SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

DEPARTMENT OF GEOLOGY

SCHOOL OF BASIC & APPLIED SCIENCES
SHRI GURU RAM RAI UNIVERSITY

Bachelor of Science

OR

Bachelor of Science (Hons.) with Research

Based on NEP

[Exit Options after completion of 01 Year, 02 Years, 03 Years, and 04 Years]

Effective from Academic Session 2025-2029

Patel Nagar, Dehradun, Uttarakhand

PROGRAMME OUTCOMES (POs)

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

PO1	Enabling the students to understand the age, composition, structure, processes, and Evolutionary history of the Earth.
PO2	Enabling the students to identify, locate, explore, judiciously exploit, and manage various Earth resources like minerals, fossil fuel and natural gas, coal, building stones, weathered Crust and soils, underground and surface water etc.
PO3	Correlating the principles and findings of science to the scientific world and apply them in everyday life.
PO4	Enabling the students to understand and assess the potential of natural processes in causing hazards and disasters
PO5	Enabling the students to understand such geological conditions that make the terrain prone to natural and anthropogenic hazards.
PO6	Enabling the students to assess the suitability of terrain for various civil engineering constructions such as dams, reservoirs, bridges, tunnels, roads, railway lines, cable-cars, and buildings etc.
PO7	Enabling the students to formulate and execute guidelines for safe developmental activities in diverse geological terrains.
PO8	Ability to devise and carry out an independent field-based project, including the formulation and testing of hypotheses whilst in the process of carrying out the project.
PO9	Graduates will acquire effective communication skills
PO10	Evolving sustainable solutions for complex problems of the society in general and for public health and safety, cultural, societal and environmental anomalies.
PO11	Develop skills in gathering and interpreting the geological and geophysical data used to gain this understanding and thereby equip students with the foundations for their professional careers or additional study.
PO12	Motivating the students to take up higher studies and research to bringing out new knowledge Yet to be understood the geological aspects of the Earth.

Program Specific Outcome (PSOs)

On successful completion of the B Sc. Geology program students will be able to

PSO1	Acquire a knowledge in the Science of geology as a whole as well as Earth materials, Petrology, Geochemistry, Mineralogy, Hydrology, Natural disaster and Stratigraphy, Structural features, and geomorphic processes and landforms.
PSO2	Apply principles of mathematics, chemistry, and physics to geologic problems
PSO3	Use compasses, survey instruments, and satellite images in geological investigations. Develop intellectual ability and geological skills through an appropriate blending of theoretical subject education, practical exercises and field training
PSO4	Attain basic knowledge, training, skills and eligibility degree for various higher academic courses and position in Govt. and private sector.

Basic Structure of UG Multidisciplinary Program (with Three Core Disciplines) –

Type of Course

Discipline Specific Core (DSC)
Discipline Specific Elective (DSE)
General Elective (GE)
Ability Enhancement Courses (AEC)
Skill Enhancement Course (SEC)
Internship/Apprenticeship / Project/ Community Outreach (IAPC)
Value Addition course (VAC)

Sem	**Core - Discipline Specific Core (DSC)**	**Elective - Discipline Specific Elective (DSE)**	**Elective-Generic Elective (GE)**	**Ability Enhancement Course (AEC)**	**Skill Enhancement Course (SEC)**	**(Internship /Apprenticeship / Project/ Community Outreach) (IAPC)**	**Value Addition Course (VAC)**	**Total credits**
	Course/credit distribution (Credits 4)	**Course/ credit distribution** (Credits 4)	**Course/ credit distribution**	**Course/ credit distribution** (Credits 2)	**Course/credit distribution** (Credits 2)	**course/ credit distribution** (Credits 2)	**Course/ credit distribution** (Credits 2)	**22**
1	**DSC A (Botany/Physics) 1- (4) DSC B (Zoology/Maths) 1- (4) DSC C (Geology)1- (4)** (3T+1L) ***Either PMG or ZBG combination is allowed**		Choose one from a pool of courses **GE – 1 (4)**	**AEC – 1 (2)**	Choose one from a pool of courses **SEC – 1 (2)**		Choose one from a pool of courses **VAC – 1 (2)**	**22**
2	**DSC A (Botany/Physics) 2- (4) DSC B (Zoology/Maths) 2- (4) DSC C (Geology)2- (4)** (3T+1L) ***Either PMG or ZBG combination is allowed**		Choose one from a pool of courses **GE – 2 (4)**	**AEC – 2 (2)**	Choose one from a pool of courses **SEC – 2 (2)**		Choose one from a pool of courses **VAC – 2 (2)**	**22**

	Students on exit shall be awarded Undergraduate Certificate (in the field of Multidisciplinary study) after securing requisite 44 credits in semester I & II						**Total= 44**
3	**DSC A(Botany/Physics) 3- (4)** **DSC B (Zoology/Maths) 3- (4)** **DSC C (Geology) 3- (4)** (3T+1L) ***Either PMG or ZBG combination is allowed**	Choose one from a pool of courses, **DSE 1 A/B/C (4)** OR **GE - 3 (4)** (4 T/or 3T+1L/or 2T+2L) OR **MOOC**	**AEC – 3 (2)**	Choose one from **SEC 3 – (2)** OR **Internship/Apprenticeship / Project/ Community Outreach (IAPC) – (2)**	Choose one from a pool of courses **VAC – 3 (2)**		**22**
4	**DSC A(Botany/Physics) 4- (4)** **DSC B (Zoology/Maths) 4- (4)** **DSC C (Geology)4- (4)** (3T+1L) ***Either ZBG or PMG combination is allowed**	Choose one from a pool of courses, **DSE2 A/B/C (4)** credits) OR **GE - 4 (4)** (4 T/or 3T+1L/or 2T+2L) OR **MOOC**	**AEC – 4 (2)**	Choose one from **SEC 4 – (2)** OR **Internship/Apprenticeship / Project/ Community Outreach (IAPC) – (2)**	Choose one from a pool of courses **VAC – 4 (2)**		**22**
	Students on exit shall be awarded Undergraduate Diploma (in the field of Multidisciplinary study/Discipline) after securing requisite 88 credits in semester III & IV						**Total= 88**
5	**DSC A(Botany/Physics) 5- (4)** **DSC B (Zoology/Maths) 5- (4)** **DSC C (Geology)5- (4)** (3T+1L) ***Either ZBG or PMG combination is allowed**	Choose one from a pool of courses, **DSE A/B/C (4)** credits) (3T+1L/or 2T+2L) OR **MOOC**	Choose one from a pool of courses **GE – 5 (4)** OR **MOOC**		Choose one from **SEC 5 – (2)** OR **Internship/Apprenticeship / Project/ Community Outreach (IAPC) – (2)**		**22**
6	**DSC A(Botany/Physics) 6- (4)** **DSC B (Zoology/Maths) 6- (4)** **DSC C (Geology)6- (4)** (3T+1L) ***Either ZBG or PMG combination is allowed**	Choose one from a pool of courses, **DSE A/B/C (4)** credits) (3T+1L/or 2T+2L) OR **MOOC**	Choose one from a pool of courses **GE – 6 (4)** OR **MOOC**		Choose one from **SEC 6 – (2)** OR **Internship/Apprenticeship / Project/ Community Outreach (IAPC) – (2)**		**22**
	Students on exit shall be awarded Bachelor of Science (in the field of Multidisciplinary study/Discipline) after securing the requisite 132 credits on completion of semester VI						**Total= 132**

7	**DSC A/B/C 7 - (4)** (3T+1L)	**Choose 3 DSE** (3x4) courses OR **Choose 2 DSE – (2x4) and one GE (4)** course OR **Choose 1 DSE (4) and 2 GE** (2x4) courses (Total= 12)		Dissertation on Major/Minor (4+2) OR Academic Project/ Entrepreneurship (4+2) **[B.Sc. Honours with Research]** **DSE 4** **Seminar 2 [B.Sc. Honours (H)]**		**22**
8	**DSC A/B/C 8 - (4)** (3T+1L)	**Choose 3 DSE** (3x4) courses OR **Choose 2 DSE – (2x4) and one GE (4)** course OR **Choose 1 DSE (4) and 2 GE** (2x4) courses (Total= 12)		Dissertation on Major/Minor (4+2) OR Academic Project/ Entrepreneurship (4+2) **B.Sc. Honours with Research]** **DSE 4** **Seminar 2 [B.Sc. Honours (H)]**		**22**
	Students on exit shall be awarded Bachelor of Science (in the field of Multidisciplinary study/Discipline) (Honours with Research or Honours with Academic project/Entrepreneurship) after securing requisite 176 credits on completion of semester VIII					**Total = 176**

Course Introduction:

The modified curriculum of Bachelor of Science OR Bachelor of Science (Hons) with Research offers one year certificate, two-year diploma, three-year degree and four-year Degree in (Hons) with Research after securing required credits as per the Curriculum and credit framework for Undergraduate program guidelines by NEP 2020 and UGC.

Eligibility Criteria for Admission: The candidate must have passed 10+2 with relevant field as a compulsory subject from a recognized board or its equivalent with minimum 45% marks.

No. of Seats in B.Sc. (PMG/ZBG)- 20

COURSE STRUCTURE

Semester Wise Discipline Specific Core

Semester	Course Type	Course Code	Course Title	L	T	P	C
I	DSC-C (Geology)	GELDC101	Physical Geology and Structural Geology	3	0	0	3
		GELDL102	Practical/Lab Course	0	0	2	1
II		GELDC201	Crystallography and Mineralogy	3	0	0	3
		GELDL202	Practical/Lab course	0	0	2	1
III		GELDC301	Petrology	3	0	0	3
		GELDL302	Practical/Lab course	0	0	2	1
IV		GELDC401	Stratigraphy	3	0	0	3
		GELDL402	Practical/Lab course	0	0	2	1
V		GELDC501	Palaeontology	3	0	0	3
		GELDL502	Practical/Lab course	0	0	2	1
VI		GELDC601	Economic Geology	3	0	0	3
		GELDL602	Practical/Lab course	0	0	2	1
VII		GELDC701	Advanced Structural Geology	3	0	0	3
		GELDL702	Practical/Lab Course	0	0	2	1
VIII		GELDC801	Geotectonics	3	0	0	3
		GELDL802	Practical/Lab Course	0	0	2	1

Semester Wise Discipline-Specific Elective

Semester	Course Type	Course Code	Course Title	L	T	P	C
III	DSE-C (Geology)	GELDE306	Hydrogeology	3	1	0	4
		GELDE307	Natural Hazards and Mitigation	3	1	0	4
IV		GELDE406	Marine Geology	3	1	0	4
		GELDE407	Glaciology	3	1	0	4
V		GELDE506	Geochemistry	3	1	0	4
		GELDE507	Evolution of life through time	3	1	0	4
VI		GELDE606	Sedimentology	3	1	0	4
		GELDE607	Geoinformatics	3	1	0	4
VII		GELDE703	Advanced Mineralogy	3	1	0	4
		GELDE704	General Geology and Geomorphology	3	1	0	4
		GELDE705	General Invertebrate Paleontology	3	1	0	4
		GELDE706	Research Methodology	3	1	0	4
		GELDE707	Geological Field Training	3	1	0	4
VIII		GELDE803	Advanced Crystallography	3	1	0	4
		GELDE804	Stratigraphy	3	1	0	4

		GELDE805	Micropalaeontology, Vertebrate and Paleobotany	3	1	0	4
		GELDE806	Advanced Metamorphic Petrology	3	1	0	4
		GELDE807	Research publication and Ethics	3	1	0	4

Semester Wise Generic Elective

Semester	Course Type	Course Code	Course Title	L	T	P	C
I	**GE-C (Geology)**	GELGE103	Introduction to Geology-I	4	0	0	4
II		GELGE203	Introduction to Geology-II	4	0	0	4
III		GELGE303	Introduction to Geology-III	4	0	0	4
IV		GELGE403	Introduction to Ocancography	4	0	0	4
V		GELGE503	Geology of Uttarakhand	4	0	0	4
VI		GELGE603	Disaster: Case studies of Uttarakhand	4	0	0	4

Semester Wise Ability Enhancement Course

Semester	Course Type	Course Code	Course Title	L	T	P	C
I	**AEC**	AEC-104	Environment Science-I	2	0	0	2
II		AEC-204	Environment Science-II	2	0	0	2
III		AEC-304	English Communication-I	2	0	0	2
IV		AEC-404	English Communication-II	2	0	0	2

