Earthquakes. *Volcanoes*:** Description, Materials of Volcanoes, Types of Eruption, Distribution and Origin, Volcanic Products, **Volcanic Landscape.**

Text Books:

1. Radhakrishnan, V., (1996) General Geology, V.V.P. Publishers, Tuticorin.
2. Mahapatra, G.P., (1992) Textbook of Geology, CBS Publishers, New Delhi.

Reference Books:

1. Holmes, A & P. L. Duff, (1996) Principles of Physical Geology, 4th revised edition, ELBS, London.
2. Mukherjee, A. K. (1990) Principles of Geology, EW Press, Kolkata.
3. Parbin Singh, (2005) A Textbook of Engineering and General Geology. S. K. Kataria & Sons, Delhi.
4. Porter, S. C.& Skinner, B.J., (1995) The Dynamic Earth, John Wiley & Sons, New York.
5. Leet, D & Judson, S., (1987) Physical Geology, McGraw Hill, New Jersey.
6. Zumberge, J., (1980) Physical Geology, Freeman, New York.

Web Resources:

1. *Underlined Titles are available in Swayam*
2. *portal.*https://opentextbc.ca/geology/chapter/1-1-what-is-geology/
3. *https://www.nap.edu/read/6024/chapter/3*
4. *https://simple.wikipedia.org/wiki/Structure_of_the_Earth*
5. *https://www.clearias.com/interior-of-the-earth/*
6. *https://www.nationalgeographic.org/encyclopedia/weathering/*
7. *https://www.livescience.com/37706-what-is-plate-tectonics.html*
8. *https://www.britannica.com/science/plate-tectonics*
9. *https://www.nationalgeographic.com/environment/naturaldisasters/volcanoes/*

Course Outcomes

On completion of Course, the students should be able to

CO1: Discuss the Basics of Geology, Solar system and Atmosphere

CO2: Evaluate the Theories of Origin of Earth and Age of the Earth

CO3: Describe the Geological time scale, Internal structure of the Earth and Isostasy.

CO4: Explain the agents of weathering, its products and mineral and rock formations.

CO5: Discuss the continental drift, theory of plate tectonics and earthquake and volcanoes.

Course Code &Title	**21GEOU0102 STRUCTURAL GEOLOGY**		
Class	B. Sc Geology	Semester	I
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the different structures in crustal rocks derived from various forces active on and within the Earth's crust. • To Describe the mechanism and classification of Folds • To Describe the mechanism and classification of Faults and joints • To Describe the mechanics of Unconformities, Foliation and Lineation • To Describe about shear zone, Boudinage and structural analysis.		

Unit	Content	Lectures
I	**Introduction to Structural Geology**: Relation to Geology, Primary and Secondary Structures - Structural Elements-*Dip and Strike - Apparent and true dip* - **Types of Dips**: Primary dip - Secondary dip - Regional dip. **Outcrop**: Outcrop pattern of strata; Outliers, Inliers- Outcrop Dimensions: Intrusions, Flows and Masses; Rule of V of outcrops. - **Methods for representing relief features**: Stereographic projections, Contours, topographic and geologic maps- their preparation and uses. Uses of Clinometers and Brunton compass. **Rock deformation**: Differential Force, Stress, Strain, Stages of deformation; mechanism of elastic, plastic and brittle deformation; strain -stress diagram; Factors controlling behavior of material.	12
II	**Folds**: Meaning and significance of folds- Basic fold geometry and nomenclature -Fold orientation - Parts of a fold – **plunge of fold - Classification of folds**: Anticlines - Synclines - Symmetrical and Asymmetrical fold - Isoclinal fold - Recumbent fold - Conjugate fold - Box fold –Open and closed fold - Concentric fold - Similar fold - Supratenuous fold - Plunging fold - Chevron fold - Cuspate fold - Domes and basins - Monoclinic fold - Homocline fold - Drag fold. Relative curvature of folds: Class 1, class 2 and class 3-fold.	12

III	**Fault:** Introduction -Fault geometry and nomenclature - Fault plane - Dip and Hade - The walls - Fault zone - Shear zone - Slip and separation - The Slickenside's - Gouge - Fault breccia - ***Classification of faults***: Normal fault - Horst and Graben - Reverse faults: Thrust faults - Nappes - Strike slip faults - Hinge faults - Oblique fault -Rocks produced by faulting (fault rocks). Relation and Repetition of outcrops due to erosion, folding and faulting. ***Joints****: Introduction - Classification:* Systematic joints - non-Systematic joints. Geometry - Origin of joints: Tension joints - Shear joints - Compression joints - Occurrence of Joints: Igneous rocks: Sheet joints - Mural joints - Columnar joints - Sedimentary rocks - Metamorphic rocks. Geometrical classification and genetic classification of joints.	12
IV	**Unconformity**: Introduction - Origin - Types: Angular Unconformity - Disconformity - Nonconformity - Local Unconformity - Regional Unconformity - Recognition of Unconformity. **Foliation**: Introduction - Metamorphic foliation: Gneissic structure - Schistocity and phyletic structure - Crenulation cleavage - Flattened pebble conglomerate - Foliations in Sedimentary rocks: Spaced cleavage. Foliation in Igneous rocks: Flow foliation - Migmatite. **Lineation**- Introduction - Types of Lineation: Intersection lineation - Crenulation lineation - Mineral lineation - Stretching lineation. **Cleavage**: Spaced cleavage; continuous cleavage; fracture cleavage.	12
V	**Shear Zone**: Pure shear zone, sub-simple shear zone, simple shear zone, ductile shear zone. Kinematic classification of shear zones. **Boudinage and pinch and swell structure**: Geometry, viscosity and strain: Asymmetric Boudinage; Foliation Boudinage. Boudinage with strain ellipse; Large scale boudinage. **Structural Identification**: Field observations, Remote sensing and geodesy, DEM, GIS and Google Earth, Seismic data, Experiments, Numerical models, other data sources: Gravimetric and magnetic data. **Structural analysis**: Geometric analysis, Strain and kinematic analysis, Dynamic analysis, Tectonic analysis	12

Text Books:

1. Billings, M. P., (2016) Structural Geology. Prentice Hall of India Ltd. New Delhi.
2. Gokhale, N.W., (2019) Theory of Structural Geology, CBS publications, Delhi.
3. Parbin Singh, B., (2013) A Textbook of Engineering and General Geology, K.Kataria& Sons. Delhi.
4. Stephen Marsha and Gautum Mitra., (2017) Basic Methods of Structural Geology. Pearson Education, India.

Reference Books:

1. Sathya Narayanaswami, B. S., (1994) Structural Geology. Dhanpat Rai & Sons, New Delhi.
2. Davis, G.H., and Reynolds, S.J., (1996) Structural Geology of Rocks and Regions, 2nd ed., Wiley, New York.
3. Gokhale, N. W., (2009) Theory of Structural Geology., CBS Publications.
4. Hobbs, B. E., Means, W. D., & Williams, P. E., (1996) An Outline of Structural Geology, John Wiley & Sons, Inc, Australia.
5. Park, R. G., (2004) Foundations of Structural Geology. Chapman & Hall.
6. Pollard, D. D., (2005) Fundamental of Structural Geology. Cambridge University Press.
7. Fossen Haakon., (2016) Structural Geology, Second Edition Cambridge University Press.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf*
3. *https://www.geoexpro.com/articles/2013/07/folds-and-folding-Part – i*
4. *https://www.civil.org/faults-geological-faults-in-earth.html*
5. *http://www.yourarticlelibrary.com/geology/faults-meaning-classification-and-importance-geology/91572*
6. *http://www.geographynotes.com/geology-2/structural-geology/joints-definition-classification-and-consideration-geology/1375*
7. *http://www.indiana.edu/~geol105b/images/gaia_chapter_6/unconformities.html/*

Course Outcomes

On completion of Course, the students should be able to

CO1: Understand the concepts of deformation and primary and secondary structures

CO2: Explain the mechanism and types of fold

CO3: Describe and classify the faults and Joints in the field

CO4: Discuss types of Unconformities and Foliation and Lineation

CO5: Describe the Shear zone, Boudinage and Structural analysis

Course Code &Title	**21GEOU0103** **SURVEY AND STRUCTURAL GEOLOGY PRACTICAL**		
Class	B. Sc Geology	Semester	I
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To introduce the basic surveying techniques relevant to Geological mapping and mining geology. • To know the operational process of the survey equipment's. • To understand and conduct geological survey investigation using the equipment's • To Complete the Structural Geology Maps, Strike and Dip of the Beds • To understand the Structural and Lithological maps and Write their Geological history		

Contents

SURVEYING

1. Definition – Primary divisions – classification
2. Chain survey – description of instruments employed – chain traverse - Open traverse and closed traverse
3. Compass survey – description of prismatic compass – whole circle bearings – reduced bearings – quadrant bearings
4. Plain table surveying: Finding distance between inaccessible stations
5. Locating the instrument station – Clinometer compass.
6. Finding dip and strike of beds
7. Modern Surveying.
8. Levelling: Rise and Fall method
9. GPS: Fundamentals and applications.
10. Surveying using GPS.
11. Theodolite: The essentials of transit theodolite; definition and terms.
12. Measurement of horizontal and vertical angles using Theodolite
13. Total Station introduction
14. Angle measurement using Total Station
15. Distance Measurement using Total Station
16. Calculation of Surface Area using Total Station.

STRUCTURAL GEOLOGY

1. Basic idea of topographic contours
2. Topographic sheets of various scales.
3. Drawing profile sections and interpretation of geological maps
4. Reading of solid, conformable maps
5. Deciphering dip and strike of outcrops
6. Completion of map when three points over a bedding plane are given
7. Determination of vertical thickness of formations.
8. Reading of solid fold and fault maps –Determination of throw of faults – Construction of vertical sections
9. Introduction to Geological maps: Lithological and Structural maps
10. Reading of solid maps of areas with more than one structure and intrusion – Writing of geological history.
11. Solving of dip and strike problems by trigonometrical method
12. Determination of true dip &apparent dip and thickness by calculation and graphical method.

Course Outcomes

On completion of Course, the students should be able to

CO1: Describe the various types of surveying and Identify the distance between two points

CO2: Assess the true dip and strike

CO3: Use the GPS for survey to evaluate the various terrains.

CO4: Analyze the contour and topographic maps and assess the strike and dip of the maps and Compute the thickness of the outcrops

CO5: Prepare the order of super position of rock beds and the structural and lithological maps

Course Code &Title	**21EVSU0101 ENVIRONMENTAL STUDIES**		
Class	B. Sc Geology	Semester	I
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the various natural resources, uses, impact of overutilization of resources • To Describe the concept of Ecosystem and Biodiversity • To know about the Various types of Pollution, their causes, impacts and control measures • To inculcate the social issues and the Policy acts to conserve the Natural resources • To know about the impact of population explosion.		

Unit	Content	Lectures
I	**Environment:** The multidisciplinary nature of Environmental studies. Definition, Scope and Importance, Need for public awareness. **Natural Resources**-**Forest resources**–uses and over exploitation and its impact on forest and its impact on tribe people - **Water resources**–uses and over exploitation water and its impact – Mineral Resources: Use and Exploitation, Environmental effects of Extracting and using mineral resources. **Energy resources** – growing energy needs, renewable and non-renewable energy sources, uses of alternative energy sources. **Land Resources**-Land as a resource, land degradation, man induced and slides, soil erosion – desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable life styles.	12
II	**Ecosystem and Biodiversity:** Concept of an Ecosystem-Structure and function of an ecosystem – Producers, Consumers and decomposers, Energy flow in an ecosystem, Ecological Succession-Food chain, food webs in ecological pyramids- Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) **Biodiversity and its Conservation**-Introduction – Definition: genetic species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values • Biodiversity at global, National and local levels. India as a mega diversity nation - Hot-sports of biodiversity – Threats to biodiversity – habits, Loss by poaching of wildlife– man vs wildlife conflicts- Endangered and endemic species- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	12
III	**Environmental Pollution:** Definition, Cause, Effect, Control Measure of Air pollution - Water Pollution-Soil Pollution-Marine pollution - Noise pollution– Thermal Pollution-Nuclear Hazards-Solid Waste Management - Causes, effects and control measures of urban and industrial wastes. Role of Individual in prevention of pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.	12

IV	**Social Issues and Environment**: Sustainable problem development – Urban problem related to environment - Water conservation, rain water harvesting, watershed management. – Environment ethics–issues and possible solution - Wasteland reclamation - Consumerism and waste products Environment Protection Act, Air (prevention and control of pollution) Act, Water (Prevention and control of pollution) Act, wildlife protection Act, Forest conservation Act, Issues involved in enforcement of environmental Legislation. Public awareness.	12
V	**Environment and Population concern**: Population growth, variation among nations. Population explosion – Family Welfare Programme Environment and human health –Environment education at various levels- HIV – AIDS- Women and child welfare, Gender issues, Gender equality, Institution for gender studies research. Role of Information Technology in Environment and human health. **Field work –** Visit to a local area to document environmental assets river /forest/ grassland/ hill/ mountain. Visit to a local polluted Site -Urban/ Rural/ Industrial/ Agricultural - Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.	12

Text Books:

1. Text book for environmental studies, For undergraduate courses of all branches of higher studies, University Grants Commission, New Delhi and Bharathi Vidyapeeth Institute of Environment Education and Research, Pune

Reference Books:

1. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
2. Jadhav, H & Bhosale, V.M., (1995) Environmental Protection and Laws, Himalaya Pub. House, Delhi.
3. McKinneys, M.L. &School, R.M., (1996) Environmental Science systems & Solutions, Web enhanced edition.

Web Resources:

1. *Underlined Titles are available in Swayam portal*.
2. *http://download.nos.org/srsec314newE/PDFBIO.EL25.pdf*
3. *http://oldwww.unibas.it/utenti/sofo/Sofo%20-20Biodiversity%20Intech.pdf*
4. *http://download.nos.org/333courseE/10.pdf*
5. *https://www.geo.lu.lv/fileadmin/user_upload/lu_portal/projekti/gzzf/zinas/8.LECTU9.*

Course Outcomes

On completion of Course, the students should be able to

CO1: Understand the concepts of natural resources

CO2: Explain the concept of ecosystem and biodiversity

CO3: Describe about various type of pollution, causes, impacts and control measures

CO4: Discuss social issues with regards to environment

CO5: Describe about environment and population explosion

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Semester – II

Course Code &Title	**21GEOU0204 GEOMORPHOLOGY**		
Class	B. Sc Geology	Semester	II
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the General Concepts of Geomorphology and explain the surface and sub-surface landform processes, mass wasting concept and wind mechanism and its landforms • To Describe the Geological work of River and associated landforms • To Describe the Geological work of Groundwater and associated landforms • To Describe the Geological work of Glaciers and associated landforms • To Learn the geological parameters of ocean and its features and coral reefs.		

