D.B.F. Dayanand College of Arts and Science, Solapur

Department of Geology

B.Sc. III

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Subject	**GEOLOGY**
Paper No. and Title	**Paper – X Geomorphology**
Module (Flipped classroom) Title	**Geom-1**
Module Tag	**DAYA.GEO.VMD5**
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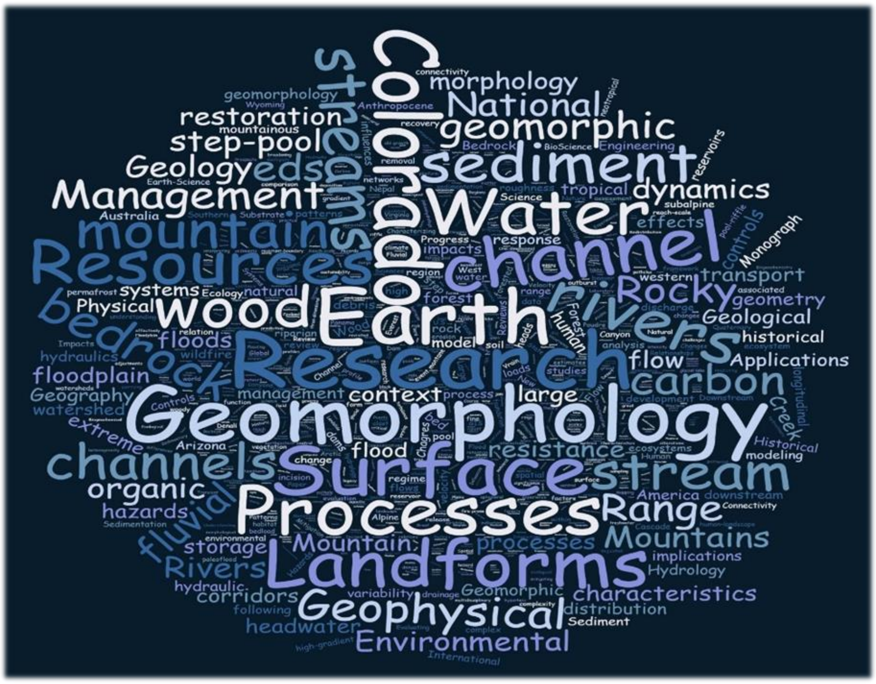
Dr. Vinay Madhusudan Dikshit
Associate Professor
Department of Geology



Module No. 1

Title – Introduction to Geomorphology and its applications.

- **Prerequisites –**
  - Knowledge of weathering (physical and chemical), erosion and deposition.
  - Basic knowledge of various erosional and depositional features formed by natural agencies like running water, groundwater, glacier, wind, etc.
  - Natural factors affecting the process of weathering, erosion, and deposition.

- **Learning outcome:**
  - Demonstrate an understanding of key geomorphic concepts and factors which influence geomorphic systems with the help of case studies.
  - Able to geomorphological processes operating in a variety of landscapes.
  - knowledge of the range of landforms presents in a range of landscapes (fluvial, marine, glacial, arid etc.)
  - Understand the issues of present climate change in the regions and/or the nature of geomorphological hazards in such areas.
  - Knowledge of applications of geomorphology in various fields.

- **Objectives of the Module**

  Students should learn about the details of the meaning and concepts in remote sensing.