Semester Wise Skill Enhancement Course/IAPC

Semester	Course Type	Course Code	Course Title	L	T	P	C
I	**SEC-C/IAPC (GEOLOGY)**	GELSC105	Field Geology	2	0	0	2
II		GELSC205	Remote Sensing and GIS	2	0	0	2
III		GELSC305	Geological Field /Training Course	2	0	0	2
IV		GELSC405	Laboratory techniques in Geology	2	0	0	2
V		GELSC505	Disaster management or Internship/Apprenticeship / Project/ Community Outreach/ OR MOOC	2	0	0	2
VI		GELSC605	Disaster management or Internship/Apprenticeship / Project/ Community Outreach/ OR MOOC	2	0	0	2

Semester Wise Dissertation

Semester	Course Type	Course Code	Course Title	L	T	P	C
VII	IAPC/Project	GELDT708	Dissertation on Major Core/Minor Elective (from VII Semester papers) OR Academic Project/ Entrepreneurship	0	0	12	6
VIII	IAPC/Project	GELDT808	Dissertation on Major Core/Minor Elective (from VIII Semester papers) OR Academic Project/ Entrepreneurship	0	0	12	6

Semester Wise Value Addition Course (VAC)

Semester	Course Type	Course Code	Course Title	L	T	P	C
I	VAC		Choose from the pool of courses offered by the University	0	0	0	2
II	VAC		Choose from the pool of courses offered by the University	0	0	0	2
III	VAC		Choose from the pool of courses offered by the University	0	0	0	2
IV	VAC		Choose from the pool of courses offered by the University	0	0	0	2

Discipline Specific Core Courses

Semester- I

Course code	**: GELDC101**			
Course Name	**: Physical Geology and Structural Geology**			
Semester /Year	**: Ist**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course gives an overall introduction to Geology from topics ranging from the formation of the solar system, internal structure of the earth and, natural hazards of Earthquake and Volcanoes.
2. To learn the concept of Structural geology, Concept of strike and dip, Dipping strata, Brunton compass, major types of fold structures,
3. The geometric and genetic classification of faults, understand the geological significance of joint, unconformity and salt dome

Course Contents

Physical Geology

Unit: 1 Introduction to geology and its scope, origin, age and structure of Earth and solar system.
Unit: 2 Processes of weathering, factors, types and their effects, Geomorphological process, Elementary idea about Earthquakes, Volcanoes and Isostacy.

Structural Geology

Unit: 1 Introduction to Structural Geology; contours, topographic and geological maps; Elementary idea of bed, dip, and strike; Clinometer/ Brunton compass and its use
Unit: 2 Basic concept of deformation; Folds, Fault, Joints, and Unconformity and Orogeny.

Text Books:

TB1: Mahapatra, G.B., 1994. A text book of Physical Geology. CBS Publishers.
TB2: Billings, M.P., 1972.Structural Geology. Prentice Hall.

Reference Books:

RB1: Holmes, A & P.L. Duff. (1996). Principles of Physical Geology, 4th revised edition, ELBS, London
RB2: Gokhale, N.W. (1995), Theory of Structural Geology, CBS, Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the different component of earth and the evolution of solar system, processes of weathering and erosion, earthquake, volcanoes. Idea of dip, strike, bed, fold, fault and unconformity.
CO2	Describe the structure of Earth, Origin of solar system, factors of weathering, erosion, earthquake, volcanoes, elementary idea of stress and strain, fold, fault, unconformity and joints.
CO3	Demonstrate the theories of earth, structures, solar system, earthquake, volcanoes, fold, fault, joints and unconformity.
CO4	Compare the various Hypotheses on Origin of Earth, dip and strike, stress and strain, weathering and erosion.
CO5	Assess the dip and strike with the help of clinometer compass/Brunton.
CO6	Arrange the concept of unconformity, normal, thrust and slip faults.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO 2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO 3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO 4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO 5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO 6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:**	**GELDL102**			
Course Name	:	**Lab Course based on GELDC101**			
Semester /Year	**:**	**I**			
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the geomorphological models and features.
2. The student is introduced to the basic knowledge relevant to geological maps
3. Practical exercises emphasize the use of compasses, Clinometer and Brunton.

Content

- **Physical Geology:**
  Study of important geomorphological models; Reading topographical maps of the Survey of India, Identification of geomorphic features.
- **Structural Geology:**
  Study of clinometers/Brunton compass; Identification of different types of folds/faults from block models; Exercises on structural problems: preparation of cross section profile from a geological map.

Text Books:

TB1: Dr. Harish Kapasya, Publisher: Himanshu Publications.
TB2: R. G. Park**,** Foundation of Structural Geology, Springer Netherlands, 2nd Edn.2012, ISBN

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	list all the geomorphological features.
CO2	demonstrate the significance of geological maps
CO3	Explain the concept of clinometers/Brunton compass
CO4	Differentiate different types of folds/faults from block models
CO5	Assess the dip and strike with the help of Clinometer compass/Brunton.
CO6	Design cross section profile from a geological map.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	3	3	3	3	3	0	0	3	0	3	0	3	0	3	3
CO 2	3	3	0	3	0	0	0	3	0	3	0	3	3	0	3	3
CO 3	3	0	3	3	3	0	3	0	3	0	3	0	0	3	3	3
CO 4	3	3	3	0	3	0	0	3	0	3	0	3	3	3	0	0
CO 5	3	0	3	0	0	0	3	0	0	0	0	3	0	3	0	0
CO 6	3	3	3	3	0	3	3	0	3	3	3	0	3	3	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester- II

Course code	**:**	**GELDC201**			
Course Name	**:**	**Crystallography and Mineralogy**			
Semester/Year	**:**	**II**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The student is introduced to the different mineral groups emphasizing their properties for megascopic and thin section identification and their distribution in different earth materials.
2. Study Crystallography which is the foundation of mineralogy, inorganic chemistry and material science, to understand the classification of different crystal systems, twinning types and its different law
3. Class lectures and practical, involving the study of crystal models and minerals hand specimens and thin sections.

Course Contents

Crystallography

Unit: 1 Crystal form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles, and crystallographic notation.
Unit: 2 Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems, and basic concept of twinning.

Mineralogy

Unit: 1 Common physical properties of minerals and Chemical properties of minerals.
Unit: 2 Classification of silicate structures, Introduction to Silica, Feldspar, Amphibole, Pyroxene, Olivine, Mica, Carbonate and Clay family of minerals.Polarizing microscope and its use and Optical properties of minerals.

Text Books:

TB1: Dana, E.S. and Ford, W. E.,2002. A textbook of Mineralogy (Reprints).
TB2: Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.
TB3: Nesse, D.W.,1986. Optical Mineralogy. McGraw Hill.

Reference Books:

RB1: Read, H.H., 1968.Rutley'sElement of Mineralogy (Rev. Ed.). Thomas Murby and Co.
RB2: Berry and Mason,1961. Mineralogy. W.H. Freeman &Co.
RB3: Kerr, B.F., 1995. Optical Mineralogy. 5thEd. McGraw Hill, New York.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the different properties of minerals, silicate structure, Polarizing microscope, Optical properties of mineral, Interfacial angle, Crystallographic axes, Miller system of notations, description of normal classes, and twinning.
CO2	Describe the mode of occurrences and uses of different mineral groups, silicate structures, optical properties of common minerals, description f normal classes of common crystal.
CO3	Differentiate different crystal systems based on symmetry and other properties of crystal and minerals, laws of twinning.
CO4	Analyze the interfacial angle by using contact goniometer, give different notations in crystal, Explain properties of minerals, Crystallographic axes.
CO5	Assess the different minerals on the bases of physical properties,optical roperties, crystal system on the bases of symmetry.
CO6	compose the concept of Polarizing microscope and twinning.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL 202				
Course Name : Lab Course based on GELDC201				
Semester /Year : II				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the common rock-forming minerals in hand specimens.

2. To understand the optical properties of minerals.

Course Content

Crystallography:

Study of symmetry elements of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

Mineralogy:

Study of physical and optical properties of common rock forming minerals.

Text Books:

TB1: Rabindra Nath Hota, Practical Approach to Crystallography and Mineralogy, CBS publishers and distributors pvt ltd; 2nd edition (30July 2017).

Reference Books:

RB1: C.D. Gribble, Rutley's Elements of Mineralogy, 27e [Print Replica] Kindle Edition; CBS publishers and distributors pvt ltd; Twenty-seven Edition (1 December 2005).

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify common rock-forming minerals in hand specimens.
CO2	Understand common rock-forming minerals in thin section.
CO3	Determination of system and class of crystals based on symmetry elements.
CO4	Analyze the hand specimen and rock slide.
CO5	Compare the hand specimen of minerals on the bases of Physical properties of minerals
CO6	Write the notations in crystal system.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	1	1	1	1	1	1	2	3	2	2	2
CO2	3	3	3	3	1	1	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	1	2	3	3	2	2	1	1	3	3	2	1	2
CO4	2	2	2	1	1	0	2	0	2	2	1	1	2	2	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester III

Course code : GELDC 301				
Course Name : Petrology				
Semester /Year : III				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understanding the textures, structures, classification of Igneous Rock.
2. To understanding the textures, structures, classification of Sedimentary Rock.
3. To understanding the textures, structures, classification of Metamorphic Rock.

Course Contents

Igneous Petrology

Unit: 1 Introduction to petrology, Magma: definition, composition, types and origin, Forms of igneous rocks, Bowen's reaction principle.
Unit: 2 Classification of igneous rocks, textures of Igneous rocks, and Structures of igneous rocks.

Sedimentary Petrology and Metamorphic Petrology

Unit: 3 Processes of formation of sedimentary rocks; Classification of Sedimentary rocks, textures of sedimentary rocks and Structures of sedimentary rocks.
Unit: 4 Process and products of metamorphism; Type of metamorphism. Factors, zones and grade of metamorphism; Textures and structures of metamorphic rocks.

Text Books:

TB1: Turner, F. J. &Verhoogen, J.,1960, Igneous & Metamorphic petrology. McGraw Hill Co.
TB2: Prasad, C.,1980. A text book of sedimentology
TB3: Mason, R., 1978.Petrology of Metamorphic Rocks. CBS Publ.

Reference Books:

RB1: Pettijohn, F.J.,1975. Sedimentary rocks, Harper& Bros.3rdEd.
RB2: Sengupta. S., 1997.Introduction to sedimentology. Oxford-IBH.
RB3: Moorhouse, WW., 1969.The study of rocks in thin sections. Harper and sons.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the properties of Igneous, Sedimentary and Metamorphic.
CO2	Discuss the formation, texture, structure of Igneous rock, Sedimentary rock and Metamorphic rock.
CO3	Explain the use of Petrography of Igneous, Sedimentary and Metamorphic rock, different structures of rocks, types of Metamorphism.
CO4	Classify the Igneous rock, Sedimentary rock and Metamorphic rock, Bowen's reaction principle,Petrography of rocks.
CO5	Distinguish between different type of rocks, chemical and mineralogical composition.
CO6	Write the process of metamorphism, agents of metamorphism, petrography of metamorphic rock, facies concept.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	0	2	1	2	2	0	2	0	1	1	3	0	2	2
CO2	3	1	3	1	0	2	2	2	1	2	2	3	2	3	3	1
CO3	2	3	2	1	2	0	1	1	1	2	1	1	2	2	1	1
CO4	3	2	2	2	2	1	1	3	2	2	2	0	3	2	2	2
CO5	2	1	1	1	0	0	0	1	1	0	2	0	1	1	1	1
CO6	1	2	2	2	0	0	1	2	1	1	1	0	1	2	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL 302				
Course Name : Lab Course based on GELDC 302				
Semester /Year : III				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the textures, structures of Igneous and Metamorphic Rock in hand specimen as well as in thin section/ microscope .
2. To understand the textures, structures of Sedimentary Rock sin hand specimen as well as in thin section/ microscope.

Course Contents

Igneous Petrology:

Identification of rocks: Detailed petrographic description of Igneous rocks in hand specimen and thin section.

Sedimentary and metamorphic Petrology:

Identification of sedimentary and metamorphic rocks both in hand specimen and thin sections.