Unit	Content	Lectures
I	**Geomorphology**: **Definition and concepts of geomorphology- Mass wasting:** Definition, classification - slow flowage, rapid flowage, sliding and subsidence; **Surface and subsurface landform features - Mass wasting process. *Geological work of Wind*:** Wind Erosion and its landforms, sediment transport by wind, and its landforms, deposition by wind and its landforms - **Sand dunes** – **Dynamics** and their types.	12
II	***Geological work of River*:** Sources of stream water – River profile – Geological work – Methods of river erosion – rate of river erosion – features of stream erosion –sediment transport by river, deposition by river. **Drainage patterns and its types, Major rivers in India. Lakes**: Geological function, classification, origin, distribution and Indian lakes.	12
III	**Geological work of Groundwater:** Description, **Sediment motion by groundwater**, Chemical Work of Groundwater, Deposition by Groundwater, Mechanical Work of Groundwater. **Landforms formed by groundwater process.**	12
IV	**Geological work of Glaciers:** Glacial morphology – Types of glaciers –glacial erosion and its rates – features of glacial erosion, transport and deposits – **Landform features of glacier origin.**	12
V	***Geological work of Sea*: Geological parameters of ocean,** Definition of continental shelf, continental slope, abyssal plain, continental rise and submarine canyons. Marine erosion and features of marine erosion – Marine deposition – **Coral reefs – Types & uses. Indian occurrence of coral reefs.**	12

Text Books:

1. Radhakrishnan, V., (1996) General Geology, V.V.P. Publishers, Tuticorin.
2. Mahapatra, G.P., (1992) Textbook of Geology, CBS Publishers, New Delhi.
3. Dayal, P., (2019) A Text Book of Geomorphology, Rajesh publications.
4. Richard John Huggett, (2011) Fundamentals of Geomorphology, Taylor& Francis.

Reference Books:

1. Worcester, P. G., (1960) A Text Book of Geomorphology, East West Press Ltd. Delhi.
2. Thornbury, W. D., (2002) Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York.
3. Singh, S., (2007) Geomorphology. S. Chand &Co. Delhi.
4. Park, R. G, (1989) Foundation of Structural Geology, Blackie and Sons Ltd., Glasgow, New Zealand, Second edition.
5. Davis, G. H., (1985) Structural Geology of Rocks and Regions. Elements of Structural Geology, Wiley.
6. Siddhartha, K., (2021) The Earth's Dynamic Surface, Kitab Mahal publishers.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://geomorphology.org.uk/what-geomorphology-0*
3. *http://geographymat.blogspot.com/2011/02/fundamental-conecpts.html*
4. *http://www.preservearticles.com/2011110116387/what-is-the-gological-action-of-river.html*
5. *http://www.alevelgeography.com/the-long-profile-changing-processes-types-of-erosion-transportation-and-deposition/*
6. *http://www.preservearticles.com/2011110116404/what-is-the-geological-action-of-the-underground-water.html*
7. *http://www.preservearticles.com/2011110116411/what-are-the-geological-action-of-glaciers.html*
8. http://www.preservearticles.com/2011110116424/what-are-the-geological-activities-of-the-sea-a-oceans.html

Course Outcomes

On completion of Course, the students should be able to

CO1: Outline the concept of Geomorphology and Geological work of Wind

CO2: Describe the Landforms created by River and Lakes.

CO3: Evaluate the Landforms created by Groundwater and describe drainage pattern

CO4: Explain the Landforms developed by Glaciers

CO5: Describe the Geological Work of Sea.

Course Code &Title	**21GEOU0205 STRATIGRAPHY**		
Class	B. Sc Geology	Semester	II
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To learn the geological time scale, physiographic and geological divisions of India • To Describe Proterozoic stratigraphy of Indian sub-continent • To Explain Paleozoic Group of Indian stratigraphy. • To Discuss Mesozoic age group of Indian Strata. • To Summarize the Origin of Deccan traps		

Unit	Content	Lectures
I	Stratigraphy – Definition, Laws of stratigraphy. ***Principles of correlation*** – Objectives – Elements of correlation – Standard stratigraphic scale – Order of superposition, Geological Timescale, Indian Geological Timescale, Faces and Faces Change, Break in Records. Physiographic Divisions of India. The Himalayas. Elements of lithostratigraphic, chronostratigraphic and biostratigraphic classification. – Difficulties in correlation. **The Archean Group**: Introduction – Distribution – **Lithology**: Bundelkhand gneiss – Charnockite series – Gneiss: Champion gneiss – Peninsular gneiss – Schist. **Dharwar System**: Definition and distribution – Lithology – Classification Lower Dharwar – Middle Dharwar – Upper Dharwar– Life and Economic importance of Archean group. Archean rocks of TamilNadu, economic mineral deposits**.**	11
II	**Proterozoic group: The Cuddapah System**: Definition and distribution – **Cuddapah Basin of Andhra**: Kistna series – Nallamalai series – Cheyair series – Papaghani series. Cuddapah rocks of Madhya Pradesh –The Delhi System - Economic minerals of Cuddapah system. **The Vindhyan System**: Definition and distribution – Lithology – Life – **Stratigraphic classification of Vindhyan System**: Upper Vindhyan – Lower Vindhyan – Kurnool system- Economic minerals of Vindhyan system.	11
III	**Palaeozoic Group**: Introduction – **The Cambrian system**: Definition and Distribution – Cambrian of Spiti (Haimanta system) – Lithology-Classification: Upper Haimanta, Middle Haimanta and Lower Haimanta– Life – The Cambrian of Kashmir – Cambrian of Salt range. **The Ordovician system**, **The Silurian System and Devonian System. The carboniferous system:** Carboniferous of Spiti – Carboniferous of Kashmir**. The Permian System:** Kashmir – Salt range**.**	11
IV	**Mesozoic Group:** Introduction – The Mesozoic of Tethys Himalaya. **The Triassic System**: Spiti- Definition – Lithology – Classification: Keuper – Muschelkalk - Bunter – Life. Kashmir: Lithology – **Classification:** Upper Triassic- Middle Triassic – Lower Triassic – Life. Salt range. **The Jurassic System**: Spiti – Kashmir – Salt range-The Jurassic of Kutch: Patcham series – Chari series – Katrol series – Umia series. **The Cretaceous system:** Definition and distribution – The marine facies of cretaceous system – The Coromandal coast – Cretaceous of Narmada valley – Marine cretaceous of Extra-Peninsula – Origin of Marine cretaceous – The Fluviatile Cretaceous (Lameta series).	11

V	***Deccan Traps:*** Definition and distribution – Petrology – Structural features – Classification: Upper traps- Middle traps – Lower traps – Life – Origin – Age. **The Gondwana group**: Introduction – Distribution – Classification –Upper Gondwana – Middle Gondwana – Lower Gondwana – Lithology – Life – Economic importance. **Cenozoic Group: The Tertiary group;** Introduction – Distribution – Tertiary group of extra peninsulas–Cuddalore sandstone. **The Eocene system**; Definition and distribution – lithology – Life. **The Oligocene- Lower Miocene systems** – **The Siwalik system**: Definition and distribution – Lithology – classification – Life – structure – Origin – **The Pleistocene system**: Definition and distribution – Indo-gangetic alluvium – lithological characters – Origin	11

Text Books:

1. Krishnan, M. S., (1986) Geology of India, Burma and Pakistan, CBS. New Delhi.
2. Mehdiratta, R. C., (1974) Geology of India, Pakistan, Bangladesh and Burma. Atma Ram & Sons. Delhi.
3. Kumar, R., (1988) Fundamentals of Historical Geology and Stratigraphy of India, Wiley, New Delhi.

Reference Books:

1. Wadia, D.N., (1953) Geology of India. McMillan India, Delhi.
2. Boggs, S., (1987) Principles of Sediment logy and Stratigraphy, Merrill Publishing Co. New York.
3. Weller, J.M., (1960) Stratigraphic Principles and Practice, Asia Publishing House. Delhi.
4. Gignoux, M., (1960) Stratigraphical Geology, Mc Graw hill publications.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://eps.mcgill.ca/~courses/c240/W3_L1.pdf*
3. *https://www.gktoday.in/academy/article/indias-rock-formation-archean-dharwar-cudappah-vindhyan-gondwana-and-tertiary-rocks/*
4. *https://www.pmfias.com/indian-rock-system-archaean-purana-dravidian-aryan-rock-system/*
5. *https://digital.library.adelaide.edu.au/dspace/bitstream/2440/103376/2/02wholeGeoHon.pdf*
6. *https://theodora.com/encyclopedia/c/cambrian_system.html*
7. *https://www.britannica.com/science/Permian-Period*
8. *https://massextinction.princeton.edu/deccan-volcanism/01-deccan-volcanism-adventure-science*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the fundamental principles of Stratigraphy and physiographic divisions of India.

CO2: Identify rocks and fossils of the Proterozoic period.

CO3: Evaluate the sub divisions of the Paleozoic period.

CO4: Describe the Mesozoic systems.

CO5: Outline the age of Deccan traps, Gondwana and Tertiary group of series.

Semester - III

Course Code &Title	**21GEOU0306 PALAEONTOLOGY**		
Class	B. Sc Geology	Semester	III
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Explore the fundamentals of Palaeontology and its divisions • To Understand the phylum vs time of various fossils explored. • To Describe the different phylum and the fossil details associated with it. • To Illustrate the mega-fossils and microfossils and their economic importance. • To Define and explain the vertebrate fossils and invertebrate fossils.		

Unit	Content	Lectures
I	**Detailed account on Geological time scale. Fossils and fossilization:** Definition – Mass Extinction and their causes, Modes of preservation of fossils – Physico- chemical conditions for fossilization – Types of fossils – Significance of fossils. **Collection, preparation and nomenclature of fossils**: Study of chrono stratigraphy – Bio stratigraphy - Index fossils and zone fossils - *study of paleogeography* – study of paleo climate, paleo ecology, organic evolution – use of fossils. ***Paleobotany:*** Modes of preservation of plant fossils. Major extinction and origination through ages. Outline of classification of organisms. Dendrochronology and its application.	12
II	**Short account of Gondwana flora;** Tertiary flora; Glossopteris, Gangamopteris, Calamites, Lepidodendron, Sigillaria and Ptilophyllum. **A brief idea about Indian plant fossils** – Phylum Mollusca - Morphology, classification, geological distribution and important fossils of ***Lamellibranchia – Gastropoda – Cephalopoda.***	12
III	***Brachiopoda:*** Morphology, classification, geological distribution and important fossils of ***Brachiopoda*** - **Coelenterata – Hemichordata - Class Graptozoa - Devonian System. The carboniferous system:** Carboniferous of Spiti – Carboniferous of Kashmir**. The Permian System:** Kashmir – Salt range**.**	12
IV	Morphology, classification, geological distribution and important fossils of ***Echinodermata*** –***Trilobites*** **- Foraminifera** - **Porifera** – Sponges. **Introduction to Ichnology:** Introduction to microfossils – General types and uses. Indian microfossil studies.	12
V	**Vertebrate fossils Pisces**: General features - **Amphibians:** Origin, general features - **Reptiles**: Origin, general features, Dinosaurs – general characteristics, classification and causes for extinction**-Aves:** Origin, general features - **Mammals**: Origin, general features of: Equus, Elephas and Homosapiens. Mega Fossils of Indian sub-continent.	12

Text Books:

1. Jain, M. L. & Anantharaman P. C., (2013) An Introduction to Palaeontology. Vishal Publications. Delhi.
2. Henry Woods., (2005) Palaeontology Invertebrate, The University Press.

Reference Books:

1. Moore, R.C, Lalicker, C.G & Fisher, A.G., (1997) Invertebrate fossils. (1st Indian edition), CBS Publishers &Distributors, New Delhi.
2. Black, R.M., (1972) Elements of Palaeontology, Oxford University Press, UK.

3. Clarkson, E.N.K., (2005) Invertebrate Palaeontology and Evolution, Wiley, New Delhi.
4. Shrock & Twenhofel., (2005) Principles of invertebrate Palaeontology, 2nd edition, New Delhi.
5. Easton, W. H., (1960) Invertebrate Palaeontology. Harper & Brothers. New York.
6. Raup D.M., (2004) Principles of Palaeontology 2Ed, CBS Publishers.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://www.biologydiscussion.com/articles/geological-time-scale-meaning-divisions-and-events/22622*
3. *http://www.uno.edu/cos/earth-environmental-sciences/ees-docs/ClassResources/Lab6_Fossilization.pdf*
4. *https://sites.google.com/site/paleoplant/home/what-is-paleobotany*
5. *http://www.ucmp.berkeley.edu/mollusca/mollusca/gastropoda/gastropodafr.html*
6. *https://theodora.com/encyclopedia/l/lamellibranchia.html*
7. *http://www.ordovicianatlas.org/atlas/brachiopoda/brachiopod-general-morphology/*
8. *http://www.ucmp.berkeley.edu/echinodermata/echinomm.html*
9. *http://www.ucmp.berkeley.edu/foram/forammm.html*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the modes of preservation of fossils

CO2: Evaluate the morphology of the Mollusca fossils

CO3: Describe the morphology of the Brachopida, Coelenterata and Graptozoa.

CO4: Explain the morphology of Echinodermata, Trilobites, Foraminifers and Porifera

CO5: Outline the origin of vertebrates.

Course Code &Title	**21GEOU0307 Palaeontology – Practical**		
Class	B. Sc Geology	Semester	III
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Know various types of fossils • To Examine the morphological characteristics of the fossils • To Describe the age with respect to the fossils • To Explain the uses of fossils		

Contents

Identification and description of the following fossils:

a) **Lamellibranchs:** Arca, Meretrix, Pecten, Cardita, Lima, Allectronia, Inoceramus, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Trigonia.
b) **Gastropods**: Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cyprea.
c) **Cephalopods**: Nautilus, Orthoceras, Ceratite, Goniatite, Belemnites, Baculites, and Perisphinctes.
d) **Echinodermata**: Cidaris, Holaster, Hemiaster, Stigmatophygus, Apiocrinus.
e) **Trilobites**: Paradoxides, Olenus, Olenellus, Phacops, Calymene.
f) **Corals**: Calceola, Zaphrentis, Lithostrotion, Omphyma, Thecosmelia.
g) **Brachiopoda**: Terebratula, Spirifer, Productus, Monograptus, Tetragraptus, Diplograptus.
h) **Plant fossils**: Ptilophyllum, Glossopteris, Lepidodendron and Petrified wood.

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the morphology of Lamellibranchs and Gastropods.

CO2: Evaluate the morphology of the Cephalopods and Echinodermata

CO3: Describe the morphology of the Trilobites, Corals, Brachiopoda.

CO4: Outline of the Plant fossils.