Content	**Objectives (Learner should be able to)**	**Cognitive Level**
Definition Introduction and applications	Definition and meaning of Geomorphology	Remembering
	Evolution of landscape through time	Remembering
	Applications of geomorphology in various fields of studies	Remembering
	Visualization method	Applying
	Proper thought process	Understanding
	Asking questions.	Evaluating

Table of Content:

Sr. No.	**Introduction to Geomorphology and its applications**
1	Introduction
2	Definition and meaning
3	Geomorphic processes
4	Applications of geomorphology

1. INTRODUCTION

Over millions of years, the Earth has gone through many changes which have shaped its current form and structure. From a dust ball according to nebular hypothesis, to the current form, the Earth has transformed a lot. Once an inhabitable place, during the Hadean time, our Earth has seen many processes over a long time of more than 4 billion years. Developmental stages which formed the current habitable world include both internal and external forces. The meteoritic impact, volcanic activities, and erosional activities of rivers, winds, glaciers, oceans, etc. along with the sea floor spreading and plate tectonic activities have been constantly working to shape the Earth as we see now. Many of these activities occur during a short interval, while some take millions of years to create various climatic, geologic, and geomorphic regimes. All of these never-ending processes are still continuously going on and shaping our Earth currently. The most notable of all these processes are geomorphic processes since they create the shape and form of the Earth as we see it now. Hence, the study of these geomorphic processes is critical to understand the phenomena and process that are occurring in nature.

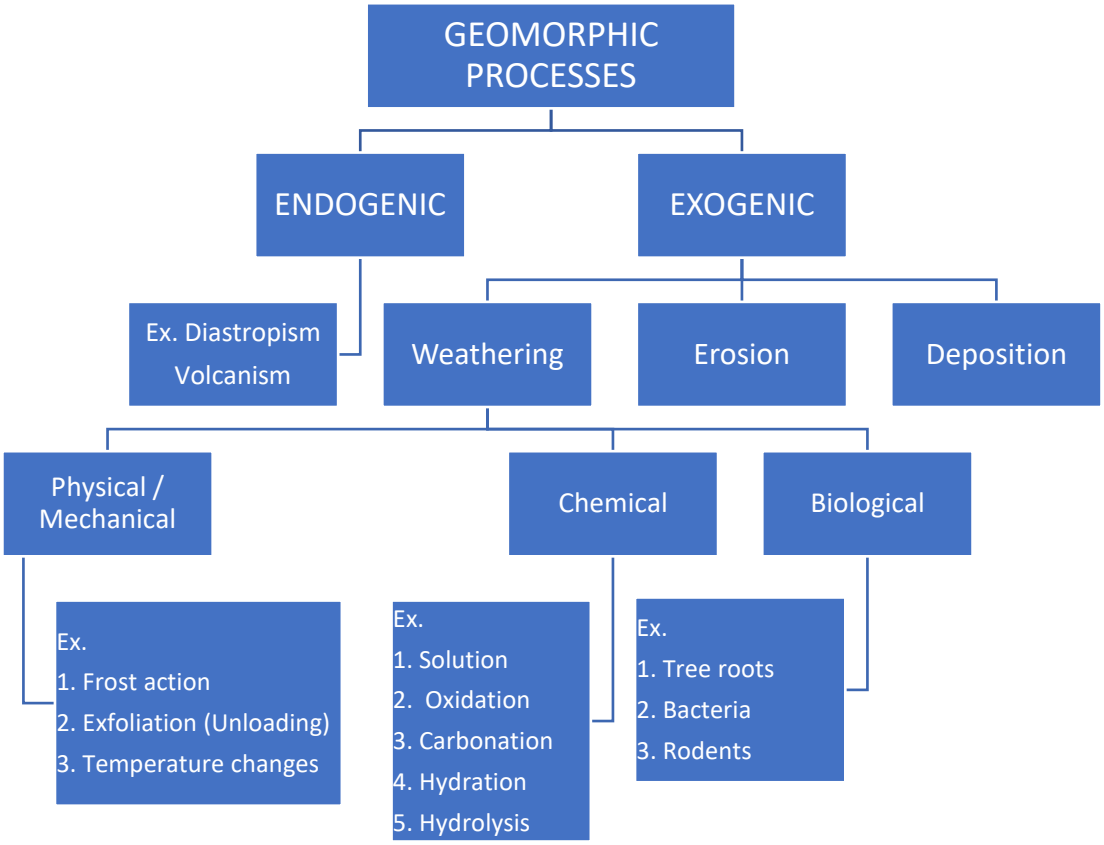
For understanding the evolution of landscape, the golden rule, "the present is the key to the past," has been followed. This rule assumes that the processes that are visible in action today must have occurred in the past also, which can be used to infer the reasons for formation of the landscape in the past. Hence, the past formation was mainly dependent on the relative information and aging method.