Text Books:

TB1: Rabindra Nath Hota, Practical Approach to Petrology 2nd Edition, Kindle Edition, CBS publishers and distributors pvt ltd; 2nd edition (11 August 2020).

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe microscopic properties of igneous, sedimentary, and metamorphic rocks.
CO2	Compare different type of rocks in hand specimen and thin section.
CO3	Prepare the slides of different types of rocks.
CO4	Distinguish the rock in microscopic and macroscopic level.
CO5	Analyze the thin section of Igneous, Sedimentary rock and Metamorphic Rock.
CO6	Write the Physical properties of rocks in hand specimen.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	3	3	3	2	3	2	1	1	1	3	3	1	2
CO2	1	2	3	2	2	2	1	2	1	2	1	3	1	1	2	1
CO3	2	1	1	1	2	2	2	2	1	3	1	1	2	1	1	2
CO4	1	1	2	2	1	1	1	3	2	1	2	2	1	1	2	1
CO5	2	2	1	1	2	1	2	1	1	3	1	1	2	2	1	2
CO6	1	1	2	2	1	1	3	1	2	1	2	2	1	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester IV

Course code : GELDC 401				
Course Name : Stratigraphy				
Semester /Year : IV				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course aims at providing a basic understanding of the various stratigraphic units

2. To understand the concept of Geological Time Scale and Facies concept.

3. It aims to provide understanding of the Precambrian geology, stratigraphy, fossil content and the economic resources of the lithounits from the Peninsular India.

Course Contents:

Stratigraphy

Unit I: Definition, types of stratigraphy; Principles of Stratigraphy, Geological time scale and stratigraphic classification;Physiographic division of India.

Unit II: Study of following Precambrian succession: Archaean System, Dharwar, Singhbhum, Cuddapha, Vindhyanand Mesozoic type succession of Kutch and Cretaceous of Tiruchirapalli.

Unit III: Gondwana: classification and importance of Gondwana, and Deccan Trap.

Unit IV: Classification of Siwalik succession.

Text Books:

TB1: Wadia, D. N.,1973. Geology of India. McGraw Hill Book co.

TB: Krishnan, M.S.,1982. Geology of India and Burma,6th Edition. CBS Publ.

TB3: Ravindra Kumar,1985. Fundamentals of Historical Geology & Stratigraphy of India.Wiley, Eastern.

Reference Books:

RB1: Principle of Stratigraphy: Dunbar and Roggers, (1964), John Wiley and co, New York

RB3: Stratigraphic Principles and Practices: Weller, J.M, (1962), Harper & Bros, New York.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the fundamentals of stratigraphic principles and various methods of stratigraphic analysis will be provided.
CO2	Describe the concept of Geological Time Scale and Facies concept, Physiographic division of India, succession of Gondwana, Mesozoic, Siwalik, Decan traps.
CO3	Explain about the various age group rocks occurring in India and the boundaries separating them, Geological Time events of The Paleozoic, Gondwana, Triassic, Jurassic and Cretaceous and the Tertiary Group
CO4	Analyze the stratigraphic classification from craton, Proterozoic to Phanerozoic successionfrom India is the goal of this course.
CO5	Compare the stratigraphy succession on the bases of fossils, Dharwar and Archean.
CO6	Write the detailed significance of the Siwalik, Pleistocene, Holocene, Himalayas, and Eocene systems.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	1	2	1	1	2	1	2	2	3	1	1	0
CO2	2	0	0	1	0	0	2	0	1	1	0	0	2	1	1	0
CO3	3	2	2	1	2	1	2	0	1	2	1	3	3	3	2	1
CO4	3	2	1	1	0	0	1	2	2	2	2	0	3	1	1	2
CO5	1	2	1	1	2	1	0	2	0	0	1	0	2	1	1	0
CO6	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL 402				
Course Name : Lab Course Based on GELDC 401				
Semester /Year : IV				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Be able to locate the resources based on fossils.

2.To learn identify the fossils.

Course Contents

- Preparation of lithostratigraphic maps of India showing distribution of important geological formations.
- Assigning stratigraphy Formations based on fossils.
- Study of specimens representing rock formations of Dehradun.

Text Books:

TB1: Rajeeva Guhey (1 January 2017), Geology: Principles and Practical Manua; New India Publishing Agency**.**

Reference Books:

RB1: Ramakrishnan, M and Vaidynadhan, R., (1994), Geology of India, Geological Society of India Publication, Bangalore. Vol. I and II.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the stratigraphy sequences of various formation.
CO2	Identify hand specimens representing rock Formations of Dehradun.
CO3	Solve problems in stratigraphic correlation.
CO4	Explain the lithostratigraphic maps of India showing geological formation.
CO5	Discriminate stratigraphy Formations based on fossils
CO6	Write the various stratigraphic horizons in outline map of India

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	2	1	2	1	2	3	2	1	3	2	1
CO3	1	2	1	1	2	2	2	1	1	2	1	1	2	3	1	3
CO4	2	1	2	2	1	2	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	2	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester V

Course code : GELDC 501				
Course Name : Palaeontology				
Semester /Year : V				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn about the remains of plants and animals which have been preserved in the earth's crust by natural processes. With these objectives keeping in views of mind it becomes pertinent to understand the basic concepts of Paleontology

2. It would add to their knowledge regarding the basic concept of paleontology using mode and methods of fossil preservation and species identification

3. To learn about the vertebrate paleontology and Paleobotany.

Course Contents

Unit 1: Paleontology, definition, subdivisions and scope, Fossils: definition, characters, mode of preservation, condition of fossilization and significance of fossils, Trace fossils and Ichno-fossils and Index Fossils.

Unit 2: Elementary ideas about origin of life and adaptation to various environments. Systematic classification of organisms.

Unit 3: Invertebrate Paleontology- Morphology, classification, evolutionary trends, and geological distribution of Brachiopods, Lamellibranches, Gastropods, Cephalopods, and Trilobites**.**

Unit 4: Vertebrate Paleontology: Introduction of Siwalik vertebrate fauna- Equidae, Proboscidea and Hominidae**.**

Unit 5: Introduction to Paleobotany; fossil record of plants through time; Gondwana Flora.

Text Books:

TB1: Raup, D. M., Stanley, S. M., Freeman, W. H. (1971). Principles of Paleontology.

TB2: Clarkson, E. N. K. (2012). Invertebrate paleontology and evolution 4th Edition by Blackwell Publishing

TB3: Moore, R.C. Lalliker, C.G. and Fischer, A.G. (1952). Text book of Invertebrate Palaeontology.

Reference Books:

RB1: Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.

RB2: Schrock, Twenhofel and Williams (1953). Principles of Invertebrate Palaeontology. CBS,

RB3: Shukla, A. C. and Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the concept of fossils, conditions and modes for fossilization**,** Invertebrate, vertebrate Paleontology, paleobotany and Micropaleontology.
CO2	Describe the morphology of the hard parts of different phyllum's and geological time range.
CO3	Explain the origin and evolution of life through geological time and the major evolutionary breakthroughs, and to correlate the evolutionary history with other synchronous geological events.
CO4	Analyze the condition of fossilization and significance of fossils, classification of organisms. Distinguish between different phyllum.
CO5	Distinguish between the Upper Gondwana and Lower Gondwana**,**
CO6	Write the collection techniques of fossils, mode of preservation, types of fossils.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	1	0	0	0	2	0	1	1	3	3	1	2
CO2	1	3	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	0	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL 502				
Course Name : Lab Course based on GELDC 501				
Semester /Year : V				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn about the Important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significance.

2. Be able to get application of fossils in Stratigraphy.

Course Contents

- Morphological characters, systematic position and age of fossil genera pertaining to brachiopods, pelecypods, cephalopods, and trilobite.
- Study of plants fossils.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	list the identification of fossils.
CO2	Describe the fossils/casts/shells w.r.t their morphology and geological age.
CO3	Demonstrate the collection of the rock sample from the field
CO4	Analyze the formation of rock based on fossils.
CO5	Compare the rock succession based on fossils.
CO6	Write uses of the animal and Plant fossils.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	0	0	0	2	1	0	1	3	1	0	2
CO2	2	2	1	2	1	1	0	0	0	2	1	2	1	3	0	1
CO3	1	3	1	1	2	1	0	0	0	3	1	1	2	3	0	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	0	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	0	3
CO6	2	1	2	2	1	1	0	0	0	1	2	2	1	3	0	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester VI

Course code : GELDC 601				
Course Name : Economic Geology				
Semester /Year : VI				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The student is introduced to the basic principles of Economic geology.

2. To learn about the hydrological cycle, origin of ground water and groundwater exploration methods.

Course Contents

Unit: 1 Concept of ore and ore deposits, ore minerals and gangue minerals; Tenor of ores; Metallic and non-metallic ore mineral.

Unit: 2 Processes of formation of ore deposits; Magmatic, Mechanical and residual concentration, contact metasomatic, hydrothermal, sedimentation, oxidation, supergene enrichment.

Unit: 3 Occurance of important metallic and non-metallic minerals of India, Strategic, Critical and essential minerals, mineral resources of Uttarakhand. Brief idea about the coal and petroleum occurances in India.

Text Books:

TB1: Brown, C. and Dey, A.K.1955. Indian Mineral Wealth. Oxford Univ.

TB2: Umeshwar Prasad, 2003. Economic Geology. CBS Publishers and distributors.

Reference Books:

RB1: Krishnaswamy, S., 1979.India's Minerals Resources. Oxford and IBH Publ.

RB2: Sharma, N.L. and Ram, K.V.S., 1972. Introduction to India's Economic Minerals, Dhanbad.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the basic principles of economic geology, Processes of formation of ore deposits, metallic minerals, coal, petroleum.
CO2	Describe the economic value of the ores.
CO3	Explain the formation of ore deposits.
CO4	Analyze Demand and supply of ores and Mineral conservation.
CO5	Distinguish between various ore deposits of India.
CO6	Write the concept of metallic and non-metallic minerals.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	0	0	0	2	1	0	1	3	1	0	2
CO2	2	3	1	2	1	1	0	0	0	2	1	2	1	3	0	1
CO3	1	3	1	1	2	1	0	0	0	3	1	1	2	3	0	3
CO4	2	1	0	2	0	1	3	1	2	1	0	2	1	3	0	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	0	3
CO6	2	1	2	2	1	1	0	0	0	1	2	2	1	3	0	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL 602				
Course Name : Lab Course based on GELDC 601				
Semester /Year : VI				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To analyze the Ore samples.
2. To learn about the preparation of Ore map.

Course Contents

Economic Geology: Study of ore and economic minerals in hand specimen; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

Text Books:

TB 1: Umeshwar Prasad, 2003. Economic Geology. CBS Publishers and distributors.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify samples of ore deposits.
CO2	Describe the distribution of minerals in India.
O3	Uses of maps showing distribution of important metallic and non-metallic deposits in India.
CO4	Analyze the samples of economic minerals.
CO5	Compare the different ore minerals.
CO6	Write importance of coal and oil fields of India.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	0	0	0	2	1	0	1	3	1	0	2
CO2	2	2	1	2	1	1	0	0	0	2	1	2	1	3	1	1
CO3	1	0	1	1	2	1	0	0	0	3	1	1	2	3	0	3
CO4	2	1	1	2	1	0	3	1	2	1	0	2	1	0	1	1
CO5	1	3	1	1	2	1	2	0	1	3	1	1	2	3	0	3
CO6	2	1	2	2	1	1	0	0	0	1	2	2	1	3	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester -VII

Course code	**: GELDC 701**				
Course Name	**: Advanced Structural Geology**				
Semester /Year	**: VII**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The present course will teach the student how to unravel the underlying deformation processes and mechanisms through an accurate geometric and kinematic analysis of these natural structures.
2. The present course will teach the dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales, which manifests in a variety of complex structures in these rocks.

Course Content:

Unit1: Definition and scope of structural geology, properties of rocks and factors affecting the deformation behavior of rocks.
Unit2: Theory of stress and strain, Mohr's Circles, strain, and stress ellipsoids.
Unit3: Geometry and Classification of fold & Mechanics of folding, and distribution of strains in folds.
Unit4: Geometry, Causes and dynamics of faulting: joints, foliations and lineation, unconformities. Salt domes and diapairs

Text Books:

TB1: Ghosh, S.K.: Structural Geology, Fundamental and Modern Concepts, Pergamon Press.