Semester – IV

Course Code &Title	**21GEOU0408 CRYSTALLOGRAPHY**		
Class	B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To identify the crystal forms in minerals • To Know the Internal and External structures of crystals and its characteristics • To describe the Isometric and Tetragonal system • To Classify the Hexagonal system and Rhombohedral divisions. • To Learn the Orthorhombic, Monoclinic and Triclinic crystal forms. • To Explain the characters of twinning in crystals		

Unit	Content	Lectures
I	***Crystallography:*** Definition of a crystal - Molecular structure in general - Crystalline and amorphous - External form - Variation of form and surface - Constancy of the Interfacial angles in the same species - Diversity of Form or habit - Diversity of Size –**Basic crystal symmetry** - Planes of symmetry - Axes of symmetry - Centre of symmetry - Relation of Geometrical to Crystallographic symmetry - Pseudo symmetry - Crystallographic axes - *Systems of crystallization*. **Concept of point groups.**	12
II	**Isometric system**: Normal class - Pyritohedral class - Tetrahedral class - Plagiohedral class - Tetratohedral class. **Tetragonal system**: Normal class - Hemimorphic class - Tripyramidal class - Pyramidal - Hemimorphic class - Sphenoidal class - Trapezohedral class - Tetratohedral class.	12
III	**Hexagonal system**: Normal class - Hemimorphic class - Tripyramidal class - Pyramidal - Hemimorphic class - Trapezohedral class - **Rhombohedral division**: Trigonal class - Rhombohedral class - Rhombohedral hemimorphic class - Tri-Rhombohedral class - Trapezohedral class.	12
IV	**Orthorhombic system**: Normal class - Hemimorphic class - Sphenoidal class. **Monoclinic system**: Normal class - Hemimorphic class - Clinohedral class -**Triclinic system**: Normal class - Asymmetric class. Crystallographic notation – parameter system of Weiss, index system of Miller. **Crystal chemistry:** Dimorphism, polymorphism, pseudomorphism, isomorphism and solid solution.	12
V	**Compound or Twin crystals**: Definition - Distinction between Twinning and Parallel grouping - Twinning Axis - Twinning Plane - Composition plane - Contact and Penetration twins - Paragenic and Metagenic twins - Repeated twinning, polysynthetic and symmetrical - Secondary twinning - **Twinning**: Isometric system - Tetragonal system - Hexagonal system -Orthorhombic system - Monoclinic system - Triclinic system. **Uses of crystals in different fields.**	12

Text Books:

1. Ford, W.E., (1988) Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint).
2. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology, S. K. Kataria & Sons. Delhi.
3. Wade, F.A. & Mattox. R.B., (1960) Elements of Crystallography and Mineralogy. Harper & Brothers—Harper's Geoscience Series, New York.

Reference Books:

1. Perkins, D. & Henke. K. R., (2003) Minerals in Thin Section, Prentice Hall, New Delhi.
2. Kerr, P. F., (1977) Optical Mineralogy, 4th ed. McGraw Hill New York.
3. Berry Mason, L.G, (1977) Mineralogy, W.H. Freeman &Co.
4. Deer, W. A., Howie, R. A & Zussman., (2013) An Introduction to Rock Forming Minerals, Third Edition, ELBS, Ed.
5. Ravell Phillips, W. M. & Dana. T. Griffen., (2004) Optical Mineralogy-The Non-Opaque Minerals, CBS publishers & Distributors.
6. Phillips, R.C., (2011) An introduction to Crystallography, Read Books.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *https://www.britannica.com/science/isometric-system*
3. *http://www.mineralogy4kids.org/all--crystals/crystal-systems/tetragonal-system*
4. *https://uwaterloo.ca/earth-sciences-museum/resources/crystal-shapes/hexagonal-crystal-system*
5. *https://www.britannica.com/science/orthorhombic-system*
6. *https://uwaterloo.ca/earth-sciences-museum/resources/crystal-shapes/monoclinic-crystal-system*
7. *http://www.chem.wisc.edu/~danny/interactive/triclinic/*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the basics of crystallography, various crystal forms, Crystallographic Axis and symmetry

CO2: Describe Isometric and tetragonal crystal forms.

CO3: Identify and describe the Hexagonal, rhombohedral and mineral forms

CO4: Identify the Orthorhombic, Monoclinic and triclinic crystal forms.

CO5: Describe Twinning crystals.

Course Code &Title	**21GEOU0409 MINERALOGY**		
Class	B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Learn the physical and chemical properties of minerals • To Explain the Quartz and Feldspar Groups of Minerals and its verities • To Classify the Feldspathoid and Pyroxene Group of essential minerals. • To Categorize minerals in Amphibole, Olivine, Mica, Garnet, and Zeolite groups of minerals, and accessory minerals		

Unit	Content	Lectures
I	**Mineralogy**: An Introduction of mineral and mineraloid. Properties of minerals – ***Physical properties of minerals*****: Based on cohesion**: Form, structure, Cleavage, Hardness, Fracture, Tenacity, Specific gravity. Prosperities Based on Light: Colour, Streak, Lustre, Transparency, fluorescence, Phosphorescence - **Properties based on heat, electricity, and Magnetism - Properties based on senses:** Taste, Odour, feel. **Chemical properties of minerals:** Reaction with acid, Isomorphism, Polymorphism and Psedumorphism - Atomic bonding.	12
II	**Structure of silicates - Quartz Group:** Description, General Characteristics, Crystalline Verities, Cryptocrystalline Verities, Amorphous Verities. **Feldspar Group:** Crystal System Details, Introduction, **Alkali Feldspar**: Orthoclase, Sanidine, Microcline, Celsian, Perthite. **Plagioclase Feldspar: Plagioclase Series -** Albite, Labradorite, Oligoclase, Bytwonite, Andesite and Anorthite. Phenomena of Solid Solution. Solid Solution, Solid Solution in Plagioclase Feldspars.	12
III	**Feldspathoid Group:** Introduction, Chemistry, Leucite, Nepheline, Cancrinite, Sodalite, Hauynite, Noselite, Lazurite. **Pyroxene Group:** General Characteristics, Orthopyroxene, Clinopyroxene, Clino-enstatites, Pigeonite, Diopside-Hedenbergite, Augite, Wollastonite, Agerite, Jadeite, Spodumene, Rhodonite.	12
IV	**Amphibole Group:** General Characteristics, Anthophyllite, Cummingtonite, Tremolite- Actinolite, Hornblende, Glaucophane – Arfvedsonite. **General description and Mineral characteristics**: Olivine, Mica, Garnet, Zeolite Group of Minerals. **Salient Features of Accessory Minerals:** Epidote, Scapolite, Beryl, Apatite, Fluorite, Kyanite, Sillimanite, Andalusite, Topaz, Tourmaline, Cordierite, Calcite, Dolomite, Staurolite, Talc, Kaoline, Serpentine, Steatite, Zircon, Sphene, Rutile, Magnetite, Ilmenite.	12
V	**Optical Mineralogy: Elementary concept of Light**. **Polarization and Nicol Prism.** Refractive Index – Dispersion – Total Reflection – Double Refraction - **Petrologic Microscope and its Behavior of the light through the Microscope.** Study of Minerals under Petrological Microscope. **Simple Optical Accessories**. Important optical properties: R.L, Relief, Pleochroism, Pleochroic, Haloes, Extinction and Extinction angle, Birefringence, Interference colors; behavior of convergent polarized light in Uniaxial and Biaxial Minerals.	12

Text Books:

1. Berry Mason, L.G., (1985) Mineralogy, W.H. Freeman &Co.
2. Gribble, C. D., Rutley's., (1988) Elements of Mineralogy. CBS, New Delhi.

3. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology, S. K. Kataria & Sons, Delhi.

Reference Books:

1. Perkins & Dexter., (2010) Mineralogy (3rd Edition) Prentice Hall.
2. Ford, W.E., (1988) Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint).
3. Kerr B.F, (1995) Optical Mineralogy. McGraw Hill, 5thEdition, New York.
4. Deer, W. A., Howie, R. A & Zussman., (2013) An Introduction to Rock Forming Minerals, Third Edition, ELBS, Ed.
5. Revelli Phillips, W.M. & Dana. T. Griffen., (2004) Optical Mineralogy-The Non-Opaque Minerals, CBS publishers & Distributors, New Delhi.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *https://www.tulane.edu/~sanelson/eens211/silicate_structures08.htm*
3. *https://www.britannica.com/science/mineral-chemical-compound/Nesosilicates*
4. *http://bsrithai.geol.science.cmu.ac.th/pdf/205234/Sorosilicate.pdf*
5. *http://bsrithai.geol.science.cmu.ac.th/pdf/205234/Cyclosilicate.pdf*
6. *https://www.tulane.edu/~sanelson/eens211/inosilicates.pdf*
7. *http://www.geo.umass.edu/courses/geo311/phyllosilicates.pdf*
8. *http://www.geo.umass.edu/courses/geo311/lecture%2012%20Tectosilicates.pdf.*
9. *http://www.geo.umass.edu/courses/geo311/pyroxenes.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify the physical and chemical properties of the minerals

CO2: Explain verities of minerals in Quartz and Feldspar Groups

CO3: Describe minerals in Feldspathoid and Pyroxene Groups.

CO4: Outline the minerals in Amphibole, Olivine, Mica, Garnet, Zeolite groups of minerals, and accessory minerals.

CO5: Identify the Optical Characteristics of various Minerals.

Course Code &Title		**21GEOU0410 CRYSTALLOGRAPHY – PRACTICAL**		
Class		B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3			
Course Objectives	**The Course aims** • To Do Exercises on Crystal Models • To Identify the Crystal Axis and Symmetries • To Identify the Twinning Crystals. • To Explain the general characteristics and the uses of crystals			

Contents

Description of forms present and determination of Miller indices of the following crystal models:

I. **Isometric System:** Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper- Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite.

II. **Tetragonal System**: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, Meionite Sphenoidal Class – Chalcopyrite.

III. **Hexagonal System**: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz.

IV. **Orthorhombic System**: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite.

V. **Monoclinic System**: Normal – Gypsum, Pyroxenes and Amphiboles.

VI. **Triclinic System**: Normal – Axinite, Albite, and Rhodonite.

VII. **Twin Crystals**: Contact and Penetration twins of Fluorite, Iron Cross Twin of Pyrite, Knee type twin of Cassiterite, Polysynthetic twin of Aragonite, Cyclic twin of Cerussite, Swallow Tail of Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify the various crystal Systems and Symmetry through crystal models

CO2: Assess the miller Indices of the crystal models

CO3: Identify of Twining crystals

Course Code &Title	**21GEOU0411 MINERALOGY – PRACTICAL**		
Class	B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Study the megascopic properties rock forming minerals • To Understand the Origin and Occurrences of the minerals • To Examine the optical properties of rock forming minerals		

Unit	Contents
	Megascopic identification and description of the following: a) **Quartz group**: Quartz, chalcedony, opal, agate, flint, jasper, amethyst, rose quartz b) **Feldspar group**: Orthoclase, microcline, albite, Anorthite, oligoclase, labradorite c) **Feldspathoid group**: Adularia, sanidine, nepheline, sodalite, lapislazuli d) **Pyroxene group:** Enstatite, bronzite, hypersthene, augite, Diopside e) **Amphibole group**: Anthophyllite, Hornblende, Actinolite, Tremolite f) **Olivine group:** Olivine, serpentine g) **Mica group**: Muscovite, biotite, phlogopite, lepidolite, vermiculite h) **Other minerals**: Chlorite, epidote, garnet, apophyllite, stilbite, heulandite, talc, steatite, beryl, kaolin, cordierite, apatite, andalusite, staurolite, sillimanite, kyanite, tourmaline, topaz, calcite, dolomite and fluorspar. **Optical Mineralogy:** i) **Microscopic identification and description of the following**: quartz, orthoclase, albite, oligoclase, andesine, labradorite, anorthite, nepheline, leucite, sodalite, hypersthene, augite, diopside, aegirine, hornblende, tremolite, actinolite, glaucophane, riebeckite, muscovite, biotite, phlogopite, olivine, serpentine, chlorite, epidote, garnet, apatite, zircon, sphene, magnesite, tourmaline, calcite, dolomite, andalusite, staurolite, sillimanite and cordierite. Microcline,

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify the megascopic properties of Quartz and Feldspar group of minerals

CO2: Outline the megascopic properties of Feldspathoid and Pyroxene group of minerals

CO3: Describe the megascopic properties of Amphibole group of minerals

CO4: Identify, Discriminate and describe the megascopic properties of Olivine and Mica group of Minerals.

CO5: Describe Microscopic properties of minerals.

Semester - V

Course Code &Title	**21GEOU0512 IGNEOUS AND METAMORPHIC PETROLOGY**		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Describe the Composition of Magma • To Classify the various types of Igneous rocks • To Describe the origin of Igneous and Metamorphic rocks • To Discriminate the Igneous and Metamorphic rocks • To Categorize the various types of Metamorphic rocks.		

Unit	Content	Lectures
I	**Igneous Rocks:** Magma – Volcanic rocks – Plutonic rocks – Hypabyssal rocks. **Composition**: Chemical composition – Mineralogical composition. **Textures of igneous rocks**: Factors explaining textures: Degree of crystallization – Granularity – Fabric. **Types of Textures**: Equigranular and Inequigranular texture – Porphyritic texture – Poikilitic texture – Directive texture – Inter growth texture -Intergranular texture. **Structures of Igneous Rocks**: Definition – Types: Flow – Pillow – Ropy and Block – Spherulitic and orbicular- Vesicular structure – Miscellaneous structure.	13
II	**Forms of Igneous Rocks**: Concordant bodies – Discordant Bodies – Igneous extrusions. ***Classification of Igneous Rocks***: IUGS classification - Chemical Classification – Mineralogical Classification – Textural Classification -Tabular Classification - **Formation of Igneous Rocks:** The Source Magma - The Process Crystallization - **Crystallization of a Unicomponent Magma** (Basics)**:** Augite System - Grain of Igneous Rocks - Formation of Glass -**Crystallization of Binary Magma** (Concept): Diopside - Anorthite System - Albite – Anorthite system – Eutectics – Mixed crystals. **Ternary systems:** Albite – Anorthite - Diopside system, Anorthite - Forsterite - Silica system.	13
III	**Bowen's Reaction Series:** Continuous and Discontinuous series- **Mechanism and processes of magmatic differentiation**. Assimilation. **Distinguished Properties of Petrographic Characteristics of** Granite, Granodiorite and Diorite, Syenite, Nepheline - Syenite and related alkaline rocks - Gabbro, Anorthosite and peridotite – Dolerite and Lamprophyre – Rhyolite and Dacite – Trachyte and Phonolite – Andesite and Basalt. Petrography of Ophiolites, Kimberlites and Carbonatites.	13
IV	**Metamorphic Petrology: Description, Factors (Agents) of Metamorphism:** Temperature, Pressure, Chemical Environment. ***Kinds of Metamorphism***: Thermal Metamorphism, Dynamic Metamorphism, Dynamo thermal Metamorphism. **Metasomatism, Metamorphic Textures:** Crystalloblastic Textures, Palimpsest (Relict) Textures. **Metamorphic Structures:** Cataclastic Structure, Schistose Structure, Gneissose Structure, Maculose Structure, Augen Structure, Granulose Structure.	13
V	**Classification of Metamorphic Rocks**: Foliated Rocks, Non-Foliated Rocks. **Isograds and Facies:** Zeolite facies, Green schist facies, Amphibolite facies, Granulite facies**. Petrography and origin of the following metamorphic rocks:** Slate, Schist, Gneiss, Quartzite, Marble, Phyllite, Hornfels. Migmatite, Eclogites**,** Charnockites.	13

Text Books:

1. Tyrell, G. W., (1958) Principles of Petrology. B.I. Publications. New Delhi.
2. Parbin Singh, B., A., (2005) Textbook of Engineering and General Geology, S. K. Kataria & Sons. Delhi.