However, the word "geomorphology" was first coined and used between the 1870s and 1880s to describe the morphology of the surface of the Earth. But it was popularized by William Morris Davis who proposed the "geographical cycle" also known as "Davis cycle".

2. DEFINITION AND MEANING

The word Geomorphology is derived from Greek words, γεω (Earth), μορφη (morph/form), and λογος (discuss), geomorphology literally means "a discussion on Earth's form." Geomorphology, therefore, is defined as the science of description (discourse) of various forms (morphe) of the earth's surface. To be more precise, forms mean topographic features or geometric features (relief features) of the earth s surface. Geomorphology may be defined as the scientific study of surface features of the earth's surface involving interpretative description of landforms, their origin and development and nature and mechanism of geomorphological processes which evolve the landforms with a view that 'all landforms can be related to a particular geologic process, or set of processes, and that the landforms thus developed may evolve with time through a sequence of forms dependent in part, on the relative time a particular process has been operating'Hence, it is the study of various features that are found on the Earth, such as mountains, hills, plains, rivers, moraines, cirques, sand dunes, beaches, spits, etc., that are created by various agents such as rivers, glaciers, wind, ocean, etc.

3. GEOMORPHIC PROCESSES



The earth's face is dynamic in nature. It changes continuously because of forces operating on and within the earth's crust are called geomorphic processes. The vertical and horizontal differences in the earth;s crust is the result of the internal forces operating from within the earth which built up the crust have been responsible for the variations in the outer surface of the crust. The earth's surface is being continuously subjected to external forces induced basically by energy. The earth's surface is being continuously subjected to by external forces originating within the earth's atmosphere and by internal forces from within the earth.

Geomorphic processes can be classified into exogenic and endogenic processes. Endogenic forces are generated in the interior of the earth. Endogenic processes can be classified into diastrophic and sudden movements. Diastrophic forces can be classified into epeirogenic and orogenic forces. Sudden forces comprise of earthquake and volcanic eruptions. Exogenic forces are the forces generating outside the earth's surface. These forces can be classified into o weathering, mass movement, erosion and deposition. Weathering is the process of breaking down, or the disintegration and decomposition of rocks. It is a static process. Weathering can further be classified into chemical, physical and biological weathering.

Mass movement involves downhill movement of the weathered rock materials. The movement includes: creeping, flowing, sliding, slumping, and falling. Mass movements can be slow or rapid.

Erosion is the Displacement of weathered material through different agents of gradation. Deposition is a geological process by which material is added to a landform or landmass. Geomorphic agents are the mediums through which the eroded materials are transported from the place of origin to the destination. These agents are – Running water Groundwater

Glaciers Wind Wave and currents. The endogenic and exogenic forces cause physical stress and chemical actions on the earth material and bring the changes in the configuration of the earth surface is called **GEOMORPHIC PROCESSES.**

Diastrophism and volcanism are endogenic processes

Weathering, Mass wasting, Erosion & Deposition are Exogenic Processes any exogenic element of nature capable of acquiring and transporting earth materials can be called a geomorphic agent.