TB2: Ramsay J.G. (1967): Folding and fracturing of Rocks, McGraw Hill Pub.

TB3. Ramsay J.G. & Huber, M. I. (1983): The Techniques of Modern Structural Geology-I, Strain Analysis, Academic Press.

Reference Books:

RB1: Turner, F.J.& Weiss, L. E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill publ.

RB2: Jain, A, K, advance structural analysis, Nemchand and bros.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define geometric description of the structures observed in natural deformed rocks.
CO2	Describe the basic scope of structural geology, properties of rocks and factors affecting the behavior of rocks.
CO3	Classify the fold, fault, joints and unconformities and other structures
CO4	Analyze kinematics of deformation, theory of stress, strain and stress ellipsoids
CO5	Compare the Strain marker and Measurement of strain in deformed rocks the stresses when rocks go under the deformation by using Mohr's circle
CO6	Write uses of cleavage and lineation in rock deformation.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	3	3	3	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	3	3	3	1	3	1	1	2	3	1	3
CO4	2	1	2	2	3	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	0	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL702				
Course Name : Lab Course based on GELDC701				
Semester /Year : VII				
	L	**T**	**P**	**C**
			2	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the structural problems, Preparation and interpretation of geological maps and sections.

Course Content:

Structural Geology

- Preparation and interpretation of geological maps and sections.
- Structural problems.

Text Books:

TB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency- Nipa

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	List the types of deformation in rocks.
CO2	Describe preparation and interpretation of geological maps and sections.
CO3	Demonstrate the concept of folding and faulting.
CO4	Classify the stereographic projection.
CO5	Compare the strain data from deformed object.
CO6	Write the significance of geological cross section on different scales (1:25,000, 50,000 & 1:50,000).

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester -VIII

Course code	**: GELDC 801**			
Course Name	**: Geotectonics**			
Semester /Year	**: VIII**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The objective of this course is to understand the basic concept of continental drift and supporting evidences, Geomagnetic fields, palaeo-magnatism, polar wander, geomagnetic pole reversal, sea floor spreading.
2. The objective of this course is to understand the basic concept of Plate boundaries, plate motion and dynamics.
3. The objective of this course is to understand the basic concept of Relative plate motion -geodetic measurement, seismology, internal structure of the earth and to understand the geodynamics of Indian plate and evolution of Himalayas

Course Content:

Unit1: Evidence of continental drift, mechanics, objections and present status, Concept of Sea floor spreading, of and Plate Tectonics and evolution of Himalayas.
Unit2: Major tectonic features of the oceanic and continental crust, island arcs, oceanic islands and volcanic arcs, Gravity and magnetic anomalies at mid oceanic ridges**.**
Unit3: Seismic belts of the earth & seismicity and mountain chains, their global distribution and evolution.
Unit4: Palaeo-magnetism, Polar Wandering and reversal of earth's magnetic field.

Text Books:
TB1: Condie Kent, C. (1989): Plate Tectonics and Crustal Evolution.
TB2: W. J. Kious & Robert I.T.: The dynamic of Earth: the story of Plate Tectonics USGS publ.
TB3: Moores, E. & Twiss, R.J.,1995: Tectonics. Freeman publ.

Reference Books:
RB1: Keary, P.&Vine,F. J.1990: Global Tectonics. Blackwell scientific publ.
RB2: Storetvedt, K.N.1997: Our Evolving Planet. Earth History in new perspective.
RB3: Valdiya, K.S.1998: Dynamic Himalaya. Univ. Press.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Define the dynamic nature of the Earth processes,
CO2	Describe the geodynamics of the lithosphere and concept of isostasy, ocean floor spreading, continental drift, plate tectonics.
CO3	Explain the present geophysical and geological evidence for the processes operating in modern tectonic systems
CO4	Analyze the major continental features and oceanic features and other tectonic features
CO5	Compare the seismicity and their global distribution on earths and geodynamics of Indian plate
CO6	Write about the Palaeo magnetism and paleo magnetic maps, polar wandering curve.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	0	2	2	1	2	1	1	1	1	1	2	3	2	2	2
CO2	3	1	3	3	1	3	3	3	3	2	3	1	3	3	3	3
CO3	3	0	2	1	2	3	3	2	2	1	1	3	1	2	1	2
CO4	2	1	2	1	1	0	2	0	2	2	1	1	2	2	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDL802				
Course Name : Lab Course based : GELDC801				
Semester /Year : VIII				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course will provide the basic understanding of stereographic projection by using the field data.

Course Content:

Geotectonics

- Stereographic presentation of structural data
- Preparation of Stereographic projection.

Text Books:

TB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency- Nipa

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the plate motion
CO2	Describe the concept of plate tectonics
CO3	Analyze different plate boundaries.
CO4	Classify deformation structure in different outcrops.
CO5	Uses to Draw the Stereographic presentation of structural data,
CO6	To develop the structural projection.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	1	1	1	1	1	1	2	3	2	2	2
CO2	1	3	3	3	1	1	2	3	3	2	3	3	3	3	3	3
CO3	1	2	2	1	2	0	3	2	2	1	1	1	3	2	1	2
CO4	2	2	2	1	1	0	2	0	0	2	1	1	2	2	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Generic Elective Courses
I SEMESTER

Course code : GELGE103				
Course Name : Introduction to Geology-I				
Semester /Year : I				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the basic concept of geology
2- To understand the knowledge of Earths structures
3- To understand the process of formation of soil

Course content

Unit1- Definition and Scope of Geology, Importance of Geology in Everyday Life, Branches of Geology

Unit2- Layers of the Earth: Crust, Mantle, Core, Lithosphere and Asthenosphere, Earth's Magnetic Field.

Unit3- Processes of weathering and erosion: factors, types and their effects and soil formation, basic concepts of Earthquakes and Volcanoes

Text books

TB1: Mahapatra, G.B., 1994. A text book of Physical Geology. CBS Publishers

Reference books

RB1: Holmes, A & P.L. Duff. (1996). Principles of Physical Geology, 4th revised edition, ELBS, London

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define geology and its branches
CO2	Describe the structure of Earth interior and exterior
CO3	Explain about the importance of geology
CO4	Analyse the earth magnetic field and importance
CO5	Compare the process of weathering and soil formation
CO6	Develop the concept of origin of Earth

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

II SEMESTER

Course code : GELGE203				
Course Name : Introduction to Geology-II				
Semester /Year : II				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the basic concept of rock types
2- To understand the minerals properties etc.
3- To understand the basic structure of geology etc.

Course content

Unit1- Definition and Types of Rocks: Igneous, Sedimentary, and Metamorphic.
Unit2- Definition and scope, physical properties of minerals, Major Mineral Groups
Unit3- Geological structures, Geological time scale and stratigraphic classification; Physiographic division of India,

Text books

TB1: Prasad, C.,1980. A text book of sedimentology
TB2: Billings, M.P., 1972.Structural Geology. Prentice Hall.

Reference books

RB1: Pettijohn, F.J.,1975. Sedimentary rocks, Harper& Bros.3rdEd.
RB2: Gokhale, N.W. (1995), Theory of Structural Geology, CBS, Delhi.
RB3: Read, H.H., 1968.Rutley'sElement of Mineralogy (Rev. Ed.). Thomas Murby and Co.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Identify the different type of rocks
CO2	Discuss the basic information of rocks and minerals
CO3	Explain the concept of petrology and mineralogy
CO4	Analyse the geological structures and nature
CO5	Compare the geological time scale etc.
CO6	Write the concept of geological processes

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

III SEMESTER

Course code : GELGE303				
Course Name : Introduction to Geology-III				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the basic concept of natural resources
2- To understand the natural hazards
3- To understand the role of geology in engineering

Course content

Unit1- Natural Resources: Minerals, Fossil Fuels, Water, Environmental Impact of Resource Extraction
Unit2- Geological Hazards: Earthquakes, Landslides, Floods, Volcanoes, Sustainable Practices in Geology
Unit3- Definition and Scope of Engineering Geology, Role of Engineering Geologists in Civil Engineering Projects, Historical Case Studies

Text books

TB1: "Energy Resources and Systems: Fundamentals and Non-Renewable Resources" by Tushar K. Ghosh and Mark A. Prelas

Reference books

RB1:"Environmental Impacts of Mining Activities: Emphasis on Mitigation and Remedial Measures" by Jose M. Azcue
RB2:"Water Resources Engineering" by Larry W. Mays

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the natural resources
CO2	Describe the basic about the natural resources
CO3	Classify the natural resources and their impact
CO4	Analyse the hazards zonation area and their impact
CO5	Explain the sustainable practices in geology
CO6	Write or develop an idea about the engineering projects

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester IV

Course code	**:**	**GELGE403**			
Course Name	**:**	**Introduction to Oceanography**			
Semester /Year	**:**	**IV**			
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The student is introduced to the basic principles of Oceanography.
2. To teach the properties of sea water, deep ocean circulation.

Course Contents

Unit: 1 Ocean Floor topography and terminology- Continental Shelf, Continental Slope, Continental Margin, Continental Rise, Submarine Canyons, Mid ocean Ridges, Trenches, and Abyssal Plains.

Unit: 2 Definition and terms, Wave theories, Classification; progressive wave, shallow water wave, Seismic Sea wave, wind wave, stationary wave, deep and shallow water wave, tide, and types of tides.

Unit: 3 Salinity and chlorinity; temperature; physical properties of sea water, density,conductivity, viscosity, heat budget and residence time of constituents in sea water.

Text Books:

TB1: David Tolmazin (1985). Elements of Dynamic Oceanography, Allen and Unwin.
TB2: Grant Gross, M. (1977).Oceanography; A view of the Earth, Prentice Hall.

Reference Books:

RB1: Keith Sverdrup et al: Fundamental of Oceanography**.**
RB2: Alan Trujilo & Harold V. Thurman: Essential of Oceanography**.**

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Define the basic principles of Oceanology, properties of seawater, El Nino and deep Ocean circulation.
CO2	Describe the Methods of measuring properties of seawater ocean floor topography, residence time in sea water, thermal properties of sea water.
CO3	Explain the concept of El Nino and deep Ocean circulation, wave theories.
CO4	Analyse how our understanding of plate tectonics and evolution of earth comes from The study of the oceans.
CO5	Compare the major physical and chemical properties of sea water, concept of mixed layer, concept of upwelling.
CO6	Write the concept of El Nino, deep Ocean circulation, Wave theories and its classification, Salinity and chlorinity.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester V

Course code	**: GELGE 503**			
Course Name	**: Geology of Uttarakhand**			
Semester /Year	**: Vth**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide basic conceptual understanding of Geology of Uttarakhand.
2. To understand Tectonic division of Uttarakhand
3. To build skills to respond to rock deformation

Course Contents

Unit 1. Broad setup of Himalaya; Geographic setup of the Himalaya; Himalaya as an orogenic belt.

Unit II. Geological and tectonic divisions of the Himalaya; Characteristics of tectonically active mountains; tectonic division of Uttarakhand.

Unit III. Geomorphology, Stratigraphy, Structure and Tectonics of Uttarakhand, origin and evolution of Himalaya.

Text Books:

TB1: Valdiya, K.S. 1980. Geology of Kumaun Lesser Himalaya.
TB2: Valdiya, K.S. 1987. Environmental Geology-Indian Context. Tata McgrawHill.
TB3: Biyani, A.K. 2006. Dimensions of Himalaya, SSPH, Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the Geology and Geomorphological setup of Uttarakhand.
CO2	Describe the process of crustal processes, tectonics and orogenies.
CO3	Explain the different stratigraphic formations and structures
CO4	Analyze Tectonics and deformation
CO5	Distinguish between various tectonic boundaries of Uttarakhand
CO6	Write the concept of origin of the Himalaya.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO 2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO 3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO 4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO 5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO 6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester VI

Course code : GELGE 603				
Course Name : Disaster: Case studies of Uttarakhand				
Semester /Year : VI				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide basic conceptual understanding of disasters.
2. To understand approaches of Disaster Management
3. To build skills to respond to disaster

Course Contents:

Unit: I, Definition and types of Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods & drought, landslide, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit: II, Case studies of 1970; 1978 and 1998. Landslide and its managements case studies of disasters in Uttarakhand (e.g. Earthquakes, Landslide). Social Economics and Environmental impact of disasters.