Reference Books:

1. Best, M. G., (2005) Igneous Petrology. Wiley. New Delhi.
2. Best, M. G., (2003) Igneous and Metamorphic Petrology. Wiley. New Delhi.
3. Turner, F.J., (1968) Metamorphic Petrology. McGraw Hill. New York.
4. William, H., Turner, F.J. and Gilbert, C.M., (1954) Petrography, Freeman and Company.
5. Turner, F.J., and Verhoogen, J., (2004) Igneous and Metamorphic petrology, C.B.S. Publishers and Distributors, Delhi.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *https://flexiblelearning.auckland.ac.nz/rocks_minerals/rocks/*
3. *http://www.indiana.edu/~geol105/images/gaia_chapter_5/igneous_rock_textures.htm*
4. *https://www.tulane.edu/~sanelson/eens212/intro&textures.html*
5. *https://www.eartheclipse.com/geology/formation-types-and-examples-of-igneous-rocks.html*
6. *http://pages.geo.wvu.edu/~lang/Geol285/Pet5PhaseD-outline.pdf*
7. *https://opentextbc.ca/geology/chapter/3-3-crystallization-of-magma/*
8. *https://www.tulane.edu/~sanelson/eens212/typesmetamorph.html*
9. *http://csmgeo.csm.jmu.edu/geollab/Fichter/MetaRx/Textclass.html*
10. *http://www.appstate.edu/~abbottrn/rck-id/mtmchrt.html*

Course Outcomes

On completion of Course, the students should be able to

CO1: Discuss the Igneous rocks, their texture and structures

CO2: Explain forms and classification of igneous rocks

CO3: Describe the Crystallization of Unicomponent, Binary and Ternary magma as well as the petrographic properties of various igneous rocks

CO4: Explain the Metamorphic rocks, their texture and structure

CO5: Evaluate the types of metamorphic rocks.

Course Code &Title	21GEOU0513 SEDIMENTARY PETROLOGY AND MARINE GEOLOGY		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Understand the origin and concept of Sedimentary rocks • To Recognize the forms, structures and textures of the Sedimentary rocks, • To understand, classify and explain the categorization of sedimentary rocks. • To Understand the marine process. • To Evaluate the morphological features of marine landforms		

Unit	Content	Lectures
I	***Sedimentary Petrology*:** Description and formation of sedimentary rocks: Clastic (Mechanically Formed) Rocks, Chemically Formed Rocks, organically formed rocks. **Environment of Formation:** Concept of Facies, facies association, facies modelling; Classification and characteristics of common marine and non-marine sedimentary environments. **Mineralogical formation**: Nature of Gathering ground – Duration of Transport – Mixing up of sediments – Allogenic and Authigenic minerals.	13
II	**Origin of sediments-** Weathering and sedimentary flux: Physical and chemical weathering, soils and paleosols**. Textures of Sedimentary rocks:** Origin of Grains – Size of grains – shape of grains – packing of grains – fabric of grains – Crystallization trend. **Structures of sedimentary rocks**: Mechanical structure - chemical structure – organic structure.	13
III	**Diagenesis** - Concepts of diagenesis, Stages of diagenesis, Compaction and cementation **- Classification of sedimentary rocks**: **Clastic rocks:** Gravels – Sands – Silts clays – **Non- clastic rocks:** Chemically formed rocks – organic deposits – miscellaneous deposits. **Paleocurrent analysis**- Paleocurrents for different sedimentary environments Sedimentary structure- Primary and syn-sedimentary structures**.**	13
IV	**Descriptive petrography of following sedimentary rocks**: Breccia – Conglomerate – Sandstone – Shale – Limestone – Dolomite – Coal- Iron ores of sedimentary origin – Gypsum – Rock salt – Flint and chert – Tillite.	13
V	**Marine Geology:** Ocean morphology– Continental shelf – Continental slope – Submarine canyons – Mid- oceanic ridges - The sea waves and currents – Oscillatory waves – Translatory waves – Littoral currents – Rip currents - **Marine Sediments -** Classification and distribution. Factors controlling the deposition and distribution of oceanic/marine sediments - Biogenous, Cosmogenous, Hydrogenous, Terrigenous and Authigenic. **Physical and chemical properties of Ocean water** - Factors affecting surface flow of currents – Coriolis effect, Ekman's spiral. Tides and their types. **Tsunamis**: origin, significance and prediction. Ocean pollution. **Mineral deposits of ocean floor**.	13

Text Books:

1. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology. S. K. Kataria & Sons. Delhi.
2. Savindra Singh., (2014) Oceanography, Pravalika Publications, Allahabad.

Reference Books:

1. Petti john, F.J., (1975) Sedimentary Rocks, Harper & Row, New York, 3rd Edition.
2. Sengupta, S., (2011) Introduction to Sedimentology, CBS Publishers and Distributors, New Delhi.
3. Ehlers E. G., & Blatt, H., (2005) Petrology Igneous Sedimentary and Metamorphic, 3rd Edition, Wiley.
4. U.S. Army Corps of Engineers, (1995) Coastal Geology, University press of the Pacific Honolulu, Hawaii.
5. Tucker, M. E. (2006) Sedimentary Petrology, Blackwell Publishing.

Web Resources:

1. *https://www.eartheclipse.com/geology/formation-types-and-examples-of-sedimentary-rocks.html*
2. *http://www.geologyin.com/2014/12/sedimentary-textures-and-classification.html*
3. *http://www.rocksandminerals4u.com/sedimentary_rock.html*
4. *http://csmgeo.csm.jmu.edu/geollab/fichter/SedRx/sedclass.html*
5. *http://www.scseagrant.org/pdf_files/sos_chap_2.pdf*
6. *http://www.waterencyclopedia.com/Mi-Oc/Mineral-Resources-from-the-Ocean.html*
7. *Underlined Titles are available at Swayam portal*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the sedimentary rocks and their genesis of formation

CO2: Outline the various structure and texture of sedimentary rocks

CO3: Discuss the Classification of Sedimentary rocks

CO4: Evaluate the petrographic properties of Sedimentary rocks

CO5: Explain the sea waves, currents, physio chemical properties of ocean and the marine mineral deposits.

Course Code &Title	21GEOU0514 HYDROGEOLOGY		
Class	B. Sc Geology	Semester	V

Cognitive Level: K-1, K-2, K-3

The Course aims

Course Objectives:

- To Describe the Hydrologic cycle
- To Classify the types of Aquifers
- To Evaluate the Laboratory Methods
- To Estimate the quality of Groundwater
- To Describe the Groundwater pollution.

Unit	Content	Lectures
1	**Introduction and Basic Concepts:** Hydrologic Cycle – Sources of Groundwater (Origin & Occurrence of Groundwater) – Vertical Distribution of Groundwater – Water Table – Porosity – Permeability – Specific yield and Specific retention.	11
II	**Aquifers and Springs:** Aquifer – Aquifuge – Aquiclude – Aquitard – Types of Aquifers – Unconfined – Confined aquifer – Semiconfined aquifer – Perched aquifer – Rich aquifer – Water level fluctuations – Springs. **Groundwater Flow:** Seepage – Capillary movement – Laminar flow – Turbulent flow – Darcy's Law – Permeability Determination	12
III	**Darcy's Law: Permeability study by Laboratory Methods** – Laboratory methods – Constant head method – Falling head method – Non-discharge method – Field Methods – By using tracers.	11
IV	**Groundwater chemistry:** Physical, chemical and bacteriological properties of water and water quality. Introduction to methods of interpreting groundwater quality data using standard graphical plots.	12
V	**Elementary concept on groundwater pollution**: arsenic, fluoride and nitrate, seawater intrusion in coastal aquifers, Groundwater Basins of Tamilnadu.	12

Text Books:

1. Arul, P. (2000) Text book of Groundwater, Dhanam Agency, Tamil Nadu.
2. Todd, D.K., & Mays, L.M., (2013) Groundwater Hydrology, Wiley.
3. Fetter, C.W, (2007) Applied Hydrology, CBS Publications.
4. Herman Bouwer, (2014) Groundwater Hydrology, McGraw hill.
5. Raghunath, H.M., (2003) Groundwater, New age international publications.

Reference Books:

1. Davis, S.N., & R.J.M. De Wiest., (1966) Hydrogeology, Wiley, Delhi.
2. Freeze, R.A. & J.A. Cherry., (1979) Groundwater. Prentice Hall. New York.
3. Raghunath, H.M., (1988) Groundwater. East West Pub. Delhi.
4. Raghunath, H.M., (1985) Hydrology. East West Pub. Delhi.
5. Fetter, G.W., (1989) Applied Hydrogeology. CBS. Delhi.
6. Ramakrishnan, S., (2011) Ground Water. SciTech Publications, Chennai.
7. Garg, S.P., (1982) Groundwater and Tube Wells. Oxford & IBH. Delhi.
8. Underlined Titles are available in Swayam portal.

Web Resources:

1. *http://www.geographynotes.com/essay/groundwater-origin-sources-and-other-details-with-diagram/620*
2. *http://www.hwe.org.ps/Education/Birzeit/GroundwaterEngineering/Chapter%201-%20Occurrence%20of%20groundwater.pdf*

3. *http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Vertical%20Distribution%20of%20Groundwater_ACWADAM_2010.pdf*
4. *http://techalive.mtu.edu/meec/module04/Basics3.html*
5. *http://wellwater.oregonstate.edu/groundwater-movement.*
6. *https://pubs.usgs.gov/sir/2005/5168/pdf/sir2005-5168_6.pdf*
7. *http://www.klimatanpassning.se/en/climate-change-in-sweden/streams-and-groundwater/groundwater-level-fluctuations-1.97833.*

Course Outcomes

On completion of Course, the students should be able to

CO1: Understand the origin and occurrence of groundwater

CO2: Classify types of aquifers

CO3: Describe Ground water movement

CO4: Analysis the Ground water quality

CO5: Outlines of Ground water Pollution

Course Code &Title		**21GEOU0515 IGNEOUS PETROLOGY – PRACTICAL**		
Class		B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3			
Course Objectives	**The Course aims** • To Do exercises on the Igneous rocks hand specimens • To Evaluate the optical properties of important Igneous rocks.			

Contents

a) **Acid igneous rocks:** Granites: Graphic granite, aplite, pegmatite, tourmaline granite, schorl rock, pyroxene granite, hornblende granite, mica granite, pink granite, porphyritic granite, grano diorite.

b) **Intermediate Igneous rocks:** Syenites: Quartz syenite, corundum syenite, nepheline syenite, perthitic syenite, pyroxene syenite, hornblende syenite, mica syenite, porphyritic syenite, diorite.

c) **Basic Igneous rocks:** Gabbro, norite, dolerite.

d) **Ultra-basic igneous rocks:** Anorthosite.

e) **Alkaline igneous rocks:** Lamprophyre, carbonatite, kimberlite.

f) **Volcanic igneous rocks:** Basalts: Vesicular, Amygdaloidal, vitrophyric basalt, pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte**.**

g) ***Microscopic identification and description of the following***:
Mica granite, hornblende granite, tourmaline granite, schorl rock, aplite, graphic granite, quartz syenite, mica syenite, hornblende syenite, nepheline syenite, quartz diorite, hornblende diorite, olivine gabbro, hypersthene gabbro, troctolite, dunite, peridotite granite porphyry; syenite porphyry, diorite porphyry, quartz porphyry, dolerite, minette, anorthosite, rhyolite, trachyte, andesite, basalt, leucite, phonolite, nosean, and volcanic breccia.

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify and discuss the megascopic properties of acid igneous rocks.

CO2: Identify and discuss the megascopic properties of Intermediate rocks

CO3: Identify and discuss the megascopic properties of basic, ultrabasic and alkaline rocks.

CO4: Identify and discuss the microscopic properties of igneous rocks.

Course Code &Title	**21GEOU0516** **METAMORPHIC AND SEDIMENTARY PETROLOGY – PRACTICAL**		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Do exercises on the Sedimentary and Metamorphic rocks hand specimens • To Evaluate the optical properties of important Sedimentary and Metamorphic rocks		

Contents

Sedimentary Rocks:

I. ***Megascopic identification and description of the following***: conglomerate, breccia, laterite, sandstone, arkose, greywacke, grit, shales, limestones, chert, flint, peat, bituminous coal, anthracite, lignite, chalk.

II. ***Microscopic identification and description of the following***: sandstone, arkose, breccias; conglomerate shale, greywackes, limestone, flint and chert.

Metamorphic Rocks:

III. ***Megascopic identification and description of the following*:** slate, phyllite; schists: mica, kyanite, amphibole, and talc; gneisses: banded, garnetiferous, migmatite varieties; amphibolite; eclogite; granulites: charnockite types; khondalite; gondite; grodurite; leptynite, marble, quartzite, skarn, hornfels.

IV. ***Microscopic identification and description of the following*:** slate, phyllite, schists, mica, kyanite, amphibole, and talc; gneisses: banded, garnetiferous, migmatite varieties; amphibolite; eclogite; granulite: charnockite; khondalite; gondite; grodurite; leptynite; marble, quartzite, skarn,hornfels.

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify and discuss the megascopic properties of Sedimentary rocks.

CO2: Identify and discuss the microscopic properties of Sedimentary rocks

CO3: Identify and discuss the megascopic properties of Metamorphic rocks.

CO4: Identify and discuss the microscopic properties of Metamorphic rocks

Course Code &Title	21GEOU05V1 GEOPHYSICS IN GROUNDWATER EXPLORATION		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Illustrate the concept of Geophysical measurements To Record and Interpret the Resistivity data for Groundwater Exploration		

Unit	Content	Lectures
I	***Geophysics Introduction:*** Resistivity, Electrical conduction through rocks, Range of Resistivity for Rocks and Minerals. **Measurement of Earth Resistivity:** Measurement of Earth Resistance, Potential Distribution, Electrode Configuration, Configuration factor, Werner Array, Lee Partitioning Array, Schlumberger Array, D ipole Arrays, Gradient Array. **Survey Procedure:** Electrical Profiling, Resistivity Sounding (VES), Precautions. **Instruments used for Resistivity Measurements.**	11
II	**Interpretation of Resistivity Sounding Data:** Qualitative Interpretation of Resistivity Sounding Data. Quantitative Techniques.	10

Text Books:

1. Ramanuja Charry K.R, (2012), Geophysical Techniques for Groundwater Exploration. Professional Book Publisher.
2. Ramachandra Rao, M.B., (1993) Outlines of Geophysical prospecting. Ebd, Dhanbad.

Reference Books:

1. Dobrin, M.B. & Savit, C.H., (1988) Introduction to Geophysical Prospecting. 4th ed. McGraw Hill. New Delhi.
2. Kearey, P., Brooks, M & Hill. I., (2002) An Introduction to Geophysical Exploration, 3rd ed. Blackwell science.

Web Resources:

1. *https://www.geophysik.unimuenchen.de/~valerian/Oberwinkel_11/Anleitungen/Gravimetrie%20und%20Magnetik%20Grundlagen.pdf*
2. *ftp://ftp.ingv.it/pro/terrasol/materiale_consultazione/Lowrie_Fundamentals_of_geophysics_2007.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Describe the basic principles of Geophysics and its application.

CO2: Explain the field procedure and interpretation of geophysical data for groundwater exploration.

Course Code &Title	21GEOU05V2 GEMOLOGY		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Examine the physical properties of gemstones • To Summarize the origin, classification of gemstones**.**		

Unit	Content	Lectures
I	***Introduction:*** Gemstones and their Influence**.** Terminology, The Nomenclature of Gemstones. **Origin and Structure of Gemstones:** Crystal Systems. **Properties of Gemstones:** Hardness, Cleavage and Fracture, Density and Specific Gravity, Weights Used in the Gem Trade. Optical Properties, Inclusion.	11
II	**Deposits and Production of Gemstones:** Types of Deposits, Mining Methods. **Cutting and Polishing of Gems: Classification of Gemstones:** Scientific Classification, Commercial Classification. **Value of Gemstones: Description of Gemstones, Best Known Gemstones:** Diamond, Corundum, Beryl, Chrysoberyl, Spinel, Topaz, Garnet Group, Zircon, Tourmaline Group, Spodumene, Quartz, Opal Species, Jade, Peridot, Zoisite, Hematite, Pyrite, Feldspar group, Rhodochrosite, Rhodonite, Turquoise, Lapis Lazuli, Sodalite, Azurite, Malachite.	10

Text Books:

1. Walter Schumann, (2015) Gemstones of the World, 5th Edition.
2. Peter G. Read, (2005) Gemmology, NAG Press, 3rd Edition.