They Become Mobile When There Is Gradient

The Erosional Agents Are:

1. Running Water,
2. Waves
3. Underground Water,
4. Wind,
5. Moving Ice,

A process is a force applied on earth materials affecting the same. An agent is a mobile medium which removes, transports and deposits earth materials, activity also causes directional forces activating downslope movements of matter raves and tides are indirect movements of the earth caused by gravitation Without gravity and gradient there is no mobility for erosional agents as a result there is no erosion transportation, and deposition on the earth surface. All the movements on/in the earth are due to gravitation and gradient. from higher level to lower level and high pressure to low pressure areas

ENDOGENIC PROCESS:

The energy genarated due to : The energy emanating from within the earth is the main force behind endogenic geomorphic processes. This energy is mostly generated by radioactivity, rotational and tidal friction and primordial heat from the origin of the earth. This energy due to geothermal gradients and heat flow from within induces diastrophism and volcanism in the lithosphere. Due to variations in geothermal gradients and heat flow from within, crustal thickness and strength, the action of endogenic forces are not uniform and hence the tectonically controlled original crustal surface is uneven.

1. Radioactivity 2. Rotational Force 3. Tidal Friction 4. Primordial Heat From The Origin Of The Earth.

Diastrophism And Volvanism Are Due To Geothermal Grdients And Heat Flow From Within The Earth.

Crustal Thickness, Strength, Action Of Endogenic Forces Are Due To Variations In Geothermal Gradients And Heat Flow Are Uneven.

DIASTROPHISM: Diastrophism refers to deformation of the Earth's crust, and more especially to folding and faulting. Diastrophism can be considered part of geotectonics. Diastrophism comes from the Greek word meaning a twisting. Diastrophism, also called tectonism, large-scale deformation of Earth's crust by natural processes, which leads to the formation of continents and ocean basins, mountain systems, plateaus, rift valleys, and other features by mechanisms such as lithospheric plate movement (that is, plate tectonics). In the process of orogeny, the crust is severely deformed into folds. Due to epeirogeny, there may be simple deformation. Orogeny is a mountain building process whereas epeirogeny is continental building process.

THEY ARE TWO TYPES:

1. **OROGENIC PROCESSES:** An orogen or orogenic belt develops when a continental plate crumples and is pushed upwards to form one or more mountain ranges; this involves

many geological processes collectively called orogenesis. Orogeny is the primary mechanism by which mountains are built on continents. mountain building through folding

2. **PLATE TECTONICS:** Plate tectonics is the theory that Earth's outer shell is divided into several plates that glide over the mantle, the rocky inner layer above the core. The *plates* act like a hard and rigid shell compared to Earth's mantle. This strong outer layer is called the lithosphere. Involve horizontal movements.
3. **EARTH QUAKES:** An **earthquake** (also known as a **quake**, **tremor** or **temblor**) is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth 's lithosphere that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities.
4. **EPEROGENIC PROCESS:** In geology, *epeirogenic* movement (from Greek epeiros, land, and genesis, birth) is upheavals or depressions of land exhibiting long wavelengths and little folding apart from broad undulations. The broad central parts of continents are called cratons, and are subject to *epeirogeny*. uplifting large part of earth crust.

EXOGENIC PROCESSES: *Exogenic processes* include geological phenomena and *processes* that originate externally to the Earth's surface. They are genetically related to the atmosphere, hydrosphere and biosphere, and therefore to *processes* of weathering, erosion, transportation, deposition, denudation etc. The exogenic processes derive their energy from atmosphere determined by the ultimate energy from the sun and also the gradients created by tectonic factors.

Gravitational force create gradient towards down slope direction.

Force applied per unit area is called

STRESS: Stress is a force acting on a rock per unit area. Any rock can be strained. Strain can be elastic, brittle, or ductile. Ductile deformation is also called plastic deformation. Structures in **geology** are deformation features that result from permanent (brittle or ductile) strain. Stress can be produced in a sold body pushing or pulling. This includes deformation. Forces acting along the faces of earth materials are shear stresses. (Separating forces). It is this stress that breaks rocks and other earth materials. the shear stress result in angular displacement/slippage. Besides gravitational stress there is molecular stress which is caused by temperature change, crustallisation and melting. chemical processes normally lead to loosening of bonds between grains, dissolving of soluble minerals or cementing materials.

The basic reason for weathering, mass movement erosion and deposition is the development of stress in the earth materials.