Unit-III, Case studies of June 2013 Kedarnath disaster, July 2018 Kerala disaster, Feb 2021 Uttarakhand disaster, Maldevta disaster 2023, and Dharli disaster 2025.

Text Books:

TB1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)

TB2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.

TB3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the concept of Hazards and Disaster.
CO2	Describe the approaches for risk and vulnerability assessment.
CO3	Explain the causes of disaster.
CO4	Analyze the impacts of disasters
CO5	Distinguish between various natural and manmade disaster
CO6	Developed the understanding for selecting residential and business locations

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	3	3	2	2	1	1	2	2	1	1	3	3	2	2	2
CO 2	3	2	3	3	0	1	2	1	1	3	2	2	1	2	3	3
CO 3	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1
CO 4	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1
CO 5	2	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1
CO 6	1	1	1	0	0	1	1	1	1	0	1	1	1	1	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Discipline Specific Elective Courses
Semester III

Course code	**:**	**GELDE306**			
Course Name	**:**	**Geohydrology**			
Semester /Year	**:**	**III**			
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The student is introduced to the basic principles of hydrology.

2. To teach the vertical distribution of groundwater, Surface and subsurface geophysical and geological methods of groundwater.

Course Contents

Unit I: Introduction and scope of hydrology, source of water, Hydrologic cycle: precipitation, evapo-transpiration, run-off, infiltration, porosity and permeability.

Unit II: Aquifers and their types, introduction of Darcy law, Erosion, transportation and depositional features of groundwater, water table, Specific Yield and Specific retention, hydraulic conductivity, transmissivity, cone of depression, water balance equation.

Unit III: Surface and sub-surface methods of ground water exploration.

Unit IV: Elementary concept on groundwater pollution, Rainwater harvesting and artificial recharge of groundwater.

Text Books:

TB1: Todd. D.K**,** ground water hydrology, wiley pub.

TB2: S.N. Davis and R.J.M. De Weist, Hydrogeology, John Wiley and Sons, N.Y.

Reference Books:

RB1: Karanth, K. R., 1989. Hydrogeology. Tata Mc Graw Hill Publ.

RB2: H.M. Raghunath, Groundwater, (3rd Edition) , New Age International Publishers, New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the principles of Hydrology and methods of groundwater.
CO2	Describe the Hydrological cycle, origin of groundwater, geophysical methods.
CO3	Explain the water bearing properties of rocks, vertical distribution of groundwater, water table, Solve the problem based on Specific Yield and Specific retention, Transmissivity.
CO4	Analyze the concept of surface and subsurface water flow and groundwater pollution, rainwater harvesting, and groundwater pollution.
CO5	Distinguish between among Aquifers and water bearing properties and different geological methods. Cone of depression, numerical based on Transmissivity.
CO6	Write the concept of Darcy's Law; Hydrological cycle, write about geophysical methods, groundwater pollutions.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	2	3	1	3	1	2	1	2	1	2	3	2	1	1	2	1
CO3	1	3	1	2	2	2	2	1	1	2	1	1	1	1	1	3
CO4	2	2	2	2	3	3	3	1	2	1	2	2	1	1	2	3
CO5	1	1	1	3	2	2	2	2	1	1	1	1	2	1	1	3
CO6	2	1	2	1	1	1	1	1	2	1	2	2	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:**	**GELDE307**			
Course Name	**:**	**Natural Hazards and Mitigation**			
Semester /Year	**:**	**III**			
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1.This course is designed to understand the Hazards.

2. Understand the knowledge for prevention techniques for natural hazards.

Course content

Unit 1: Introduction to natural hazards and disasters, The lithosphere and related hazards Atmospheric hazards, Hydrosphere and Related hazards, Human impact on natural disaster.

Unit 2: Atmospheric circulation – Definition, types, causes. drought hazards, flooding hazards.

Unit 3: Definition, types, causes, effects and prevention techniques of earthquake hazard, landslide hazards, volcanic eruptions and tsunami.

Unit 4: Marine pollution, ocean wave hazards, sea ice hazards, sea level rise hazards, beach erosion hazards, Remote-sensing and GIS applications in hazards monitoring.

Textbooks

TB1: Monroe, J. S., Wicander, R., and Hazlett, R. (2007). Physical Geology: Exploring the Earth. Sixth Edition.

TB2: Strahler, A. Introduction to Physical Geology. Pub. John Wiley & Sons, Inc. page 632.

TB3: Hyndman, D., and Hyndman, D. (2011). Natural Hazards and Disasters. Third Edition. Pages 571.

Reference books

RB1: Mahapatra, G. P. (1994). Physical Geology, CBS Publishers, New Delhi.

RB2: Radhakrishnan, V. (1996). General Geology, V.V.P. Publishers, Tuticorin.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the concepts of hazards.
CO2	Describe the causes and consequences of earthquake, landslide, atmospheric circulation, drought and Flood.
CO3	Apply the knowledge for prevention techniques for natural hazards.
CO4	Analyze the various natural hazards and its impact and preparation of hazards map.
CO5	Evaluate the risk reduction techniques and methods.
CO6	Write about the different type of landslide, Earthquake, Flood, Remote-sensing and GIS applications.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	3	3	2	3	1	2	1	2	1	2	3	2	1	1	2	1
CO3	1	3	1	2	2	2	2	1	1	2	1	1	1	1	1	3
CO4	2	2	2	2	3	3	3	1	2	1	2	2	1	1	2	3
CO5	1	1	1	3	2	2	2	2	1	1	1	1	2	1	1	3
CO6	1	1	2	0	1	0	2	1	2	0	2	2	0	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester IV

Course code : GELDE406				
Course Name : Marine Geology				
Semester /Year : IV				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the marine geology
2- To understand the ocean floor topography
3- To understand the evolution of oceans

Course content

Unit1:- History of Marine Geology, Scope and Applications of Marine Geological Investigations. Marine sediments, sources and composition, sediment types and distribution

Unit2:- Ocean Floor topography-- Continental margins: continental shelf and slope, its origin, continental rise; Submarine canyon and their origin, Oceanic ridges: Ridges, fracture zones; Ocean basins: Abyssal plains, Abyssal hills, Seamounts and guyots, Marginal trenches.

Unit3:- Submarine volcanism, Tsunamis – causes and effects. Coral reefs – their nature and theory of atoll formation. Sea level changes, causes and types of sea level changes

Unit4:- Evolution of Oceans: Structure and evolution of Pacific, Atlantic and Indian Oceans, Red Sea and Mediterranean Sea. Oceanic circulations

Text books

TB1: "Marine Geology" by James P. Kennett

TB2: "Geology of the Indian Ocean" by R. Sengupta and E. Desa

Reference books

RB1: "Marine Geology and Oceanography of Arabian Sea and Coastal India**" edited by R. R. Nair and V. R. Rao**

RB2: "Sedimentary Basins of India: Tectonic Context**" by M. Ramakrishnan and R. Vaidyanadhan**

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and classify different types of marine sediments and their origins.
CO2	Discuss the fundamentals of marine geology
CO3	Explain the processes governing the formation and evolution of ocean basins
CO4	Identify and analyze marine geohazards**,** understanding their causes, effects, and mitigation measures
CO5	Evaluate the types, distribution, and methods of exploitation of marine resources
CO6	Assess coastal processes and their impact on coastal geomorphology**,** including the influence of human activities

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	3	3	2	2	1	2	1	2	1	2	3	2	1	0	2	1
CO3	1	3	1	2	2	2	2	1	0	2	1	0	1	0	1	0
CO4	3	2	2	2	3	3	3	1	0	1	2	2	1	1	2	3
CO5	1	1	1	3	2	2	2	2	1	1	1	1	2	1	1	3
CO6	2	1	2	0	1	1	2	1	2	0	2	0	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:**	**GELDE407**			
Course Name	**:**	**Glaciology**			
Semester /Year	**:**	**IV**			
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the basic about the glacier
2- To understand the process of glaciation
3- To understand the land forms developed by glacier

Course content

Unit1:-Introduction to Glaciology**:** History and Scope of Glaciology Types of Glaciers and Ice Sheets
Unit2:- Glacial Processes: Formation and Movement of Glaciers, Glacial Erosion and Deposition
Unit3:- Glacial Geomorphology: Landforms Created by Glaciers, Glacial Sedimentology, and remote Sensing Techniques for Glacial Studies
Unit4:- Climate and Glaciers: Interaction between Glaciers and Climate, Ice Ages and Paleoclimatology

Text books

TB1: "Glaciers and Glaciation" by Douglas I. Benn and David J.A. Evans
TB1: Glacier Science and Environmental Change" edited by Peter G. Knight

Reference books

RB1:" "Principles of Glacier Mechanics" by Roger LeB. Hooke
RB2:" Fundamentals of Glacier Dynamics" by C.J. van der Veen

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Define the different types of glaciers and ice sheets, their characteristics, and their global distribution.
CO2	Describe the landforms created by glacial activity and the processes of glacial erosion, transportation, and deposition
CO3	Comprehend the relationship between glaciers and climate, including the impact of climate change on glaciers
CO4	Analyse and utilize remote sensing techniques and Geographic Information Systems (GIS) to study and monitor glaciers
CO5	Apply interdisciplinary methods to address complex questions and problems related to glaciers and the cryosphere
CO6	Develop the ability to design and conduct independent research projects in glaciology

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	3	3	2	2	1	2	1	3	1	2	3	2	1	0	2	1
CO3	2	3	1	2	2	3	2	1	0	2	0	0	1	0	1	1
CO4	1	2	2	2	0	2	3	1	0	1	2	2	1	1	2	0
CO5	3	1	1	3	2	2	2	2	1	3	1	1	2	1	1	2
CO6	2	1	2	1	1	1	2	1	2	0	2	0	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester V

Course code	**:**	**GELDE 506**			
Course Name	**:**	**Geochemistry**			
Semester /Year	**:**	**V**			
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course is designed to understand high-T and low-T geochemical processes that operate in the earth's deeper and near-surface environments
2. The major task of geochemists is to know the physical and chemical laws governing the abundance, distribution and migration of chemical elements from one sphere to another sphere of the Earth i.e. chemical differentiation of the Earth

Content

Unit 1: Composition of Earth and its constituents (Crust, mantle and core); Ionic and co-ordination number; Rules of ionic substitution, coupled substitution; Distribution coefficient: Capture admission and camouflage, Geochemical classification of elements; Behavior of major and trace including rare earth elements during magmatic crystallization.
Unit 2: Near-Earth surface geochemical environment: Eh pH diagram; Principle of chemical mass balance and rock-cycle; Chemical weathering of minerals and rocks.
Unit 3: Introduction of Stable isotopes geochemistry, Fission Track (FT) and OSL dating techniques.

Text Books:
TB1: Allegre, C.J. and Michard, G. (1974). Introduction to Geochemistry, Reidel, Holland.
TB2: Evans, R. C. (1964). Introduction to Crystal Chemistry, Cambridge Univ. Press.
Reference Books:
RB1: Faure, G. (1986). Principles of Isotope Geology,2nd Edn., John Wiley.
RB2: Misra, K. C. (2012). Introduction to Geochemistry: Principles and Applications, Wiley-Blackwell

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the basic concept of the Geochemistry and Geochronology, Structure of earth, geochemistry of earth, geochemical behavior of different elements, Stable isotopes geochemistry.
CO2	Discuss the geochemical classification of elements, Major, minor and trace and elements.
CO3	Explain element partitioning in minerals and rocks. and Radiactive isotopes.
CO4	Classify the Fission Track (FT) and OSL dating techniques; Dendrochronology and Lichenometry
CO5	Distinguish between the different Layer of Earth, chemical weathering of mineral and rocks.
CO6	Write the chemical composition characteristics of the Earth,

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	0	1	1	0	0	0	1	1	1	1	2	2	2
CO2	2	0	1	1	0	1	1	2	3	2	1	3	1	1	2	1
CO3	1	1	1	1	1	2	1	2	0	1	1	3	3	2	0	0
CO4	2	1	2	1	1	0	2	0	2	2	1	1	2	0	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	0	1	1	1	0	1	1	0	1	1	1	0	0	0	0

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDE 507				
Course Name : Evolution of life through time				
Semester /Year : V				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1 To Understand the concept of origin of life.
2 To Understand the Geological Scale of Life.