Reference Books:

1. Peter Read, (1991) Gemmology, 2nd Ed. Butter worth Heinemanu Ltd. Lundu.
2. Peter Read, (2001) Gems 5th Ed. Buurerworth, London.
3. Richard Laddicoat, (1987) Hand book of gem identification - G.I.A. Santa Monica.

Web Resources:

1. *https://pubs.usgs.gov/gip/7000029/report.pdf*
2. *https://gem-a.com/images/Documents/JoG/2015/JoG-34-8-LR-3.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Describe the origin structure and properties of gemstones.

CO2: Explain the various deposits of gemstones and their varieties

Semester – VI

Course Code &Title	**21GEOU0619 ECONOMIC GEOLOGY**		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Understand basic terminologies and ore deposit environments • To Describe the mineral resources of India • To Summarize the distribution & mode of occurrence of economic minerals • To Evaluate the industrial applications of economic minerals • To Describe National mineral policy, and their role in National economy.		

Unit	Content	Lectures
I	Basic Terminologies of Economic Geology: Ore minerals, Gangue, Grade, Tenor and Tonnage. Resources and reserves - ***Process of formation of Mineral Deposits*****:** Endogenous and Exogenous process: Ore deposit environments **-**Magmatic concentration - Sublimation - Contact metasomatism - Bacteriogenic - Submarine exhalative and Volcanogenic - Evaporation - Residual and Mechanical concentration - Oxidation and Supergene enrichment - Metamorphism - Genetic classification of minerals deposits - Mineral paragenesis and zoning - Outline of Metallogenic Epochs and Provinces- Controls of mineral localization -	13
II	**Mineral Resources in India- I:** Ore Mineralogy**,** Association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits**– Aluminum: Iron: Chromium: Manganese: Molybdenum: Titanium**	13
III	**Mineral Resources in India- II:** Ore mineralogy**,** Association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits: **Copper: Gold: Silver**: **Uranium: Thorium: Beryllium: Zirconium, Lead & Zinc, Tin, Antimony, Bismuth**	13
IV	**Mineral Resources in India- III:** Ore mineralogy, Association, genesis, mode of occurrence, and Indian distribution of the following ore deposits: **Abrasive Minerals: Industrial minerals: Refractory minerals: Ceramic minerals: Fertilizer minerals.**	13
V	Brief account of ore textures and structures. Ore mineralogy, Association, genesis, mode of occurrence, and Indian distribution of the following ore deposits: **Chemical minerals: Mineral pigments**. ***Mineral Economics*****:** Concept of strategic, critical and essential minerals – Demand and supply - Mineral conservation and substitution. Outline of National Mineral Policy and Mineral Concession Rules.	13

Text Books:

1. Prasad, U., (2003) Economic Mineral Deposits. CBS Publishers, Delhi.
2. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology. S. K. Kataria & Sons. Delhi.

Reference Books:

1. Bateman, A.M. & M. L. Jensen., (1981) Economic Mineral Deposits. 3rd ed. Wiley. New York.
2. Lindgren, (1933) Mineral deposits, McGraw Hill.
3. Krishnasamy, S., (1988) India's Mineral Resources. Oxford & IBH. Delhi.

4. Sharma, N. L & Sinha, R. K., (1985) Mineral Economics. Oxford & IBH. Delhi.
5. Gokhale & Rao, (2010) Ore Deposits of India, Thomson press.
6. Iyengar, N. K. N., (1978) Mineral wealth of Tamilnadu, Madras Govt.

Web Resources:

1. *Underlined Titles are available at Swayam portal.*
2. *https://www.preservearticles.com/education/important terminologies-in-economic-geology/17739*
3. *https://www.lifepersona.com/what-are-the-endogenous-and-exogenous-processes-of-the-earth*
4. *http://crcleme.org.au/RegExpOre/1-oredeposits.pdf*
5. *https://www.britannica.com/science/mineral-deposit/Formation-of-mineral-deposits*
6. *http://www.preservearticles.com/2012010519974/the-processes-of-formation-of-mineral-deposits-are-grouped-into-three-main-types.html*
7. *https://www.geologyforinvestors.com/classification-of-mineral-deposits/*
8. *https://iasmania.com/mineral-resources-india-iron-coal-aluminium-copper-lead-zinc/*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the formation of mineral deposits

CO2: Describe the distribution of mineral resources.

CO3: Discuss the Classification of the mineral deposits

CO4: Outline the various mineral resources of India

CO5: Explain the mineral policies of India.

Course Code &Title	21GEOU0620 COAL AND PETROLEUM GEOLOGY		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To gain knowledge the coal, their formation, varieties and distribution. • To classify the various types of Coal and Petroliferous basins of India • To understand the chemical characterization and methods of exploration of petroleum. • To Evaluate the Well logging process • To Summarize Origin, Occurrences and Exploration of Coal and Petroleum		

Unit	Content	Lectures
I	**Coal: Origin of coal:** Definition and Basic classification of coal Fundamentals of Coal Petrology - Chemical characterization: proximate and ultimate analysis; Trace elements in coal; Depositional models of coal bearing sequences, facies correlation, facies map - **Physical description of coal:** Macroscopic description of coal: Microscopic description of coal.	12
II	**Diagenesis of peat and coalification process** – causes, role of time, temperature; Physical changes associated with increased coal rank. **Age and Occurrences of Coal:** Description, plate tectonics, stratigraphy. Gondwana and Tertiary coal deposits in India; Geology of important coalfields of India.	12
III	**Coal quality** and **Classification of coal:** Combustion, Gasification, Carbonization and coke, Hydrogenation; Coal and Environment. **Mineral content of coal: Petrographic applications: Coalification (rank):** Coalification, causes of coalification, Coal Bed Methane (CBM): Global and Indian scenario Underground coal gasification Coal liquefaction.	12
IV	**Petroleum Geology: Description of petroleum: *Origin and occurrences of petroleum*:** Surface occurrences, sub surface occurrences. Source rock, **reservoir rock and petroleum traps: Classification:** Fragmental reservoir rock –chemical reservoir rock – miscellaneous reservoir rock. Migration of petroleum. Onshore and offshore distribution of *Petroliferous basins in India.*	12
V	Chemical composition and physical properties of crudes in nature Origin of petroleum Maturation of kerogen; Biogenic and Thermal effect - ***Well logging*:** Drillers logs, sample logs, electric logs, radiation logs, drilling time logs, core and mud analysis, capillary logs, temperature logs, sonic logs, nuclear magnetism logs**.**	12

Text Books:

1. Prasad, U., (2000) Economic Geology- Economic Mineral Deposits, Second Edition, CBS Publishers and Distributors, Delhi
2. Levorsen A.I., (1985) Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition.

Reference Books:

1. Selley, R.C., (1998) Elements of Petroleum Geology, Academic press, Delhi.
2. Gokhale, K.V.G.K., & Rao, D.M., (2010) Ore Deposits of India, Thomson press.
3. Thomas L., (2002) Coal Geology, John Wiley and Sons Inc.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://www.coaleducation.org/ky_coal_facts/coal_resources/coal_origin.html*
3. *http://www.icr.org/article/origin-coal/*
4. *http://www.geologydata.info/coal_02.html*
5. *http://kvbchemicalengg.com/pdf/ORIGIN,%20OCCURRENCE%20OF%20PETROLEUM.pdf*
6. *http://www.yourarticlelibrary.com/essay/petroleum-formation-and-occurrence-of-petroleum-with-figure/25413*
7. *http://petrowiki.org/Origin_of_petroleum*
8. *http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000448GO/P000594/M022683/ET/1505974261E-TextHydrocarbonTraps.pdf*
9. *http://shodhganga.inflibnet.ac.in/bitstream/10603/41568/8/08_chapter_2.pdf*
10. *http://petrowiki.org/Types_of_logs*

Course Outcomes

On completion of Course, the students should be able to

CO1: Discuss in detail the origin, occurrence and properties of Coal

CO2: Evaluate the age and occurrences of the coal

CO3: Explain the petrography of Coal

CO4: Outline the origin and occurrences of the Petroleum

CO5: Describe the basics of petroleum geology and well logging

Course Code &Title	**21GEOU0621 APPLIED GEOLOGY**		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Coordinate several types of Geophysical surveys • To Improve the knowledge of exploration by using modern techniques • To Summarize the Geological knowledge towards the mineral exploration • To Assess the best methods to source rocks, formation of petroleum, Petroleum exploration and economic uses. • To know about the details of geology for engineering applications.		

Unit	Content	Lectures
I	**Mineral Exploration**: Introduction – Objectives – **Methods of Geological Investigations:** Surface investigations – Sub surface explorations. ***Geophysical Investigations***: **Electrical methods:** Principle – self potential method – Potential drop methods – Resistivity methods – Applications.	13
II	**Mineral Exploration**: **Seismic methods**: principle – Refraction method – Reflection methods – Applications. **Gravitational methods**: Principle – Methods and corrections – Applications. **Magnetic methods:** Principle – Methods – Applications.	13
III	**Petroleum Exploration: Petroleum prospect**: Discovery – **Geological factors** - Conversion of organic material to petroleum. Primary and secondary migration of petroleum. Porosity and permeability in reservoir rocks. **Classification and formation of petroleum** traps - Basin types and their petroleum potential. Regional petroleum geology - **Economic factors.**	13
IV	**Groundwater Exploration:** Geological investigations **-** Geological maps – Aerial photographs& Remote sensing – Test drilling. ***Geophysical Investigations***: Electrical resistivity method: Wenner configuration. International and National groundwater laws, watershed management.	13
V	**Engineering Geology**: Geological considerations for the constructions of **Dams, Tunnels, Roads and Bridges**. Hydrogeological investigations , Coastal protection structures.	13

Text Books:

1. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology. S.K. Kataria & Sons, Delhi.
2. Arogyaswamy., R.N.P., (1995) Courses in Mining Geology, CBS Publishers &Distributors pvt. Ltd., New Delhi.
3. Levorsen A.I., (1985) Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition.
4. Karanth, K.R., (1987) Groundwater Assessment, Development and Management, Tata McGraw Hill, New Delhi.
5. Reddy, V., (1997) Engineering Geology for Civil Engineers; Oxford & IBH, New Delhi.

Reference Books:

1. Ramachandra Rao, M.B., (1993) Outlines of Geophysical Prospecting. EBD, Dhanbad.

2. Lowrie, W., (2007) Fundamentals of Geophysics. 2nd Ed. Cambridge University Press, New Delhi.
3. Telford, W. M., Geldart, L. P. & Sheriff, R. E., (1990) Applied Geophysics. 2nd ed. Cambridge University Press, New Delhi.
4. Todd, D.K., and Mays, L.W., (2013) Groundwater Hydrology, Wiley.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *https://archive.epa.gov/esd/archive-geophysics/web/html/index-7.html*
3. *http://www.geosearches.com/seismic.php*
4. *https://geoinfo.nmt.edu/geoscience/projects/astronauts/gravity_method.html*
5. *https://csegrecorder.com/articles/view/magnetic-and-gravity-methods-in-mineral-exploration*
6. *https://www.omicsonline.org/open-access/groundwater-exploration-for-water-well-site-locationsusinggeophysical-survey-methods-2157-7587-1000226.php?aid=69101*
7. *http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Groundwater%20Exploration_An%20Introduction_TS%20Badrinarayanan.pdf*
8. *http://tsbm.co.in/myworks/mynotes/EngGeology/Structural%20Geology-II%20(Dams%20&%20Tunnels).pdf*
9. *http://ybu.edu.tr/muhendislik/insaat/contents/files/DAMS1(1).pdf*
10. *https://www.ideals.illinois.edu/bitstream/handle/2142/78856/geologicfactorsi13smit.pdf?sequence*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the various methods of Mineral exploration by using electrical method.

CO2: Use of Seismic, Gravitational and Magnetic methods in mineral exploration

CO3: Discuss in detail the petroleum Exploration

CO4: Describe the methods of groundwater exploration

CO5: Outline the basics of engineering geology and its applications.

Course Code &Title	**21GEOU0622 ECONOMIC GEOLOGY - PRACTICAL**		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Examine the Physical properties of the economic important minerals. • To classify the Economic minerals based on chemical composition • To Evaluate the Origin and Occurrences of the Economic minerals • To Summarize the distribution of Economic important minerals		

Contents

Economic Geology:

Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following

a) **Industrial Minerals**: magnesite, gypsum, asbestos, fluorite, calcite, graphite, barite, talc, witherite, strontianite, anhydrite, halite, dolomite, aragonite, kaolin, garnet, corundum, phosphate nodule.
b) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Fe ores**: magnetite, hematite, limonite, pyrite, marcasite and siderite.
c) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Cu ores**: chalcopyrite, cuprite, bornite, malachite, azurite, native copper.
d) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Mn ores**: pyrolusite, psilomelane, rhodochrosite, and rhodonite.
e) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Pb ores:** galena, cerussite, anglesite.
f) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Zn ores**: smithsonite, sphalerite.
g) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Sn ore:** cassiterite
h) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **As and Sb ores**: realgar, orpiment, stibnite
i) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Miscellaneous ores**: wolframite, molybdenite, bauxite, chromite, ilmenite, rutile, cinnabar.
j) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Radioactive Ores**: monazite, zircon, pitchblende, and pyrochlore.

Ore Analysis:

Identification of the following Ore mineral powders qualitatively by using blowpipe methods.

a) Calcite,
b) dolomite,
c) magnesite,
d) gypsum,
e) bauxite,
f) apatite,
o) psilomelane,
p) stibnite,
q) sphalerite,
r) cuprite,
s) wolframite,

g) anhydrite,
h) celestite,
i) barite,
j) magnetite,
k) hematite,
l) chromite,
m) galena,
n) pyrolusite,
t) malachite and smithsonite

Course Outcomes

On completion of Course, the students should be able to

CO1: Identify the physical properties of industrial minerals and Fe ores

CO2: Explain the physical properties of Cu and Mn ores.

CO3: Discuss the physical properties of Pb and Zn ores

CO4: Identify physical properties of Sn, As, Sb ores and radioactive ores

CO5: Analyze the Ore minerals quantitatively.

Course Code &Title	21GEOU06M1 INTRODUCTION TO FIELD GEOLOGY (MODULAR COURSE)		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Introduce the Field geological techniques, • To Examine the topographic maps and • To summarize the field characteristics in the report.		