Since there are different climatic regions there is variation in the exogenic process from region to region. Temperature and precipitation are the two major elements that control various processes.

All the exogenic process are covered under general term DENUDATION.

The word denude means uncover. Weathering, mass wasting erosion and transportation are included in denudation.

WEATHERING: Weathering is the breaking down of rocks, soil, and minerals as well as wood and artificial materials through contact with the Earth's atmosphere, waters, and biological organisms. It is the action of elements of weather on earth materials

Weathering is defined as mechanical disintegration and chemical decomposition of rocks through the actions of various element so weather and climate

PHYSICAL WEATHERING PROCESSES

Factors Influencing the Physical Weathering

1. Gravitational Force Overburden Pressure, Load And Shearing Stress
2. Expansion Forces Due to Temperature Changes, Crystal Growth or Animal Activity
3. Water Pressures Controlled by Wetting And Drying Cycles.

They are mostly due to thermal expansion, and pressure release. The repeated action of these processes cause damage to the rocks

UNLOADING AND EXPANSION: Removal of overlying rock load because of continued erosion causes vertical pressure release with the result that the upper layers of the rock expand producing disintegration of rock masses. fractures will develop parallel to the ground surface. In areas of curved ground surface arched fractures tend to produce massive sheets or exfoliation slabs of rock. exfoliation sheets resulting from expansion due to unloading and pressure release my measure hundreds or even thousands of metres in horizontal extent. large smooth rounded domes called exfoliation domes result due to this process

TEMPERATURE CHANGES AND EXPANSION: Various minerals found in the rocks expand at different rates when temperature increases. Each one pushes others. When temperature falls contraction takes place. Because of diurnal changes in the temperature, the effects is mostly on superficial layers of the rocks. The effects of this process is significant in hot deserts and cold deserts. Though it is small the continuous process for longer time and larger area the effect is greater. The effect is greater at the depth of the rocks. Fractures occurs parallel to the surface. Due continuous expansion and contraction the rock layers become lose and exfoliation takes place. A large dome shaped structures are formed due to this process. Tores which are large boulders also form due this process. exfoliated domes are big insize whereas exfoliated tores are varied sizes. In rocks like granites, smooth surfaced and rounded small to big boulders called tors form due to such exfoliation.

FREEZING THAWING AND FROST WEDGING:

Frost weathering occurs due to growth of ice within pores and cracks of rocks during repeated cycles of freezing and melting. This process is most effective at high elevations in mid-latitudes where freezing and melting is often repeated. Glacial areas are subject to frost wedging daily. In this process, the rate of freezing is important. Rapid freezing of water causes its sudden expansion and high pressure.

SALT WEATHERING: Salts in the rocks expand due to thermal action hydration and crystallization. ex. Calcium sodium magnesium potassium and barium. High temperature between 30°C to 50°C of surface temperature in deserts favour such salt expansion. Salt crystals in near surface pores cause splitting of individual grains within rocks. Which eventually fall off. This process of falling off of individual grains may result in granular disintegration or granular foliation.

Salt crystallization is most effective of all salt weathering processes, in areas with alternating wetting and drying conditions salt crystal growth is favoured and the neighboring grains are pushed aside. sodium chloride and gypsum crystals in desert areas heave up overlying layers of materials and with the result polygonal cracks develop all over the heaved surface. With salt crystal growth, chalk breaks down most readily followed by Limstone, Sandstone, Chalk, Gneiss and Granite.

CHEMICAL WEATHERING PROCESSES

Chemical weathering is the weakening and subsequent disintegration of rock by *chemical* reactions. These reactions include oxidation, hydrolysis, and carbonation.

These *processes* either form or destroy minerals, thus altering the nature of the rock's mineral composition. A group of weathering processes viz; solution, carbonation, hydration, oxidation and reduction on the rocks to decompose, dissolve or reduce them to a fine clastic state through chemical reactions by oxygen, surface /soil water and other acids. Water and air along with heat must be present to speed up all chemical reactions.