Coure Content

Unit 1: Fossils and chemical remain of ancient life. Geological Time Scale with emphasis on major bio-events. Biomineralization and skeletalization.
Unit 2: Mechanism of evolution. Biogeochemical cycles, Biostratigraphy and chronostratigraphy, Role of fossils in correlation.
Unit 3: Archean life: Earths oldest life, transition from Archean to Proterozoic; the oxygen revolution and radiation of life, Precambrian macrofossils: The garden of Ediacara.
Unit 4: The Cambrian explosion. Origin of vertebrates and radiation of fishes. Origin of mammals. Rise and fall of dinosaurs. Origin of birds; spread of flowering plants. Rise of modern plants and vegetation.

Textbooks

TB1: J.I. Lumine and W.H.Freeman, Earth-Evolution of a Habitable World , Cambridge University Press.
TB2: D.E. Can eld and K.o. Konhauser, Fundamentals of Geobiology, Blackwell.

Reference book:

RB1: R. Cowen, History of Life, Blackwell.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the concept of how the concept of geological time is an important factor in our understanding of the evolution of the Earth System.
CO2	Discuss the Geological Time Scale**,** Biostratigraphy and chronostratigraphy, Role of fossils in correlation, Origin of life.
CO3	Explain how the biosphere has adapted to exploit various environments in the Earth's oceans over time.
CO4	Classify the stages of the hypothesis for the origin of life on Earth by chemical evolution.
CO5	Compare the basic geological principles and geoscience knowledge in the interpretation of Earths geological and biological history.
CO6	Write the concept of origin of life, Archean life, Proterozoic, Cambrian life, Jurassic.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1	1	1	0	0	0	1	1	1	1	2	2	2
CO2	1	0	2	1	0	1	1	2	3	2	1	3	1	0	2	0
CO3	1	1	1	1	1	2	1	2	0	1	1	3	3	2	0	0
CO4	2	0	2	1	1	0	2	1	2	2	1	1	2	0	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	0	1	1	1	0	1	1	0	1	1	1	1	0	0	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester VI

Course code : GELDE 606				
Course Name : Sedimentology				
Semester /Year : VI				
	L	T	P	C
	3	1	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are:

The course in-depth knowledge about the types and origin of sedimentary rocks, and source-to- sink sedimentary processes. It emphasizes upon the modern concepts of paleoenvironmental analysis, as well as provenance determination of sedimentary rocks. The course content deals with all the essential aspects required in exploring oil and natural gas, underground water, mechanically concentrated mineral deposits (placer deposits), and building stones

Course Contents

Unit 1: Introduction of Sedimentology and its uses**,** Sedimentary texture, and textural parameters and their significance, sediment transport, bedforms and sedimentary structures. Allogenic and autogenic controls on sedimentation. Paleocurrent analysis and its significance
Unit 2: Basic Concept of sedimentary facies, Classification of Sedimentary rock.
Unit 3: Types, classification and petrogenesis of common sedimentary rocks, Evaporites: Gypsum and anhydrite, Diagenesis- physical and chemical processes, Provenance of sedimentary rock.

Text Books:

TB1: Blatt, H., Middleton, G.V. and Murray, R.C. (1980). Origin of sedimentary rocks. Prentice Hall Inc.
TB2: Collins, J.D. and Thompson, D.B. (1982). Sedimentary structures. George Allen and Unwin, London

Reference Books:

RB1: Pettijohn, F.J. (1975). Sedimentary rocks (3rd Ed), Harper and Row Publ., New Delhi.

RB2: Lindholm, R.C. (1987). A practical approach to sedimentology. Allen and Unwin, London

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the types and origin of sedimentary rocks, and source- to-sink sedimentary processes, facies, petrography.
CO2	Discuss the modern concepts of Palaeoenvironmental analysis, as well as provenance determination of sedimentary rocks, sedimentary texture.
CO3	Apply the petrography detail on the identification of sandstone, sedimentary facies concept identification of environment.
CO4	Differentiate among limestones and dolomites. Evaporites: Gypsum and anhydrite, Allogenic and autogenic controls on sedimentation.
CO5	Comapare on the bases of environment measures different facies, structures, and texture.
CO6	Write the concept of Palaeocurrent analysis and its significance, Digenesis process.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	1	2	1	1	2	1	2	2	3	1	1	0
CO2	2	0	0	1	0	0	2	0	1	1	0	0	2	1	1	0
CO3	3	2	2	1	2	1	2	0	1	2	1	3	3	3	2	1
CO4	3	2	1	1	0	0	1	2	2	2	2	0	3	1	1	2
CO5	1	2	1	1	2	1	0	2	0	0	1	0	2	1	1	0
CO6	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Cor

Course code : GELDE 607				
Course Name : Geoinformatics				
Semester /Year : VI				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1- To understand the basic concept of GIS and Remote sensing
2- To understand the application of GIS and Remote sensing

Content

Unit1:- GIS: Definition and scope, Historical development and current trends, Applications in various fields

Unit2:- Geographic Information Systems (GIS), Remote Sensing (RS), Global Positioning Systems (GPS), Data management and analysis, radar Concepts of spatial data and spatial relationships, Data models: vector and raster, GIS software and tools

Unit3:- Remote Sensing: Electromagnetic spectrum and energy interactions, Platforms and sensors: satellites, aerial photography, Types of remote sensing: optical, thermal

Unit4:- Application for Environmental management, Urban and regional planning, Disaster management, Agriculture and forestry, Hydrology and water resources

Text books

TB1: "Principles of Geographic Information Systems" by P. A. Burrough and R. A. McDonnel

TB2: "Geoinformatics for Natural Resource Management" by P. Nag and M. Kudrat

Reference books

RB1: "Remote Sensing and Image Interpretation" by Thomas Lillesand, Ralph W. Kiefer, and Jonathan Chipman

RB2: "Remote Sensing and Geographical Information System" by A.M. Chandra and S.K. Ghosh.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the GIS and remote sensing utility
CO2	Discuss the fundamental concepts of Geoinformatics and its applications across various domains
CO3	Explain about the difference between GIS and Remote sensing
CO4	Analyze remote sensing data and extract meaningful information for various application
CO5	Apply GIS software and tools for spatial data management, analysis
CO6	Write about the different type concept GIS and Remote sensing

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	1	0	0	1	2	1	2	2	3	1	1	1
CO2	1	0	1	1	0	0	2	0	1	1	0	0	2	1	1	0
CO3	3	2	2	1	2	1	2	0	1	2	1	3	3	3	2	1
CO4	3	2	1	1	0	0	1	2	2	2	2	0	3	1	1	2
CO5	1	2	1	1	2	1	0	2	0	0	1	0	2	1	1	0
CO6	0	1	0	0	0	0	0	1	0	1	1	1	1	0	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Cor

Semester VII

Course code	**: GELDE 703**			
Course Name	**: Advanced Mineralogy**			
Semester /Year	**: VII**			
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The present course will teach the characteristics of major rock forming mineral groups, crystal symmetry, and crystallography axis.
2. The present course will teach the atomic structure, formation environments and associations of rock-forming minerals.
3. The present course will teach the techniques of mineral characterization.

Course Content:

Unit1: structures and types of atoms, types of chemical bonding, chemical properties of minerals.
Unit2: Structures and classification of Silicates, Physical properties of minerals.
Unit3:-A detail study of important silicates with reference to general and structure formulae, classification, atomic structures, chemistry including substitution of element and mode of occurrence of Neosilicates/orthosilicates, Sorosilicate, Cyclosilicate, Inosilicate, Phyllosilicate, Tectosilicate.
Unit 4:- Properties of uniaxial and biaxial minerals.

Text Books:

TB1. Moorhouse, W. W.: Optical Mineralogy.
TB2. Dana, E. S. &Ford, W. E.: A Textbook of Mineralogy, Wiley Eastern Ltd.
TB3. Phillips, W. R & Guffen, D. T- Optical mineralogy.
TB4. Barry & Mason- Mineralogy.

Reference Books:

RB1. Dexter Perkin, optical mineralogy
RB2. Alexander N. Winchill, Element of optical mineralogy, ulan press pub.
RB3. Babu. S. K and Snha. D.K ,Mineralogy, CBS pub

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	List types of chemical bonding, types of atom, and properties ofminerals, different silicate structure, uniaxial and biaxial crystal.
CO2	Discuss the Properties of uniaxial and biaxial crystal
CO3	Explain structure of silicates.
CO4	Classify Silicate, and Explain the different properties of minerals.
CO5	Distinguish among different properties of minerals.
CO6	Compose structure of various silicates.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: GELDE704**			
Course Name	**: General Geology and Geomorphology**			
Semester /Year	**: VII**			
	L	**T**	**P**	**C**
	3	**1**		**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The course "Earth Surface Processes" is intended to provide a holistic approach to study the surficial features and the processes with emphasis on links and feedbacks between its components.
2. The subject will serve as a dynamic and physical based account of the processes at planet's surface with an integrated approach involving the principles of geomorphology
3. The course will provide opportunity to the students learn morphometric techniques in general and in the case of a drainage basin in particular.

Course Content:

Unit 1:- Basic concepts and Application of geomorphology in Applied Geomorphology.
Unit 2:- Elementary idea of cosmogeny, Interior of earth, theories of isostasy, cycle of erosion, rock weathering.
Unit 3:- Geosynclines, their classification and evolution, volcanoes, earthquakes, island arcs, rift valleys and grabens.
Unit 4:- Glacial, Aeolian, fluvial and costal landscapes of India, karst topography.
Unit 5:- Drainage development and slope morphometry, geomorphology and geomorphic hazards of Uttarakhand.

Text Books:

TB1. Savindra singh , geomorphology, pravalika pub. Allahabad.
TB2. Thornbury, W.D. (1980): Principle of Geomorphology, Wiley Eastern Ltd. New York.
TB3. Sharma, H.S. (1990): Indian Geomorphology, Concept Publishing Co. New Delhi.
TB4. Agrawal, L. C. Introduction to Geomorphology

Reference Books:

RB1. Holmes, A. (1992): Holmes Principles of Physical Geology, Chapman & Hall publ.
RB2. Condie, Kent. C. (1982): Plate Tectonics & Crustal Evolution, Pergamon Press.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the solar system, Earth structure, geochronology, theories of isostasy
CO2	Discuss the geomorphic process and sedimentological processes related to fluvial, coastal, aeolian, and glacial regimes.
CO3	Apply the knowledge about the environmental changes and its impact on surface processes ,landforms, weathering, soil and classification, ocean bottom topography cycle of erosion
CO4	Classify the stream orders and drainage system and concept and application of geomorphology
CO5	Differentiate between geosyncline and mountain building process their evolution, volcanoes, epeiorogeny etc.
CO6	Write about the slope morphometry, quaternary geomorphology, and geomorphic hazards of Uttarakhand.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	1	1	1	1	1	1	2	3	2	2	2
CO2	3	3	3	3	1	1	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	1	2	3	3	2	2	1	1	3	3	2	1	2
CO4	2	2	2	1	1	0	2	0	2	2	1	1	2	2	1	2
CO5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CO6	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: GELDE705**			
Course Name	**: General Invertebrate Palaeontology**			
Semester /Year	**: VII**			
	L	**T**	**P**	**C**
	3	**1**		**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Making students understand the evolution of life in geological past is an important aspect of geology. Palaeontology, the study of fossils includes the study of vertebrate and invertebrate fossils, micro-fossils, plant fossils, trace fossils their evolution and distribution in time and space.

2. The study of Palaeontology encompasses the aspects of appearance, evolution and extinction of life through the geologic time.

3. The students will acquire skills of describing fossils and their taxonomic classification. They will also be introduced to the application of palaeontology and the use of fossils in hydrocarbon exploration, establishing biostratigraphy, inferring paleoecology, paleobiogeography of the geological past.

Course Content:

Unit 1:-Modern Taxonomy, Identification of fossils, collection of fossils, types of fossils, and mode of preservation, uses of fossils.

Unit 2:-Biostratigraphy, Paleoecology, origin of life and organic evolution.

Unit 3:-Early Precambrian life, Ediacaran fossil assemblags.