Unit	Content	Lectures
I	Introduction - Literatures and maps - Destruction of rocks - Physiography - Topographic expressions and relief - Inliers and outliers - requirements of the field - suggestions and precautions. **Equipment and Supplies:** General, Geological Hammers, Pocket and Hand Lenses, Hydrochloric Acid, Streak Plate, Pocket Magnet, Pocket Knife, Measuring Tapes and Scales, Haversack or Rucksack, Mohs Scale of Hardness, Cold Chisel, Protractors, Pocket Calculator, Cameras, Care and Upkeep of Instruments. **The compass and Clinometer:** The compass and its uses- Dip of the compass needle - Magnetic declination **- Clinometer:** Bearing and Reading directions - Measuring altitudes - Handling of the compass.	11
II	**Topographic maps:** Base Maps, Scale of maps – Depiction of relief - Latitudes and Longitudes - Map grids - Measurement of mapped areas- Mounting and folding field maps- Marking on maps. **Field documentation:** Field sketches and Drawings - Field photographs. **Basic field procedures:** Location - Soils and vegetation- measuring distances - Compass and tape traversing - Determination of slopes and gradients- Measuring difference in elevation - Field identification of rocks - Basic field observations.	11

Text Books:

1. Mathur, S. M., (2001) Guide to Field Geology. Prentice Hall India. New Delhi.
2. Compton, R. R., (1985) Geology in the Field, John Wiley & Sons Inc., New Delhi.
3. Gokhale, N.W., (2001) A Guide to Field Geology. CBS Publishers, New Delhi.

Reference Books:

1. Coe, A. L. (ed)., (2010) Geological Field Techniques. Open University Press, Milton Keynes, UK.
2. Barnes, J. W., (2004) Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.
3. Freeman, T., (1999) Procedures in Field Geology. John Wiley & Sons Inc., New Delhi.
4. Lahee, F., (1987) Field Geology, CBS Publishers, New Delhi.

Web Resources:

1. *https://pubs.usgs.gov/gip/7000029/report.pdf*
2. *https://gem-a.com/images/Documents/JoG/2015/JoG-34-8-LR-3.pdf*
3. *http://www.physicalgeography.net/fundamentals/2d.html*
4. *https://pubs.usgs.gov/gip/70039402/report.pdf*
5. *http://www.geographynotes.com/geology-2/structural-geology/uses-of-compass-clinometer-with-diagram-structural-geology/1437.*
6. *https://research.cnr.ncsu.edu/sites/woodlandstewardseries/wp-*
7. *content/uploads/sites/15/2015/03/UsingaCompassandClinometer.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the features of field geology

CO2: Describe the use of topographic maps and field equipment's

Course Code &Title	21GEOU06M1 GEOLOGICAL MAPPING (MODULAR COURSE)		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To introduce the geological mapping techniques and sampling techniques. • To study the fossils in the field. To identify the various structures of igneous, sedimentary and metamorphic rock in the field.		

Unit	Content	Lectures
I	**Geological Mapping:** General considerations - Reconnaissance - Surface features - Cuttings - Quarries and Mines - Unconsolidated and residual deposits - soils. **Systematic Mapping:** Strike and dip - Contacts and boundaries - correlation - Geologic cross- sections - Marking the map - Mapping on Aerial photographs. **Specimens and Sampling:** General - Trimming of Hand specimens - Fossil specimens - Mineral specimens - Samples and sampling - Numbering and labeling of specimens - packing and storage.	11
II	**Study of Fossils and Biogenic structures. Field observations of Sedimentary rocks - Igneous rocks - Metamorphic rocks. Structures:** General, Top and bottom Strata - Joints - Unconformities - folds - faults. **Mineral Investigation and Identification**: General - Geological plan - Sampling - pitting and trenching.	11

Text Books:

1. Mathur, S. M., (2001) Guide to Field Geology. Prentice Hall, India. New Delhi.
2. Compton, R. R., (1985) Geology in the Field, John Wiley & Sons Inc., New Delhi.
3. Gokhale, N.W., (2001) A Guide to Field Geology. CBS Publishers, New Delhi.

Reference Books:

1. Coe, A. L. (ed). (2010) Geological Field Techniques. Open University Press, Milton Keynes, UK.
2. Barnes, J. W., (2004) Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.
3. Freeman, T., (1999) Procedures in Field Geology. John Wiley& Sons Inc., New Delhi.
4. Lahee, F., (1987) Field Geology, CBS Publishers, New Delhi, 1987.

Web Resources:

1. *https://orkustofnun.is/gogn/unu-gtp-sc/UNU-GTP-SC-11-04.pdf*
2. *http://yunus.hacettepe.edu.tr/~kdirik/Barnes%202004%20-%20Basic%20Geological%20Mapping.pdf*
3. *https://profiles.uonbi.ac.ke/cnyamai/classes/sgl-308-introduction-geological-field-mappingfieldwork*
4. *https://www.eolss.net/Sample-Chapters/C01/E6-64-01-04.pdf*
5. *http://funnel.sfsu.edu/students/frankv/gcourses/Students/Nolen%20Brown/FIELD%20METHODS/Geological%20Field%20Techniques.pdf*
6. *http://www.montana.edu/earthsciences/fieldcampprograms/documents/Intro-Field-Mapping_Lageson.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain in detail the Geological mapping and sampling techniques

CO2: Identify and describe the fossils, structures of igneous, sedimentary and metamorphic rocks and minerals in the field.

Course Code &Title	21GEOU06M2 MEDICAL GEOLOGY (MODULAR COURSE)		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Explain the Medical geology, • To understand the geology and its influence on human health • To summarize the medicinal and economic values of minerals		

Unit	Content	Lectures
I	Fundamental Principles of Medical Geology - Public Health and Geological Processes: An Overview of a Fundamental Relationship - Essential and Non-essential Elements with Reference to Human Health - Sources, intake pathways, and uptake of minerals by the human body - Importance and Impact of minerals and Trace Elements on human health. Importance of Medical Geology in present environment.	11
II	Water Hardness and Health Effects. - Uses and medicinal value of following minerals: Magnesite, Gypsum, Calcite, Fossiliferous Limestone, Rock Salt, Orpiment, Realgar, Ferrogenous Shale, Chalcanthite, Rock Salt, Borex, Malachite and Azurite, Salt Petre and Mica, Hematite, Magnetite and Siderite. Medicinal mineral and their economic value.	11

Reference Books:

1. Park, K. (2013) Textbook of Preventive and social medicine, M/s Banaras Bhanot publishers Jabalpur.
2. Dissanayake, C. B., Chandrajith, R. (2009) Introduction to Medical Geology Springer-Verlag.

Reference Books:

1. Centeno, J.A., Finkelman, R.B., Selinus, O., (Eds), (2016) Medical Geology: Impacts of the Natural Environment on Public Health, MDPI AG publishers.
2. Selinus, O., (Ed.)(2013) Essentials of Medical Geology, Springer.

Web Resources:

1. *https://www.redalyc.org/journal/2738/273865670016/html/*
2. https://www.episodes.org/journal/view.html?doi=10.18814/epiiugs/2003/v26i4/001
3. https://www.linkedin.com/pulse/importance-medical-geology-present-environment-nitish-priyadarshi

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the features of medical geology

CO2: Describe the use of medicinal minerals

Course Code &Title	21GEOU06M2 FUNDAMENTALS OF GIS (MODULAR COURSE)		
Class	B. Sc Geology	Semester	VI
Cognitive Level	K-1		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To explain about the GIS • To understand the components of GIS • To summarize the applications of GIS		

Unit	Content	Lectures
I	Introduction - History of GIS - Overview of Information System - Contribution Disciplines - GIS definitions and Terminology - Attributes - Topology - GIS Queries and Architecture - Components of GIS - Functional Elements of GIS - Operations of GIS - Levels and Scales of Measurements.	11
II	Raster and vector data: Raster and Vector data and Models - Raster data: Raster Coding, Resolution, Gridding and Linear features - Raster Precision and Accuracy - Vector Data. Raster and Vector Structures - Raster and Vector Advantages and Disadvantages. Application of GIS.	11

Text Books:

1. Anji Reddy.M.,(2012) Textbook of Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad.
2. Lillesand T.M and Kiefer R.W. (2015) Remote sensing and Image, Interpretation, John Wiley and Sons, INC, New York.

Reference Books:

1. Kang - Tsung Chang, (2002) Introduction to Geographic Information System, Mc Graw Hill, Boston.
2. Gurugnanam, B., (2009) Geographic Information System, New India Publishing Agency.

Web Resources:

1.https://www.saylor.org/site/textbooks/Essentials%20of%20Geographic%20Information%20Systems.pdf

2. https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesGIS.pdf
3. http://www.geografie.webzdarma.cz/GIS-skriptum.pdf
4. https://eos.com/blog/gis-mapping/

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the features of GIS

CO2: Describe the elements of GIS

Course Code &Title	21GEOU04E1 INTRODUCTION TO REMOTE SENSING AND GIS (DISCIPLINE CENTRIC)		
Class	B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To introduce the principles of Remote Sensing and the characteristics of Electromagnetic radiation • To Learn about the types of sensors • To Learn about the Geometry and types of Aerial Photography • To Describe the application of remote sensing in various disciplines • To Describe the fundamentals of Geographic Information System		

Unit	Content	Lectures
I	**Fundamental Concept of Remote sensing:** Early history - Electromagnetic energy - Characteristics of Electromagnetic Energy - Energy interactions with earth surface features: vegetation, soil, water, snow and clouds. **Remote sensing platforms and sensors :** Satellite system parameters, Instrumental parameters, viewing parameters, sensor parameters.	12
II	**Sensor systems used in remote sensing: Passive systems:** Imaging and non-imaging sensors, Photographic camera, Television camera, Return beam vision, Electro optical scanner, **Active systems:** Imaging and non-imaging sensors, Radar**. Remote sensing data acquisition. Reference data. Remote Sensing satellites: Landsat - Indian remote sensing satellites. Indian meteorological satellites**	12
III	**Aerial Photography:** Types of Aerial photographs - Oblique, Vertical - Geometry of aerial photographs: Drift, Crab and Stereo pair. Scale of Photographs: Determination of scale - Relief displacement - Stereoscopes – Parallax Bar–Mosaic.	12
IV	**Remote Sensing Applications:** Mineral resources - Mapping of Land use/Landcover - Agriculture - Forestry - Water resources: Detection of water pollution - - Monitoring Environmental hazards- Climate, Environment, Disaster management Indian satellites and its specifications.	12
V	**Geographic Information System:** Content of GIS - Use of Remote Sensing data in GIS - Spatial elements, data encoding and storage - Data manipulation - Data output	12

Text Books:

1. Guha, P.K., (2003) Remote Sensing for the Beginner, Affiliated East- west press Pvt Ltd, New Delhi.
2. Curran, P.B., (1985) Principles of Remote Sensing. ELBS. London.

Reference Books:

1. Pandey, S.N. (1989) Principles and Applications of Photo geology Wiley Eastern. New Delhi.
2. Lillesand, T.M & R.W. Kiefer., (2000) Remote Sensing and Image Interpretation, Wiley, Delhi.
3. Sabins, F.F., (1974) Remote Sensing Principles and Interpretation. Freeman, New York.
4. Reddy, A., (2010) Principles of Remote Sensing and GIS. CBS. Delhi.

5. Kumar, S., (2005) Basics of Remote sensing and GIS, USP/Laxmi Publications (P) Ltd., New Delhi
6. Anji Reddy, M. (2006) Remote sensing and Geographical Information systems, BS Publications Books, Hyderabad.

Web Resources:

1. *http://sar.kangwon.ac.kr/etc/rs_note/rsnote/cp1/cp1-1.html*
2. *https://www.uprm.edu/biology/profs/chinea/gis/g06/NRC2_1_2_9.pdf*
3. *https://gisgeography.com/passive-active-sensors-remote-sensing/*
4. *https://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/air-photos/-aerial-photography/9687*
5. *https://www.environmentalscience.org/principles-applications-aerial-photography*
6. *https://www.tankonyvtar.hu/en/tartalom/tamop425/0027_DAI6/ch01s05.html*
7. *http://grindgis.com/remote-sensing/remote-sensing-applications*
8. *https://researchguides.library.wisc.edu/GIS*
9. *https://gisgeography.com/what-gis-geographic-information-systems.*
10. *www.isro.gov.in*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the fundamentals of Remote Sensing and Electromagnetic radiation

CO2: Discuss the various types of Sensor systems

CO3: Describe the aerial remote sensing and its types

CO4: Evaluate the Application of Remote sensing in various fields

CO5: Outlines of Geographic Information System.

Course Code &Title	**21GEOU04E2 MICROPALAEONTOLOGY (DISCIPLINE CENTRIC)**		
Class	B. Sc Geology	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Describe the history of microfossil studies • To Classify and explain the types of microfossils • To define the multidisciplinary uses of various microfossils • To Estimate the correlation of microfossils with economy • To Describe the basics of nanofossils and uses.		

Unit	Content	Lectures
1	Introduction to Micropalaeontology: History and significance; Microfossils, Marine environments – Palaeoecology – Microfossils and sedimentation. **Calcareous Microfossils**: Foraminifera - Planktic foraminifera, their modern biogeography, outline of morphology, significance in Cenozoic oceanic biostratigraphy and paleoceanographic, paleoclimatic interpretations; Benthic foraminifera - their brief morphology and application in bottom water paleoceanography and paleobathymetric reconstructions; Larger foraminifera, their outline of morphology and application in Indian stratigraphy;	**12**
II	**Ostracoda** - outline of morphology and wall structure, their significance in environmental studies and oceanic biostratigraphy; **Pteropoda** - a brief introduction, application of pteropods in reconstruction of the Quaternary oceanography and climate; A brief introduction of calpionellids and calcareous algae.	**12**
III	**Siliceous Microfossils**: Radiolaria, diatoms and silicoflagellate - outline of morphology, modern biogeography, their environmental significance and application in biostratigraphy. **Phosphatic Microfossils:** Conodonts - outline of morphology, paleoecology, geological significance and biological affinities; Stratigraphic significance of conodonts with special reference to India. Introduction to Organic walled microfossils and their biostratigraphic and palaeoenvironmental significance.	**12**
IV	Microfossils: Utility in dating, biozonation, biostratigraphic correlation; biozones and their types. Concepts and methods for the development of micropaleontological indicators in reconstruction of palaeohistory, environmental changes and biostratigraphic correlation.	**12**
V	Nannofossils: Introduction, history of study and significance of various groups of nannofossils. Sampling and methods of separation of nannofossils; Types of Nanoliths: Nanoplanktons, Discoasters, Nanoconids; Applications of microfossils in biostratigraphy, palaeoenvironmental interpretation and sequence stratigraphy. Role of micropalaeontology in hydrocarbon exploration. Determination and correlation of paleofacies by microfossils.	**12**

Text Books:

1. Woods, H. (1961) Invertebrate Palaeontolgy. Cambridge University Press.
2. Brasier, M.D. (1980) Microfossils. George Allen & Unwin.
3. Raup, D.M. and Stanely, M.S. (1978) Principles of Palaeontology. CBS Publishers.
4. Bignot, G. (1985): Elements of MicroPalaeontology, Graham & Trotman, London, 212 p.

5. Armstrong, H.A. and Brasier, M.D. (2005) Microfossils, II Edition, Blackwell Publishing.
6. Cushman, J. A. (1947): Foraminifera Their Classification & Economic Uses, Harvard Univ.
7. Glassener, M. F. (1945): Principles of MicroPalaeontology, Haftner Press, New York, 645 p.