Over and above the carbon dioxide present in the air, decomposition of plants and animals increases the quantity of carbon dioxide underground. these chemical reactions on various minerals are very much reactions on various minerals are very much similar to the chemical reactions in a laboratory.

SOLUTION: The water /acid with dissolved content is called solution. This process involves removal of solids in solution and depends upon solubility of a mineral in water or weak acids. when water reacts with any solid many solids may become solution. Ex. Sulphates, nitrates, potassium. When rain comes these solids dissolve into solution without leaving any residue. Calcium carbonate, magnesium bicarbonate present in the lime stone are dissolved in and form carbonic acid, CO^2 produced by decaying organic matter along with soil water greatly aids in this reaction. Common salt is also susceptible to this process.

CARBONATION: *Carbonation* is another type of chemical *weathering*. *Carbonation* is the mixing of water with carbon dioxide to make carbonic acid. This type of *weathering* is important in the formation of caves. Dissolved carbon dioxide in rainwater or in moist air forms carbonic acid, and this acid reacts with minerals in rocks. It is the reaction of carbonate and bicarbonate with minerals such as feldspar, & carbonate minerals CO_2 from atmosphere and soil air is absorbed by water to form carbonic acid. Ca CO_3 & Mg CO_3 are dissolved in carbonic acid and washed away to form the caves in lime stone region. Clay minerals are easily eroded due to the presence of minerals which can exchange the ions with the water.

HYDRATION: *Hydrolysis* is a chemical reaction caused by water. Water changes the chemical composition and size of minerals in rock, making them less resistant to *weathering*. It is the chemical addition of water. minerals take up water and expand. This expansion increases the volume of material. ex. calcium sulphate takes water and convert into gypsum.it is unstabel than calcium sulphate.it is reversible reaction and when this process continuous for longer time the materials disintegrate. Many clay minerals swell and contract during wetting and drying and a repetition of this process results in cracking of overlying materials. salts inpore spaces undergo rapid and repeated hydration and help in physical weathering through exfoliation and granular disintegration

OXIDATION AND REDUCTION

Oxidation means combination of minerals with oxygen to form oxides and hydroxides.

Oxidation occurs when there is sufficient water and atmosphere. EX. Iron, manganese, sulphur. In the process of oxidation breakdown occurs due the addition of oxygen. red colour of iron becomes into yellow colour. when oxidised minerals re kept in the places where there is no oxygen reduction takes place. ex. such conditions occurs below water table waterlogged areas. Red colour of iron becomes greenish or bluish grey.

4. APPLICATIONS

GEOMORPHOLOGY AND HYDROLOGY: Both surface and groundwater used by human is available from different sources like streams, lakes and rivers. The lithological zones present different conditions of surface as well as groundwater. Comprehensive understanding of geomorphology is key to understand the hydrological problem of the various lithological terrains.

GEOMORPHOLOGY AND MINERAL EXPLORATION: There is a close association of geological structure and minerals deposits. Characteristic of landscapes of specific areas could indicate these geological structures. Economic geologist has not appreciated the exploration of some minerals in the name of understanding of the geomorphic features and history of a region. In search for mineral deposits, these three points may serve for Geomorphic features as:

i. some minerals have direct topographic expression for its deposits;
ii. the geologic structure and topography of an area have correlation which clue the accumulation of minerals;
iii. geomorphic history clearly indicates the physical condition under which the minerals accumulated or were enriched of a particular area.