Unit 4:-Classification, Morphology, Evolutionary trend and geological history of major invertebrate group: Mollusca (Bivalve, Gastropoda and Cephalopoda), Brachipoda, Arthopoda, Echinoidea and Graptolite.

Text Books:

TB1. Jain, P.C.&Anantharaman, M.S., 1983.Paleontology: Evolution& Animal Distribution. Vishal

TB2. Clarkson, E. N.K. (1998): Invertebrate Paleontology and Evolution.

TB3. Smith, A.B. (1994): Systematic and fossil record- Documenting Evolutionary patterns.

Reference Books:

RB1. Henry woods, invertebrate paleontology,

RB2. Shrock and twen hofel, principle of invertebrate paleontology

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the fossils, Identification of fossils, origin and evolution of life, dispersion and extinction.
CO2	Classify types of fossils, morphology and geological distribution of various groups.
CO3	Explain the techniques of collection of fossils, explain the mode of preservation, Explain the origin and evolution of life.
CO4	Compare the evolutionary relationships among a set of organisms, types of fossils.
CO5	Summarize the modes of life of fossil organisms, Biostratigraphy and Uses.
CO6	Write and develop the fundamentals concept of dispersal and extinction of organism, Early Precambrian life.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : GELDE706				
Course Name : Research Methodology				
Semester : VII				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Objectives: The objectives of this course are

1. To introduce with meaning, functions of research and research process.
2. To highlights the various postulates of research problems, research Design, interpretation and report writing.
3. To expose the student to concepts of measure of central tendency and variation and their application to analyze the statistical data.
4. To acquire the knowledge of correlation, regression, data analysis and hypothesis testing using suitable test of statistical significance.

Unit-I: Meaning &Functions of Research

Meaning of Research, Characteristics of Research, Steps involved in Research, Research in Pure and Applied Sciences, Inter Disciplinary Research, Trans disciplinary research, Significance of Research, Research and scientific methods, Research Process, Criteria of good Research, Problems encountered by Researchers, Literature review.

Unit –II: Research Problem and Research Design

Selecting the Research problem, Necessity of defining the problem, Goals and Criteria for identifying problems for research, Perception of Research problem, Formulation of Research design, Need for Research design, Features of good design, Basic principles of experimental designs, Computer and internet in designs.

Unit- III: Interpretation and Report Writing

Meaning and Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in writing a report, Layout of a Research report, Types of report, Mechanics of writing a research report, Precautions for writing a research report

Unit-iv: Statistical Techniques and Tools -I

Introduction of statistics, frequency distribution, Graphical representation of data, Measures of central tendency, Mean, Median, Mode, Standard deviation, Co-efficient of variation, Probability & distribution

Unit-v: Statistical Techniques and Tools –II

Correlation, coefficient of correlation, Scatter diagram, Regression, Sampling distribution, Standard error, Hypothesis testing, Level of significance, Degree of freedom, Chi Square, T-test, Analysis of variance (ANOVA)

Suggested readings:

1. Kothari C. R, Research Methodology Methods & Techniques, New Age international Publishers.
2. Gupta G. and Gupta M., Research Methodology, PHI Learning Private Ltd.
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical statistics, , Sultan Chand & Sons, New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define various kind of research, objectives of doing research, research process and research design.
CO2	Discuss the ability to choose methods appropriate to research aims and objectives.
CO3	Explain analyse data and draw reasonable interpretations as well as communicate research findings in a clear and well-organized way.
CO4	Explain Statistical tools and techniques to carry out data analysis and hypothesis testing using suitable test of statistical significance.
CO5	Summarize the properties of mechanism of research methodology
CO6	Create a research methodology

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	3	3	2	2	1	2	1	3	1	2	3	2	1	0	2	1
CO3	2	3	1	2	2	3	2	1	0	2	0	0	1	0	1	1
CO4	1	2	2	2	0	2	3	1	0	1	2	2	1	1	2	0
CO5	3	1	1	3	2	2	2	2	1	3	1	1	2	1	1	2
CO6	2	1	2	1	1	1	2	1	2	0	2	0	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

-

Course code	**: GELDE 707**			
Course Name	**: Geological Field Training**			
Semester /Year	**: VII**			
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: **The objectives of this course are**

1. To Provide basic knowledge of surveying techniques.
2. To upgrade and relate the theoretical knowledge of Geological aspects to field observations.
3. Learn to plan for a geological field trip.

Course Content:

Students will be required to visit geologically important areas including mines, dams, oilfields, fossiliferous sequences and laboratories/institutes of repute and submit a report thereon, under the supervision of a faculty member.

Text Books:

TB1: Mathur S.M., Guide To Field Geology
TB2: Gokhale N.W., A Guide to Field Geology

Reference Books:

RB1: Mathur S.M., Guide To Field Geology
RB2: Gokhale N.W., A Guide to Field Geology

Course outcomes (COs):
Upon successful completion of the course a student will be able:

CO1	The course is intended to students to Identify any economic deposit, familiarize them abouthost rock and economic mineral relationship, variable geometry of ore bodies.
CO2	Discuss the planning of exploration and exploitation, Open and/or undergroundmine-section.
CO3	Aapply the knowledge of geology to identify the structures and microstructures in the field
CO4	Analyze the fundamentals, work on the field.
CO5	Summarize the collected data from the field.
CO6	To develop skills for the writing of the tour report.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester VIII

Course code : GELDE803				
Course Name : Advanced Crystallography				
Semester /Year : VIII				
	L	**T**	**P**	**C**
	3	**1**		**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The objective of this course is to present the basic concepts needed to understand the crystal structure of materials.

2. Fundamental concepts including lattices, symmetries, point groups, and space groups will be discussed and the relationship between crystal symmetries and physical properties will be addressed.

3. Application of X-ray diffraction to proteins, electron diffraction and neutron diffraction will be briefly discussed.

Course Content:

Unit 1:-Introduction to space group, space lattices, lattice defects, symmetry elements.

Unit 2:-Historical development of X-ray crystallography, Bragg equation, goniometer.

Unit 3:-Description of normal classes, types of crystal projections and crystal imperfaction.

Unit 5:-Twinning and twinning laws – common types of twins and their examples.

Text Books:

TB1. Dana, mineralogy

TB2. Perkinson. D, mineralogy

Reference Books:

RB1. Wahlstrom-optical crystallography.

RB2. Sands, D.E. (1975): An Introduction to Crystallography, W.A. Benjamine Inc., N.Y.

RB3. Phillips, F.C.: Introduction to Crystallography.

RB4. Evans, R.C. (1964): Introduction to Crystal Chemistry, Cambridge Uni. Press.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the space group, space lattice, defects, symmetry elements, Bragg's Law, goniometer, normal class of crystal system, projection, imperfection, twinning
CO2	Describe the concepts of normal class of crystal system, lattice defects, point, and imperfection.
CO3	Apply the basic concept of twinning and its application and methods of X-ray on the crystal system.
CO4	Evaluate Bragg's law and explain different type of crystal projection.
CO5	Comapre the packing density of Braves lattice and describe different diffraction methods and symmetry elements of normal class.
CO6	Write and express the views on goniometer, symmetrical elements of different crystal system and imperfection of crystal.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: GELDE804**			
Course Name	**: Stratigraphy**			
Semester /Year	**: VIII**			
	L	**T**	**P**	**C**
	3	**1**		**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. The course is intended to familiarize the student with stratigraphic principles and nomenclature, major stratigraphic units, methods of stratigraphic correlation, depositional environments and tectonostratigraphic framework of various lithostratigraphic units of India.
2. Archaean to Holocene, and mass extinction boundaries.

Course Content:

Unit 1:-Principle of Stratigraphy and its type, Geological time scale, stratigraphic correlation, nomenclature of modern stratigraphic code, Walther's Law

Unit 2:- Archean and Precambrian stratigraphy of peninsular India.

Unit 3:- Phanerozoic stratigraphy of Peninsular India.

Unit 4:- Phanerozoic stratigraphy of Himalaya and Indo-Gangetic Plain.

Unit 5:- Precambrian-Cambrian, Cretaceous- Tertiary boundaries (with Indian examples)

Text Books:

TB1. Naqvi, S.M. & Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford Univ. Press.

TB2. Schoch, Robert, M. (1989): Stratigraphy-Principles and Methods, Van Nostrand Reinhold, New York.

TB3. Kumar, R. (1984): Fundamentals of Historical Geology & Stratigraphy of India.

TB4. Krishnan, M.S. (1982): Geology of India and Burma, C.B.S. Publishers & Distributors, Delhi.

TB5. Valdiya, K.S. (2009): The Making Of India: Geodynamic Evolution. Macmillan Publishers India

TB6. Ramakrishnan M. and Vaidyanadhan,(2008 &2010) Geology of India (Vol. 1 & 2), GSI pub.

Reference Books:

RB1. Dunbar, C.O. & Rodgers, J. (1957): Principles of Stratigraphy, John Wiley & Sons.

RB2. Krumbein, W. C. & Sloss, L.L. (1963): Stratigraphy and sedimentation.

RB3. Freeman, W. H. & Kummel, Co. (1961): History of the earth.

RB4. Hollis D. Hedbug (Ed.) International stratigraphic guide - International sub commission on

RB5. Stratigraphic classification of IUGS commission on stratigraphy John Wiley and Sons

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the fundamentals of stratigraphic principles and various methods of stratigraphic analysis will be provided.
CO2	Discuss the concept of Geological Time Scale and Facies concept
CO3	Explain about the various age group rocks occurring in India and the boundaries separating them, Geological Time events of The Paleozoic, Gondwana, Triassic, Jurassic and Cretaceous and the Tertiary Group
CO4	The stratigraphic classification from craton, mobile belt, Proterozoic to Phanerozoic succession from India is the goal of this course.
CO5	Compare the stratigraphic boundaries eg: PC, PT, KT with Indian example
CO6	Write the detailed significance of the Siwalik, Pleistocene, Holocene, Himalayas, and Eocene systems.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: GELDE805**			
Course Name	**: Micropaleontology, Vertebrate and Palaeobotany**			
Semester /Year	**: VIII**			
	L	**T**	**P**	**C**
	3	**1**		**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course covers basically the evolution of vertebrates from basal fishes to hominids.

2. The main objective of the course is to impart knowledge on diversity, evolution, and interrelationships among vertebrates.

3. It is also aimed at providing insights into current debates on vertebrate paleobiology and geological and biological processes responsible for vertebrate evolution.

Course Content:

Unit 1:-Microfossils; types of microfossils and its Importance, Collection and preparation of microfossils.

Unit 2:- Micro-paleontology: morphology, Palaeo-ecology and geological distribution of foraminifera, conodonts, ostracodes, radiolaria and diatoms.

Unit 3:- Vertebrate life through ages and landmarks in their evolution, evolutionary trends in man, horse and elephant.

Unit 4:- Palaeobotany: Morphology, distribution and significance of Gondwana flora.

Text Books:

TB1. Romer, A.S. 1966. Vertebrate Paleontology, Chicago Univ. Press.
TB2. Swinnerton, H.H. (1950) An outline of palaeontology.
TB3. Arnold, C.A. (1947) An Introduction to palaeobotany, Mc Graw Hill.

Reference Books:

RB1. Armstrong, H. & Brasier M. (2005): Micro fossils. Black Well pub.
RB2. Colbert, E.H.(1984) Evolution of the vertebrates. Willey Eastern Ltd.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the main systematic groups of vertebrate, microfossils, its distribution and Paleobotany.
CO2	Describe the various microfossils group on the basis of morphology,
CO3	Explain the morphology of Gondwana flora and Collection and preparation of microfossils.
CO4	Analyse descriptive data of microfossils and associated sedimentary materials using adequate concepts, methodologies.
CO5	Correlated the concept of plant fossil, their distribution of various group.
CO6	Construct the phylogeny of man, horse and elephant.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: GELDE806**			
Course Name	**: Advanced metamorphic Petrology**			
Semester /Year	**: VIII**			
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

The study of metamorphic rocks encompasses the chemical and physical transformations that take place in response to changing pressure, temperature, and chemical environments in the Earth's interior. In this course, different petro genetic processes involving mineral reactions will be explored using equilibrium thermodynamics.

Course content:

Unit 1: Introduction of Metamorphic rock, Agents of metamorphic rock, Textures of metamorphic rocks; Deformation and metamorphism.