Reference Books:

1. Saraswati, P. K. & Srinivasan, M. S. (2016): Micropaelontology, Principles & Applications, Springer, 224p.
2. Kathal, P. K. (2012): Applied Geological Micropaleontology, Scientific Publishers, 230 p. New Delhi-Jodhpur.
3. Murray, John, (2006): Ecology & Application of Benthic Foraminifera, Cambridge University Press, 426 p.
4. Clarkson, E. N. K. (1979 & 2002), Invertebrate Paleontology & Evolution, London Gorge Allen & Unwin, 323 p.
5. Sen Gupta, B. K. (1998): Modern Foraminifera, Kluwer Academic Publishers, 371 p.
6. Loelich, A. R. (Jr.) & Tappan, J. (1988): Foraminifera Genera & Their Classification (v. 1 & 2), Van Nostrand Renhold. 970 p., pls. 847.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000010ES/P001694/M020138/ET/1494502494046.N011.ES07-273BiostratigraphyANReddy.pdf*
3. *https://ucmp.berkeley.edu/fosrec/Lipps1.html*
4. *https://www.slideshare.net/pramodgpramod/nano-fossils-and-its-significance-in-nano-geoscience*
5. *https://www.slideshare.net/pramodgpramod/nano-fossils*

Course Outcomes

On completion of Course, the students will be able to

CO1: Understand the origin and occurrence of microfossils

CO2: Classify types and characters of microfossils.

CO3: Describe the morphology, distribution and uses of individual microfossils.

CO4: Analysis the process related with formation of microfossils.

CO5: Outlines of Nano fossils and their significance.

Course Code &Title	21GEOU05E1 MINING GEOLOGY (DISCIPLINE CENTRIC)		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Introduce fundamental concepts of various mining methods • To Assess the Explosives used in the mining • To Classify the types of mining and • To Describe the ore separation process and the geological sampling methods • To explain the economic oriented mine planning techniques.		

Unit	Content	Lectures
I	**Introduction to Mining Methods** - **Mining terminologies**: Development –Shaft sinking – Hanging wall – Adit – Drive – Level – Cross cut – Tunnel – Raise – Winze- Stope- Ventilation stopping – Fire stopping –**,** drifting, sloping, Mine subsidence, mine support, room & piller, mining hazards, mine inundation, rock blast **- Excavations and its types**. **Drilling:** Percussion drills – Rotary drills – Miscellaneous drilling methods – drill sampling.	12
II	**Explosives**: Low explosives – High explosives – sheathed explosives – permitted explosives – Liquid oxygen – AN/FO and slurry types. **Classification of mining methods: *Alluvial mining*:** Pan and batea – Rocker **–** Longtom – Sluicing- Derrick and cableway – Hydraulicking – Drift mining- Dredging. **Preparation of mine plans and sections.**	12
III	**Opencast mining:** Loading by manual – Loading by machines- Glory hole – Kaolin mining. **Underground mining -** Open stopes: Overhand stopping: Timbered stopes – Filled stopes – Shrinkage stopes – Mitchell slicing system. **Caving methods:** Top slicing – sub level caving – Block caving.	12
IV	**Coal mining methods:** Pillar method – Longwall advancing – Longwall retreating – Horizon mining – Underground hydraulic mining – strip mining. **Sampling:** Coning and quartering- Diamond drill sampling – Sampling placers.	12
V	**Ore dressing**: Crushing – Grinding – Sizing – classification – Air sizing – Electrical Precipitation of dust. **Concentration**: Washing and scrubbing – Gigging – Tabling – Vanners - Floatation. **Magnetic separation: Electrostatic separation. Environmental impacts by mining industries and reclamation techniques.**	12

Text Books:

1. Arogyaswamy., R.N.P., (1995) Courses in Mining Geology, CBS Publishers & Distributors Pvt. Ltd, New Delhi.
2. Parbin Singh., (2013) Engineering and General Geology, S. K. Kataria & Sons, New Delhi.

Reference Books:

1. Thomas, R. T., (1986) Introduction to mining Methods, McGraw Hill, New York.
2. Peters, W. C., (1978) Exploration and mining Geology, Wiley, New York.
3. McKinstry, H. E., (1948) Mining Geology, Asia Publishing House, Delhi.
4. Gaudin, A. M., (1939) Principles of Mineral Dressing, TMH, Delhi.
5. Taggart, A. F., (1945) Handbook of Mineral Dressing, Chapman and Hall, Delhi.

Web Resources:

1. *Underlined Titles are available in Swayam portal.*
2. *http://www.aadnc-aandc.gc.ca/eng/1100100028056/1100100028058*

3. *https://everydayoil.wordpress.com/2012/11/16/different-types-of-drilling-and-its-breif-description/*
4. *http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf.*
5. *https://www.americangeosciences.org/critical-issues/faq/what-are-main-mining-methods*
6. *http://emfi.mines.edu/emfi2011/Coal%20Mining%20Methods%20-%20EMFI%20Summary.pdf*
7. *https://www.kau.edu.sa/Files/0052737/Subjects/(8)%20Ore%20processing%20(beneficiation).pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the basics of mining Geology

CO2: Discuss the Various mining methods

CO3: Describe the Opencast mining

CO4: Discuss the Coal mining methods

CO5: Outline the Ore separation processes.

Course Code &Title	21GEOU05E2 EARTH AND CLIMATE (DISCIPLINE CENTRIC)		
Class	B. Sc Geology	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Analyze the climate system • To Classify the layers of Atmosphere • To Evaluate the Climate changes • To Explain Orbital Cyclicity and Climate • To Summarize mechanism of Monsoon.		

Unit	Content	Lectures
I	**Climate System: Forcing and Responses:** Components of the climate system. Climate forcing, Climate controlling factors. Climate system response, response rates and interactions within the climate system. Feedbacks in climate system. **Heat budget of Earth:** Incoming solar radiation, receipt and storage of heat transformation. Earth's heat budget. Interactions amongst various sources of earth's heat.	12
II	**Atmosphere – Hydrosphere:** Layering of atmosphere and atmospheric Circulation. Atmosphere and ocean interaction and its effect on climate. Heat transfer in ocean. Global oceanic conveyor belt and its control on earth's climate. Surface and deep circulation. Sea ice and glacial ice.	12
III	**Response of Biosphere to Earth's Climate:** Climate change: natural vs. anthropogenic effects. Humans and climate change. Future perspectives. Brief introduction to archives of climate change. Brief introduction to palaeoclimate. Palaeoclimate data from India.	12
IV	**Orbital Cyclicity and Climate:** Milankovitch cycles and variability in the climate. Glacial-interglacial stages. The last glacial maximum (LGM). Pleistocene Glacial-Interglacial cycles. Younger Dryas. Isotope Palaeontology.	12
V	**Monsoon:** Mechanism of monsoon. Monsoonal variation through time. Factors associated with monsoonal intensity. Effects of monsoon.	12

Text Books:

1. Rudiman, W.F., (2001) Earth's climate: past and future, Edition 2, Freeman Publisher.
2. Rohli, R.V., and Vega, A.J., (2007) Climatology. Jones and Barlatt.

Reference Books:

1. Lutgens, F., Tarbuck, E., and Tasa, D., (2009) The Atmosphere: An Introduction to Meteorology. Pearson Publisher.
2. Aguado, E., and Burt, J., (2009) Understanding weather and Climate. 5th Edition, Pearson Publisher
3. Dorothy Merritts, Kirsten Menking and Andrew deWet, (2014) Environmental Geology: An Earth Systems Science Approach. Edition 2, W.H. Freeman and Co Ltd.

Web Resources:

1. *http://funnel.sfsu.edu/students/frankv/gcourses/Students/Adam%20Rincon/Earths_Climate-Past_and_Future.pdf*
2. *http://nas-sites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf*
3. *http://danida.vnu.edu.vn/cpis/files/Books/Atmosphere%20Weather%20and%20Climate%208th%20ed%20-%20R%20Barry%20R%20Chorley%20%20Routledge%202003%20WW.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain fundamental concept of Climate system

CO2: Discuss the various layers of Atmosphere

CO3: Describe Earth's climatic conditions

CO4: Understand the variability in the climate

CO5: Outlines of mechanism of monsoon variations

ELECTIVES : GENERIC

Course Code &Title	**21GEOU03N1 ENGINEERING GEOLOGY (GENERIC)**		
Class	B.Tech Civil Engineering	Semester	III
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Understand the basics of Geology • To Describe the various minerals • To Describe the various rock types • To illustrate the various types of structures • To Summarize the application of Geology in Engineering construction		

Unit	Content	Lectures
I	**GENERAL GEOLOGY:** Geology in Civil Engineering – Branches of Geology – Earth Structures and Composition – Elementary Knowledge on Continental Drift and Plate Tectonics. Earth Processes – Weathering – Geological Work of Rivers, Wind and Sea and their Engineering Importance – Earthquake Belts in India. Groundwater – Mode of Occurrence – Prospecting – Importance in Civil Engineering.	13
II	**MINERALOGY:** Elementary Knowledge on Symmetry Elements of Important Crystallographic Systems– Physical Properties of Minerals – Study of the Following Rock Forming Minerals – Quartz Group, Feldspar Group, Pyroxene Group, Amphibole Group and Mica Group. Fundamentals of Process of Formation of Ore Minerals – Identification of Minerals - Coal and Petroleum – Their Origin and Occurrence in India.	13
III	**PETROLOGY**: Classification of Rocks – Distinction between Igneous, Sedimentary and Metamorphic Rocks. Description of Structures, Textures and Mode of Occurrence, Engineering Properties, Distribution and uses of following rocks. Igneous Rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt; Sedimentary Rocks - Sandstone, Limestone, Shale, Laterite, Conglomerate and Breccia; Metamorphic Rocks - Quartzite, Marble, Slate, Phyllite, Gneiss, Charnockite and Schist – Identification of Rocks.	13
IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD:** Attitude of Beds – Outcrops – Introduction to Geological Maps – Study of Structures – **Folds**: Parts, classification of folds, Causes of folding. **Faults:** Parts, classification of fold, Causes of folding. **Joints:** Classification and Occurrence and origin of joints – Importance of structures on Engineering Construction. Seismic and Electrical Methods for Civil Engineering Investigations.	13
V	**GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones - Improvement of sites. Causes and Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	13

Text Books:

1. Parbin Singh., (2012) Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint.
2. Chennakesavalu N., (2009) Textbook of Engineering Geology, Macmillan India ltd.,
3. Venkat Reddy D., (2010) Engineering Geology, Vikas Publishers.

Reference Books:

1. Krynine and Judd., (2005) Engineering Geology and Geotechniques, CBS Publisher.
2. Tyrrell., (1989) Principles of Petrology, B.I. Publications.
3. Billings P Marland., (2008) Structural Geology, 3rd Edition, PHI Learning.
4. Varghese P. C., (2012) Engineering Geology for Civil Engineers, PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi.

Web Resources:

1. *https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf*
2. *http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf*
3. *http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf*
4. *http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf*
5. *http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf*
6. *http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf*
7. *http://www.subsurfacesurveys.com/pdf/Methods.pdf*
8. *http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf*
9. *http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf*
10. *https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf*
11. *https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf*
12. *http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf*
13. *http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf*
14. *http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf*

Course Outcomes

On completion of Course, the students should be able to

CO1: Describe the importance of Geology in Civil Engineering

CO2: Assess the role of structural features and rocks in civil constructions

CO3: Describe the different types of minerals and rocks

CO4: Predict the natural disasters to prevent failure of Civil Projects

CO5: Describe the investigating techniques for site selection

Course Code &Title	21GEOU04N1 DISASTER MANAGEMENT (GENERIC)		
Class	B. Sc	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Explain the origin and interior of the earth. To Classify the various types of Natural Disasters • To Describe the man induced Disasters and its impacts. • To Mitigate them from various disasters. • To Know about the disaster management in India.		

Unit	Content	Lectures
I	**Introduction to Earth Sciences and Natural Disasters**: Origin of the earth, Interior of the Earth. Endogenic processes and exogenic processes of the Earth. Geological Time Scale. Definition of Disaster, Nature and Socio-Economic Factors – Relations. Types of Disasters	12
II	**Natural Disasters; Earthquakes**: Seismic waves, Origin, Classification and Causes of Earthquake, Earthquake Intensity Scale. **Landslides:** Morphology and classification - **Volcanoes:** Structure, Classification and Products of Volcanoes. **Tsunami Disaster**, **Cyclone Disaster.**	12
III	**Man Induced Natural Disasters; Deforestation and its impacts, Drought Disaster**: Types of droughts and its management, and **climate change: cause, effects** and its management. Other disasters and their management. **Flood Hazard: Primary and secondary effects and** Occurrence of Floods in India.	12
IV	**Disaster Mitigation:** Mitigation strategies for earth quakes, landslides, floods, tsunami. cyclone, drought, climate change. Industrial environmental disaster: pollution. Gas leakage - chemical and fire accident. Human disaster: road and rail accidents, Biological Disasters,	12
V	**Disaster Management:** Introduction, Disaster Management Cycle. Four Phases of disaster management (Mitigation, Preparedness, Response and Recovery) **Disaster Risk Management in India**: hazards and vulnerability profile of India – Institutional Arrangements Disaster Management (DM) act and Policy: DM Act, SDMA, DDMA and Local authorities.	12

Text Books:

1. Dhawan, N.G., Khan, A.S., (2014) Disaster Management and Preparedness, CBS Publishers and Distributors, New Delhi.
2. Parbin Singh., (2009) A Text Book Of Engineering and General Geology, Publishers of Engineering and Computer Books.
3. Mukerjee. P.K., (1997) A Textbook of Geology, Thirteenth Edition. The World Press Pvt. Ltd.

Reference Books:

1. Mahapatra, G.B., (1987) A Text Book of Geology, CBS Publishers and Distributors, New Delhi.
2. Jonathan Turk and Thompson, G.R., (2000) Environmental Geoscience, Saunders College Division.
3. Karan, P.P., Subbiah, S.P., (2012) The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd.
4. Santra S.C., (2004) Environmental Science, New Central Book Agency.

5. Schneid, T.D., (2001) Disaster Management and Preparedness" Tata McGraw Hill, New Delhi.
6. Jain, V.K., (2005) Earth Science, CBS Publishers and Distributors, New Delhi.
7. Janet Edwards and Martin Gustafsson., (2007) Handbook for Vulnerability Mapping. Serdish Rescue Services Agency.

Course Outcomes

On completion of Course, the students should be able to

CO1: *Understand the interior and exogenic and endogenic processes of earth.*

CO2: *Recognize the sources and their effects for the natural disasters*

CO3: *Recognize the sources and its impacts of man induced disasters.*

CO4: *Identify the mitigation measures for the natural disasters*

CO5: *Understand the* Disaster Risk Management in India.

Course Code &Title	21GEOU04N2 APPLIED GEOLOGY (GENERIC)		
Class	B. Sc	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the basics of Geology • To Describe the various group of minerals • To Describe the types of rocks • To illustrate the various types of structures • To Summarize the application of Geology in Engineering construction		

Unit	Content	Lectures
I	**GENERAL GEOLOGY:** Branches of Geology – Earth Structures and Composition – Elementary Knowledge on Continental Drift and Plate tectonics. Earth Processes – Weathering – Geological Work of Rivers, Wind and Sea – Earthquake Belts in India. Groundwater – Mode of Occurrence – Prospecting.	12
II	**MINERALOGY:** Elementary Knowledge on Symmetry Elements of Important Crystallographic Systems – Physical Properties of Minerals – Study of the Following Rock Forming Minerals – Quartz Group, Feldspar Group, Pyroxene Group, Amphibole Group and Mica Group. Fundamentals of Process of Formation of Ore Minerals – Coal and Petroleum :Their Origin and Occurrence in India.	12
III	**PETROLOGY**: Classification of Rocks – Description of Structures, Textures, Mode of Occurrence, Distribution and uses of following rocks. Igneous Rocks Granite, Gabbro, and Basalt; Sedimentary Rocks - Sandstone, Limestone, and Conglomerate. Metamorphic Rocks: Marble, Slate, Gneiss, and Schist.	12
IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD:** Attitude of Beds – Outcrops – Introduction to Geological Maps – Study of Structures – Folds: Parts, classification of folds, Causes of folding. Faults: Parts, classification of faults, Causes of faulting. Joints: Classification and Occurrence and origin of joints. Seismic and Electrical Methods for Geological prospecting.	12
V	**GEOLOGICAL INVESTIGATIONS:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones - Improvement of sites. Causes and Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	12

Text Books:

1. Parbin Singh., (2012) Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint.
2. Venkat Reddy D., (2010) Engineering Geology, Vikas Publishers.

Reference Books:

1. Krynine and Judd., (2005) Engineering Geology and Geotechniques, CBS Publisher.
2. Tyrrell., (1989) Principles of Petrology, B.I. Publications.
3. Billings P Marland., (2008) Structural Geology, 3rd Edition, PHI Learning.
4. Varghese P. C., (2012) Engineering Geology for Civil Engineers, PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi.

Web Resources:

1. *https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf*
2. *http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf*
3. *http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf*
4. *http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf*
5. *http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf*
6. *http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf*
7. *http://www.subsurfacesurveys.com/pdf/Methods.pdf*
8. *http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf*
9. *http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf*
10. *https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf*
11. *https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf*
12. *http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf*
13. *http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf*
14. *http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf.*

Course Outcomes

On completion of Course, the students should be able to

CO1: Explain the internal structure of the Earth and plate tectonics.

CO2: Discuss the various minerals and their physical properties

CO3: Identify the igneous, metamorphic and sedimentary rocks.

CO4: Evaluate the structural features of the Earth

CO5: Discuss the Geological investigations for the construction of dams and reservoirs.

Course Code &Title	21GEOU05N1 ENVIRONMENTAL GEOSCIENCES (GENERIC)		
Class	B. Sc	Semester	V
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To Explain the Scope and importance of Environmental science • To understand the Natural Resources and its related problems. • To Illustrate the concept and types of Ecosystem • To Assess various types of Pollution and control measures • To Describe the Disaster Mitigation and Management		

Unit	Content	Lectures
I	**Environment Geology –** Definition, Importance and its Scope. Need for Public Awareness. **Natural Resources:** Renewable & Non-Renewable Resources and its Associated Problems. **Forest Resources**: Uses and impacts of deforestation -Types of forest in India.	12
II	**Water Resources:** Uses and over Exploitation of Surface and Groundwater, Flood, Drought. Dams, Benefits and Problems. **Mineral Resources:** Introduction and types of Exploitation, Effects of Extraction on Environment.	12
III	**Land Resources:** Land Degradation, Man induced landslides, **Soil Erosion:** Cause, effect and mitigation Measures. Desertification. Role of Individual in Conservation natural Resources, Equitable use of resources for sustainable lifestyle.	12
IV	**Ecosystem:** Concept of an Ecosystem, Structure and function of an ecosystem. Forest, Grass land, Desert, Aquatic Ecosystem. **Cause, effects and control measures** of Air pollution, Marine pollution and Noise pollution.	12
V	**Cause, effects and control measures** of Thermal pollution-Nuclear hazards- Solid waste management. Role of Individual in prevention of Pollution. **Disaster management:** Floods, Earthquakes, Cyclone and Landslides.	12

Text Books:

1. Arul. P, (2011) Text Book of Environmental Studies, Selvi publications, Thanjavur.
2. Bangar, K.M., (2010) Principles of Engineering Geology, Nem Chand Jain Publishers.

Reference Books:

1. Grija Bhushan Mahapatra, (1987) A Text Book of Geology, CBS Publishers and Distributors, New Delhi.
2. Jonathan Turk and Graham R. Thompson, (2000) Environmental Geoscience, Saunders college division.
3. Parbin Singh, (2009) A text book of Engineering and general Geology, publishers of engineering and computer books.
4. Pradyumna, P. Karan, Shanmugam, P. Subbiah., (2012) The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd.
5. Santra S.C, (2004) Environmental Science, New central book agency.
6. Thomas D. Schneid, (2001) Disaster Management and Preparedness" Tata McGraw Hill, New Delhi.
7. Vinod K. Jain, (2005) Earth Science, CBS Publishers and Distributors, New Delhi.

Course Outcomes

On completion of Course, the students should be able to

CO1: Understand the importance of Environmental science

CO2: Utilize the various natural resources wisely

CO3: Prepare the mitigation measures for the land degradation.

CO4: Understand different types of ecosystem.

CO5: Apply the suitable precautionary methods for disasters.

ALLIED COURSES

Course Code &Title	**21GEOU03A1 ALLIED GEOLOGY - I**		
Class	B. Sc	Semester	III
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the basics of Geology • To Describe the Structural Geology • To Describe the various types of Crystals • To illustrate the minerals and their occurrences		

Unit	Content	Lectures
I	**General Geology:** Definition and Scope of Geology. Origin of Solar System: Nebular and Planetesimals hypotheses. Introduction and outline of constitution and composition of earth's interior. Brief account of the important methods of determining the age of the Earth. Earthquakes and their effects. Short note on Seismograph and Seismogram. Richter's scale of earthquake intensity. Brief account of volcanoes.	12
II	**Structural Geology:** Definition and scope of Structural Geology. Concept of rock outcrop - definition of dip and strike of rock formations. Folds: Definition and parts of a fold. Brief description of the following fold types: anticline, syncline, symmetrical, asymmetrical, isoclinal and recumbent folds. Brief description of the following fold systems: anticlinorium and synclinorium. Faults: Definition and parts of a fault. Brief description of the following types of faults: normal, reverse, strike, dip, oblique, parallel and steep faults. Brief outline of joints and unconformities.	12
III	**Crystallography:** Definition of crystallography and crystals. Morphological characters of crystals: Faces - forms - edges. Symmetry elements of crystals: Axis, plane and center of symmetry. Miller's indices. Study of the following crystal systems: normal classes of the cubic, tetragonal, orthorhombic, monoclinic and triclinic systems.	12
IV	**Mineralogy I:** Definition of mineralogy and mineral. Outline of physical properties of minerals: Color, form, luster, hardness, cleavage, fracture and specific gravity. Description of the following minerals: Quartz. Orthoclase - Microcline - Albite - Labradorite - Anorthite. Nepheline - Leucite - Sodalite. Enstatite - Hypersthene - Augite - Dipside.	12
V	**Mineralogy II:** Description of the following minerals: Hornblende - Actinolite - Tremolite - Muscovite - Biotite - Chlorite. Topaz - Olivine - Serpentine - Talc. Tourmaline - Beryl - Apatite - Corundum. Garnet - Diamond - Apatite - Staurolite - Sillimanite - Epidote.	12

Text Books:

1. Parbin Singh., (2012) Engineering and General Geology", S.K. Kataria & Sons,
2. Venkat Reddy D., (2010) Engineering Geology, Vikas Publishers.

Reference Books:

1. Krynine and Judd., (2005) Engineering Geology and Geotechniques, CBS Publisher.
2. Tyrrell., (1989) Principles of Petrology, B.I. Publications.
3. Billings P Marland., (2008) Structural Geology, 3rd Edition, PHI Learning.
4. Varghese P. C., (2012) Engineering Geology for Civil Engineers, PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi.

Web Resources:

1. *https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf*
2. *http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf*
3. *http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf*
4. *http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf*
5. *http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf*
6. *http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf*
7. *http://www.subsurfacesurveys.com/pdf/Methods.pdf*
8. *http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf*
9. *http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf*
10. *https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf*
11. *https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf*
12. *http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf*
13. *http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf*
14. *http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf.*

Course Outcomes

On completion of Course, the students should be able to

CO1: Understate the importance of Earth Science

CO2: Discuss the various Earth's structures

CO3: Describe the characters of the crystals

CO4: Evaluate the mineralogical characters

Course Code &Title	**21GEOU03A2** **ALLIED GEOLOGY – PRACTICAL I**			
Class		B. Sc	Semester	III
Cognitive Level	K-1 K-2 K-3			
Course Objectives	**The Course aims** • To know the basic principles of Crystallography and their forms • To describe Mineralogy • To classify the various types of minerals and their uses.			

Contents

Crystallography: Simple forms of the Normal classes of the different crystal systems and models representing the following minerals: **Cubic system**: Galena, fluorite and garnet. **Tetragonal system**: Zircon, Cassiterite. **Hexagonal system**: Beryl. **Orthorhombic system**: Barite, sulfur, staurolite. **Monoclinic system**: Gypsum. **Triclinic System**: Axinite.

Mineralogy: Identification and physical description of the following minerals: **Quartz group**: rock crystal, chalcedony, agate, jasper, flint. **Feldspar group**: orthoclase, microcline, albite, perthite. **Pyroxene group**: augite, hypersthene. **Amphibole group**: hornblende, tremolite, actinolite. **Mica group**: muscovite, biotite, chlorite. **Other silicate minerals**: olivine, garnet, beryl, tourmaline, Staurolite. **Non-silicates**: corundum, apatite. **Ore minerals**: magnetite, chromite, bauxite, pyrolusite, pyrite, galena, hematite. **Industrial minerals**: talc, asbestos, Magnesite, barite, gypsum. **Coal varieties**: peat, lignite, bituminous, and anthracite.

Course Outcomes

On completion of Course, the students should be able to

CO1: Describe the various types of Crystals

CO2: Identify the various types of minerals

CO3: Describe the ore and industrial minerals.

Course Code &Title	**21GEOU04A3 ALLIED GEOLOGY - II**		
Class	B. Sc	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To understand the basics of Palaeontology • To Describe the Stratigraphy • To Describe Petrology • To illustrate the Economic minerals and their occurrences		

Unit	Content	Lectures
I	**Palaeontology:** Definition of Palaeontology and fossils. Outlines of modes of preservation in sedimentary rocks. Brief account of the uses of fossils. Study of the morphological characters and geological age of the following fossil groups: Pelecypods, gastropods, cephalopods, brachiopods, corals and trilobites**.**	12
II	**Stratigraphy:** Definition and scope of Stratigraphy. Outline of the Geological Time scale. Brief account of the following geological formations in India: Dharwar Group, Cuddapah Group, Vindhyan Group, Gondwana Group, Cretaceous formations of Tiruchirapalli and Karewa formation.	12
III	**Igneous Petrology**: Definition of Igneous petrology and igneous rocks. Forms of Igneous rocks: Sill, lopolith, laccolith, phacolith, dyke and batholith. Brief description of the following igneous rocks: dunite, pyroxenite, gabbro, dolerite, syenite, granite, pegmatite, aplite, andesite and basalt.	12
IV	**Sedimentary petrology:** Definition of sedimentary rocks and sedimentary petrology. Primary structures of sedimentary rocks: common bedding, cross bedding, current bedding, graded bedding. Surface structures: ripple marks, mud cracks, and rain prints. Brief description of the following sedimentary rocks: Sandstone, arkose, grit, shale and limestone**.** **Metamorphic Petrology:** Definition of metamorphic rocks. Metamorphism and metamorphic process. Agents of metamorphism. Brief description of the following metamorphic rocks: Slate, phyllite, schist, gneiss, marble, quartzite, granulite, and amphibolite.	12
V	**Economic Geology:** An outline of the following process of Ore formation: magmatic - hydro thermal - placer - marine evaporites. Brief description of the physical properties and Indian occurrences of the following ore and industrial minerals: graphite, bauxite, magnesite, hematite, magnetite, chromite, gold, pyrolusite, pyrite, galena, asbestos, gypsum, chalk, calcite, dolomite, barite and kaolin. Brief description of the following coal types: peat, lignite, bituminous and anthracite. Brief introduction to petroleum, its origin and occurrences in India.	12

Text Books:

1. Parbin Singh., (2012) Engineering and General Geology", S.K. Kataria & Sons,
2. Venkat Reddy D., (2010) Engineering Geology, Vikas Publishers.

Reference Books:

3. Krynine and Judd., (2005) Engineering Geology and Geotechniques, CBS Publisher.
4. Tyrrell., (1989) Principles of Petrology, B.I. Publications.
5. Billings P Marland., (2008) Structural Geology, 3rd Edition, PHI Learning.

6. Varghese P. C., (2012) Engineering Geology for Civil Engineers, PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi.

Web Resources:

1. *http://www.biologydiscussion.com/articles/geological-time-scale-meaning-divisions-and-events/22622*
2. *http://www.uno.edu/cos/earth-environmental-sciences/ees-docs/ClassResources/Lab6_Fossilization.pdf*
3. *https://sites.google.com/site/paleoplant/home/what-is-paleobotany*
4. *http://eps.mcgill.ca/~courses/c240/W3_L1.pdf*
5. *https://www.gktoday.in/academy/article/indias-rock-formation-archean-dharwar-cudappah-vindhyan-gondwana-and-tertiary-rocks/*
6. *https://www.pmfias.com/indian-rock-system-archaean-purana-dravidian-aryan-rock-system/*
7. *https://flexiblelearning.auckland.ac.nz/rocks_minerals/rocks/*
8. *http://www.indiana.edu/~geol105/images/gaia_chapter_5/igneous_rock_textures.htm*
9. *https://www.tulane.edu/~sanelson/eens212/intro&textures.html*

Course Outcomes

On completion of Course, the students should be able to

CO1: Understate the importance of Palaeontology and Stratigraphy

CO2: Discuss the Igneous Petrology

CO3: Discuss the Sedimentary petrology

CO4: Discuss the Metamorphic Petrology

CO5: Evaluate the Economic minerals uses, origin and distribution.

Course Code &Title	**21GEOU04A4** **ALLIED GEOLOGY – PRACTICAL II**		
Class	B. Sc	Semester	IV
Cognitive Level	K-1 K-2 K-3		
Course Objectives	**The Course aims** • To know the basic principles of Crystallography and their forms • To describe Mineralogy • To classify the various types of minerals and their uses.		

Contents

Petrology: Identification and physical description of the following rocks:

Igneous rocks: granite, pegmatite, syenite, diorite, gabbro, dolerite, dunite, pyroxenite. **Metamorphic rocks**: slate, mica schist, chlorite schist, hornblende gneiss, garnet-mica gneiss, granulite, marble.

Sedimentary rocks: sandstone, conglomerate, arkose, grit, shale, limestone.

Fossils: Identification and physical description of the following fossils: **Pelecypods**: meretrix, arca, pecten, ostrea. **Gastropods**: turritella, natica, turbo, conus. **Cephalopods**: nautilus, acanthoceras. **Brachiopods**: terebratula, spirifer. **Trilobites:** calymene, paradoxites. **Corals:** lithostrotion. **Plant fossils:** glossopteris, ptillphyllum.

Geological maps: Geological maps drawing exercises: drawing strike lines and determining dip amounts. Outcrop completion geological maps with conformable series of beds. Preparation of geological sections for conformable series of beds.

Course Outcomes

On completion of Course, the students should be able to

CO1: Classify the rock types

CO2: Identify the fossils.

CO3: Complete the Geological maps