Some of ore bodies have surface expression, but many do as topographic forms, as outcrops of ore, gossan, or residual minerals, or as such structural features as faults, fractures, and breccia zones. Geomorphology can play an important role for several important economic minerals which are essentially weathering residues of present or ancient geomorphic cycles. Apart from iron deposits, materials like clay minerals, caliche, bauxite and some manganese and nickel ores are of this nature. Recent weathering surfaces may exhibit residual weathering products or it may lie upon ancient weathering surfaces which are now buried. Placer deposits are mixtures of heavy metals with specific location, geomorphic principles have been applied other than any other phase of economic geology. Geomorphic processes are the main cause of placer concentration of minerals, found in specific positions with distinctive topographic expression. Several oil fields have been discovered because of their striking topographic expression. These oil fields are characterized by anticlinal structures which strikingly reflected in the topography. When viewed from aerial photographs, many of the Gulf Coast salt dome structures are evident in the topography.

GEOMORPHOLOGY AND ENGINEERING WORKS: Evaluation of geologic factors of one type or another often involve in most of the engineering projects, among all the factors terrain characteristics is most common. A detailed study of the geomorphic history of an area may support the proper evaluation of surficial materials and the bedrock profile configuration. *Road construction:* Topographic features of an area determined the most feasible highway route. Road engineering faces a number of problems by different types of terrain that includes geologic structure, geomorphic history of the area, lithological and stratigraphic characteristics and strength of the surficial deposits. *Dam site selection:* A synthesis of knowledge concerning the geomorphology, lithology, and geologic structure of terrains has greatly helped while selecting sites for dam construction.

GEOMORPHOLOGY AND REGIONAL PLANNING: Geomorphologic information can be utilized at various levels of planning. Combination of topographic information, soils, hydrology, lithology, terrain characteristics and engineering included on terrain maps make suitable for regional planning. Applied geomorphology has distinct place in regional planning. At broadest scale it can be used as delineate areas for forest, mountain, plateau,

recreational, rural and urban areas. A balanced growth of a country's economy requires a careful understanding of its natural resources and human resources. Rural or underdeveloped terrain fulfills a variety of recreational needs. There is a transformation from a terrain map into land-use suitability maps to develop rural and urban areas. Detailed information on topography enlightened regional planners who may then advise development projects best suited for separate region.

GEOMORPHOLOGY AND COASTAL ZONE MANAGEMENT: Coastal zones are not in linear as a boundary between land and water rather viewed as dynamic region of interface of land and water. The major threat to the fragile coastal zone is its deteriorating coastal environment through shoreline erosion, loss of natural beauty, pollution and extinction of species coastal zone management requires an integrated approach. The most widespread material is beach sand, found mainly in low latitudes. Beach sand and gravel is widely used for construction industry. Geomorphologists have made some significant contribution towards an understanding of shoreline equilibrium in Eastern Australia where it considerable development of sand mining for heavy minerals has been done. Some measures have been designed or coast protection includes sea-defence structures such as seawalls, breakwaters, jetties and groynes. To protect the sea backshore zone from direct erosion cut, sea walls are designed since these walls are impermeable they increase the backwash and produce a destructive wave effect. Breakwaters can be built either normal or parallel to the coast. It is necessary to monitor and quantify wave conditions, tidal currents and sediment movement in the nearshore zone to evaluate how sea defenses and other man-made structures affect shoreline equilibrium.

GEOMORPHOLOGY AND HAZARD MANAGEMENT: Hazards can be put in natural or man-induced where tolerable level or unexpected nature exceeds. According to Chorley, geomorphic hazard may be defined as "any change, natural or man- made, that may affect the geomorphic stability of a landform to the adversity of living things". These hazards may arise from immediate and sudden movements like volcanic eruptions, earthquakes, landslides, avalanches, floods, etc. Faulting, folding, warping, uplifting, subsidence, or vegetation changes and hydrologic regime due to climatic change arise from the long term factors. Areas having past case histories of volcanism and seismic events help in making predictions of possible eruptions and earthquakes respectively. Regular monitoring of seismic waves, measurement of temperature of craters lake, hot springs, geysers and changes in the configuration of volcanoes whether dormant or extinct can reduce the hazard to some extent. A detailed knowledge of topography can predict the path of lava flow and its eruptions points in advance. The behavior of a river system can be well understood by its geomorphic knowledge through its channel, morphology, flow pattern, river metamorphosis and so on. It may help controlling excess water in river and control measures during flood season. Prior knowledge of erosion in the upper catchment area and carrying sediments to its proportion may help in understand the gradual rise in river bed, which may lead to levee breached and cause sudden floods. Earthquakes may be man induced or natural geomorphic hazards. Detailed study of seismic waves region would help in identifying and mapping the zones of high to low intensity to reduce the risk of human life.

Some of the applications of geomorphic principles have been used in applied geomorphology but there are other fields where geomorphic knowledge of terrain is more important. Soils maps to some extent are topographic maps and difference in soil series fundamentally rest upon topographic conditions under which each portion of soil series

developed. Soil erosion related problem is essentially a problem involving recognition and proper control of such geomorphic processes like sheet wash erosion, gulleying, mass-wasting, and stream erosion. The angle of slope is not a single factor determined the severity of erosion. With the introduction of air photographs and satellite imageries preparation of specialized maps and interpreting them has become easier and more accurate. Now a days, aerial photographs are being used for evaluating landforms and land use for city developmental plans, construction projects, highway etc. Another tool i.e. Remote sensing is necessary for sustainable management of natural resources like soil, forest, crops, oceans, urban and town planning etc. At present Geographical Information Systems (GIS) technology has been used along with Remote Sensing techniques in geomorphic features interpretation. All fields discussed in this chapter should be sufficient to show an understanding of geomorphic principal, besides the geomorphic history of a particular region, geomorphic features may contribute in applied geology to the solutions of problems. To control the adverse effects of human activities on geomorphic forms and processes, application of geomorphology can be of immense use.

Learning resources:

1. **Books:**
   I. Geomorphology – Savindra Singh
   II. Principles of Geomorphology – Thornbury
   III. Concepts of Geomorphology: Gupta and Kale
   IV. Geomorphology - Bloom A. I.
   V. Environmental Geology - K.S. Valdiya

2. **Syllabus of B. Sc. III Geology**
   https://drive.google.com/file/d/120EHc9HiM6KicNhnx6IYn_PEHqL47zf8/view?usp=sharing
3. **Material OER/URL/Instructor-made/**
   A. Lecture notes
   https://drive.google.com/file/d/1GoaKVs7dM_iq-P0hRodzxyvgslcnYxob/view?usp=sharing

   B. Online book:
   https://drive.google.com/file/d/1C6JD2yod69AOZJSFcGZM9nxFxYMZX2-z/view?usp=sharing
4. **Instructor-made -**
   A. Power Point Presentation:
   https://docs.google.com/presentation/d/1agPplzcm-OwYJVohUjlHrP3jFJXAIZBX/edit?usp=sharing&ouid=108299766632040200276&rtpof=true&sd=true

   B. Video -
   https://www.youtube.com/watch?v=5ieigKikIRY&t=1365s

   C. Question Bank:
https://drive.google.com/file/d/11J-Ljo7mpzVqHeAodwzIuGNX8UaS3ei8/view?usp=sharing

   D. Quizzes / Practice tests:
https://forms.gle/ire6Rgc5edDngZun8

Detailed Plan of Out-of-class and In-class activities

Sub Unit 1 - **Introduction to Geomorphology and its applications**

Objectives –

- Definition of geomorphology
- Clarity of various concepts of geomorphology.
- Understanding geomorphic processes
- Its applications in various fields.

Units	**Out-of-class activity** **Details of Activity**	**In-class activity** **Details of Activity**	**Assessment**
1.1	Students should read out the topic from a book Students study the ppt.	Discussion on the topic Check the level of understanding through Question – answer session	Question – answer session
1.2	Students should read out the topic from a book Students should watch video on given links	Discussion on the topic Help students to understand the concept and components of remote sensing Help students to know various applications of remote sensing	Question to write in detail On-line quiz