Unit 2: Types of metamorphism, Law of thermodynamics and Gibbs Equation.

Unit 3 Isograds and Reaction Isograds, Metamorphic differentiation, origin of migmatites, Paired metamorphic belts, Concept of metamorphic facies, Introduction to ACF,AKF and AFM diagrams.

Text Books

TB1. Winter, J. D. (2001): An Introduction to Igneous and Metamorphic Petrology New York.

TB2. Bucher, K. and Martin, F. 2002: Petrogenesis of Metamorphic Rocks, Springer-Verlag,7th Revised Edition.

Reference Books:

RB1. Yardley, B. W. D. 1989: An Introduction to Metamorphic Petrology, Longman scientific &Technical, New York.

RB2. Spry, A.1976: Metamorphic Texture, Pergamon Press.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the characterize, identify and name different types of rocks in the field and in hand-specimens, and rock-thin sections, and finally they will propose the rock-forming processes.
CO2	Describe types of metamorphism, texture of Metamorphic rock.
CO3	Explain the thermal equilibrium, Facies.
CO4	Classify the Metamorphic rock.
CO5	Distinguish between different types of metamorphic rocks.
CO6	Write the process of metamorphism, agents of metamorphism, petrography of metamorphic rock.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	2	2	2	2	1	2	1	2	2	2	2	2	1	0	2	1
CO3	3	1	1	2	2	3	1	3	0	2	0	0	1	0	1	1
CO4	3	3	0	2	0	3	2	1	0	1	2	1	1	0	2	0
CO5	3	2	0	3	2	2	2	2	1	3	1	1	2	1	1	2
CO6	2	1	1	2	1	0	1	1	0	0	2	0	1	0	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code: GELDE807				
Course Name: Research and Publication Ethics				
Semester/Year: VIII				
	L	T	P	C
	3	1	0	4

L - Lecture T – Tutorial P – Practical C – Credit

PRPE-102: Research & Publication Ethics

Course Objective:
The main aim of this course to convey the principles of ethical research. Students will gain the knowledge of hands-on experience to identify research misconduct and predatory publications.

Theory

- **RPE 01 Philosophy and Ethics**
  1. Introduction to philosophy: definition, nature and scope, concept, branches.
  2. Ethics: definition, moral philosophy, nature of moral judgements and reactions.

- **RPE 02 Scientific Conduct**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, and Plagiarism (FFP)
4. Redundant publication: duplicate and overlapping publication, salami slicing
5. Selective reporting and misrepresentation of data

- **RPE 03 Publication Ethics**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals Practice

- **RPE 04: Open Access Publishing**

1. Open access publications and initiatives
2. SHERPA / ROMEO online resource to check publisher copyright and self-archiving policies
3. Software tools to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

- **RPE 05: Publication Misconduct**
  - **A. Group Discussion**

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad.

B. Software tools

Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

- **RPE 06: Databases and Research Metrics**

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

1. Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score
2. Metrics: h-index, g index, i10 index, altimetrics

Recommended Books:

Text book:

1. Todorovich M, Kurtz P, The Ethics of Teaching and Scientific Research, Sidney Hook.
2. Michael P Marder (2004) Research Methods for Science. Oxford Press
3. Murthy, SN, BhojannaU (2008) Business Research Methods Excel Books

Reference books:

1. Kambadur M K, GhoshA, Singhvi, A K, (2019) ETHICS in, Science Education, Research and Governance, Indian National Science Academy New Delhi, India
2. Erlbaum J LL,(2003) Ethics and Values in Industrial-Organizational Psychology.
3. Barbara H. S., Joan E. Sieber; Gary B. Melton Research Ethics: A Psychological Approach

Course outcomes (COs):

Upon successful completion of the course student will be able to

CO1	List the research ethics, publications misconduct and plagiarism.
CO2	Discuss the Intellectual honesty and research integrity.
CO3	Explain various sources of information for data bases and research matrices.
CO4	Analyze understanding of Open access publications and initiatives.
CO5	Comapre the components of scholarly writing and evaluate its quality.
CO6	To create the research matrics based on cite score.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Skill Enhancement Courses

Semester I

Course code	**:**	**GEL SC105**			
Course Name	**:**	**Field Geology**			
Semester /Year	**:**	**I**			
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To Provide basic knowledge of surveying techniques.
2. To upgrade and relate the theoretical knowledge of Geological aspects to field observations.
3. Learn to plan for a geology field trip.

Course Contents

Unit 1 Definition and scope of Field Geology . Basic equipment required for field work – Types of field investigations. Prior planning of Field work and objectives.
Unit II: Studying the geologic maps, understanding the interaction between topography and geologic structures and drawing of field structures and their description.
Unit III: Basics and types of field data collection, analyses, interpretation, and geological report writing.
Text Books:
TB1: Lahee, F (1987). Field Geology, CBS Publishers, New Delhi.
TB2: Gokhale, N.W**.** (2001). A Guide to Field Geology. CBS Publishers, New Delhi
Reference Books:
RB1: McClay, K.R. (2003) The Mapping of Geological Structures, 2nd ed., John Wiley & Sons Ltd, New Delhi.
RB2: Barnes, J.W**.** (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and Gains knowledge into the methods of geological mapping and can gain expertise by proper practice.
CO2	Understand Rock outcrop.
CO3	Use of field note book and information on personal safety and camping.
CO4	Analyze the rock samples in field.
CO5	Measure the dip direction and dip strike from the clinometer compass.
CO6	Prepare field geological reports.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester II

Course code	**:**	**GEL SC205**			
Course Name	**:**	**Remote Sensing and GIS**			
Semester /Year	**:**	**II**			
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learnremote sensing principles, purposes, advantages and limitations.
2. The basic concepts of image production, processing and interpretations are covered.
3. To learn about GIS component.

Course Contents

Unit 1 Elementary idea about photogeology: electro-magnetic spectrum, types & geometry of aerial photo graphs; factors affecting aerial photography.
Unit 2 Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; Application of remote sensing in geosciences and geomorphological studies.Concept and application of GPS. Visit to survey of India museum or IIRS.
.**Unit 3** Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing.

Text Books:
TB1: Bhatta, B.,2008. Remote Sensing and GIS. Oxford, New Delhi.
TB2: Pandey, S.N.,1987. Principles and Application of Photo geology. Wiley Eastern, New Delhi.
Reference Books:
RB1: Siegel, B.S. and Gillespie, A.R.,1980. Remote Sensing in Geology. John Wiley.
RB2: Gupta, R.P.,1990. Remote Sensing Geology. Springer Verlag.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Learn and Gain Knowledge of Remote sensing and GIS.
CO2	To understand the interpretation of photography, component of GIS, Digital Image processing.
CO3	Use of Remote Sensing in various field, Explain the concept of aerial photography, tools used in GIS.
CO4	Analyze various physiographical features through GIS, explain factors affecting aerial photography; types of camera.
CO5	Evaluate the data with the help of satellites Images, Application of remote sensing.
CO6	Write the GIS concept, remote sensing sensor.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	2	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	1
CO5	1	3	1	1	2	1	2	1	1	3	0	1	2	3	1	3
CO6	2	1	2	2	2	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester III

Course code	**:**	**GELSC305**			
Course Name	**:**	**Geological Field/Training Course**			
Semester /Year	**:**	**III**			
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To Provide basic knowledge of surveying techniques.

2. To upgrade and relate the theoretical knowledge of Geological aspects to field observations.

3. Learn to plan for a geology field trip.

Course Contents

The paper will be based on training on geological field, and various instruments used in geological analysis. During fieldwork the students will be exposed to terrains of different geological characteristics, different types of mines, natural resource exploration sites, various types of geohazard sites. Students will prepare geological reports based on their training, which will be evaluated for the marking.

Text Books:

TB1: Lahee, F (1987). Field Geology, CBS Publishers, New Delhi.

TB2: Gokhale, N.W. (2001). A Guide to Field Geology. CBS Publishers, New Delhi

Reference Books:

RB1: McClay, K.R**.** (2003) The Mapping of Geological Structures, 2nd ed., John Wiley & Sons Ltd, New Delhi.

RB2: Barnes, J.W. (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

Course Outcomes:

Upon successful completion of the course a student will be able to

CO1	Define the methods of geological mapping and can gain expertise by proper practice.
CO2	Describe Rock outcrop.
CO3	Use of field note book and information on personal safety and camping.
CO4	Analyze the rock samples in field.
CO5	Measure the dip direction and dip strike from the clinometer compass.
CO6	Prepare field geological reports

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester IV

Course code : GELSC405				
Course Name : Laboratory techniques in Geology				
Semester /Year : IV				
	L	T	P	C
	2	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To Provide basic knowledge of surveying techniques.

2. To upgrade and relate the theoretical knowledge of Geological aspects to field observations.

3. Learn to plan for a geology field trip.

Course Contents

Unit 1: Definition and scope of Field Geology, Basic equipment required for field work, Types of field investigations, Preparation of topographic maps: parts, symbols, and other information, relief, contours, slope, gradients, profiles and sections.

Unit 2: Field geological report: parts and preparation. Geological and topographic map symbols. Brief introduction of field indicators used in geological mapping: geomorphological, weathering, mineral composition and petrography. Geological materials: types of samples – mineral, ore, fossil, rock. Methods of sampling -care and packing of samples in the field. outline of preparation of thin sections of geological samples, draw stereographic projection.

Text Books:

TB1: Lahee, F (1987). Field Geology, CBS Publishers, New Delhi.

TB2: Gokhale, N.W**.** (2001). A Guide to Field Geology. CBS Publishers, New Delhi

Reference Books:

RB1: McClay, K.R. (2003) The Mapping of Geological Structures, 2nd ed., John Wiley & Sons Ltd, New Delhi.

RB2: Barnes, J.W**.** (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and explain the scope and importance of Field Geology.
CO2	Identify and list the basic field equipment; explain types of field investigations.
CO3	Interpret and prepare topographic maps including symbols, contours, profiles, and gradients.
CO4	Write field geological reports with correct use of geological and topographic map symbols.
CO5	Explain geological mapping indicators, identify sample types, and demonstrate sampling techniques.
CO6	Describe and perform preparation of thin sections, and draw stereographic projections.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	2	2	1	1	1	1	3	2	1	1	3
CO2	2	3	1	3	1	2	1	2	1	2	3	2	1	1	2	1
CO3	1	3	1	2	2	2	2	1	1	2	1	1	1	1	1	3
CO4	2	2	2	2	3	3	3	1	2	1	2	2	1	1	2	3
CO5	1	1	1	3	2	2	2	2	1	1	1	1	2	1	1	3
CO6	2	1	2	1	1	1	1	1	2	1	2	2	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Semester V/VI

Course code : GELSC505/GELSC605				
Course Name : Disaster management				
Semester /Year : III				
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Objective of the Course

1. To provide basic conceptual understanding of disasters.
2. To understand approaches of Disaster Management
3. To build skills to respond to disaster

Course Content

Unit 1. Hazards and Disaster- Concepts, Vulnerability, and risks, Hazard and disaster types- Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes. Man-made disasters: gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit 2: Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its types.

Unit 3. GIS and Remote Sensing, Disaster management Cycle- Rescue, Relief, Rehabilitation, Reconstruction, prevention, mitigation and Preparedness, awareness generation strategies for the community on safe practices in disaster, Early Warming Systems.

Text Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
3. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the key concepts of hazards, disasters, vulnerability, and risks, including the various types of natural and manmade disasters.
CO2	Describe the characteristics, causes, and effects of major natural disasters (earthquakes, floods, droughts, landslides, cyclones, volcanoes) and manmade disasters (gas leaks, radiations leaks, toxic waste, disposal, oil spills, forest fires).
CO3	Use knowledge of disaster types, hazard mapping, and risk assessment tools (including GIS and Remote Sensing) to analyze reallife disaster scenarios.
CO4	Differentiate between types of disasters, their management strategies, and the roles of various stages in the disaster management cycle (rescue, relief, rehabilitation, reconstruction, prevention, mitigation, preparedness).
CO5	Predict the potential impacts of specific hazards on vulnerable communities using seismic zone data, flood/drought patterns, and environmental indicators.
CO6	Prepare disaster management and community awareness plans incorporating early warning systems, mitigation measures, and safe practices for disaster resilience.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated