B.Sc. I Year
Geology

Subject: Fundamentals of Geology, Crystallography and Mineralogy, Structural Geology
Nature of course: Theory Course No.: GEO101
Full marks: 100 Total period: 150
Pass marks: 35

Fundamentals of Geology

Total marks: 40 Total period: 62

Main Topics	Contents	Period	Marks
Introduction	The science of geology, scope, its various branches, method of study, application of geology in mineral resource, infrastructure developments, disaster mitigation.	4	12
Minerals	Definition, processes of formation, and classification of minerals	4	
Rocks	Classification of rock, rock cycle	4	
Earth's interior	Probing e Earth's interior, internal structure of the Earth, Earth's major internal boundaries, the crust, mantle and core, lithosphere and asthenosphere, pressure, temperature and seismic wave velocities inside the earth.	4	16
Earthquake	Earthquakes and faults; elastic rebound theory, seismic waves; seismograph, magnitude and intensity of earthquakes, world distribution of earthquakes, forecast and prediction of earthquakes	4	
Introduction to Plate tectonics	Continental margins, ocean basin floor, mid ocean ridge, Ocean trenches; earlier theories on geosynclines and continental drift; global plate systems, seafloor spreading and subduction zones; theories on coral reef development	8	
Isostasy	Gravity and continental crust.	2	16
Geological structures	Primary structures: Bedding, cross-laminations, ripple marks. Secondary structures: Faults, Folds, Foliation, Joints	4	
Weathering and mass wasting	Earth's external processes, weathering, soil formation, the soil profile, types and causes of mass wasting	6	

Geological work of running water	Runoff and discharge, geological importance of running water, process of stream erosion and deposition, floods	4	
Groundwater and its geological activities	Groundwater movement, water table, aquifers and aquicludes, wells, springs, geologic work of groundwater,	4	**16**
Glaciers and glaciations	Types of glaciers, glacier erosion and transportation, landforms associated with glaciers	4	
Geological work of sea and ocean	Geological work of sea and ocean and associated landforms	4	
Geological work of wind	Wind erosion, transportation, and deposition, eolian landforms	4	

Crystallography and Mineralogy

Total marks: 30 **Total period: 44**

Main Topics	**Contents**	**Periods**	**Marks**
Introduction to crystallography	Definition of crystals, Crystal symmentry elements, crystal face, Bravais law, law of constancy of interfacial angles, Crystallographic axes	2	16
Internal order in crystals	Symmetry operations, unit cell, lattice; Thirty-two point groups and their symmetry elements; Bravais lattices, screw and glide symmetries, concept of space group and international space notation	4	
Morphology of crystals and Crystal systems and classes	Axial ratios, parameter system of Weiss, Miller indices, forty-eight forms, combination of forms; Crystal systems: Classes and forms of Triclinic, monoclinic, orthorhombic, hexagonal, tetragonal and isometric systems	8	
Crystal growth and twining	Growth of crystals from solution and from a melt under controlled conditions, crystal growth in open fractures, solution cavities, or vesicles, Twining in crystals, different types of crystal twins, causes of twining in crystals, twin laws.	2	

Introduction to mineralogy and physical properties of minerals	Definition of mineral, scope of determinative mineralogy Scalar properties–colour, lustre, and streak, their definition and varieties with examples, specific gravity, determination of specific gravity of pure mineral grains by sink and float method, fluorescence and phosphorescence, magnetic properties–ferromagnetic, paramagnetic, and diamagnetic minerals.	6	16
Crystal chemistry of minerals	Vector properties–cleavage, parting, and fracture, their definitions, mineral examples, hardness–definition, Moh's scale of hardness, determination of hardness of minerals, crystallinity and forms of minerals– crystalline, cryptocrystalline, and amorphous, habit of minerals– elongated, tabular, flattened, and equant forms of crystalline and cryptocrystalline aggregates–type examples and use in identification. (a) Concept of crystal structure of minerals, Crystal structures and lattices of cubic system; dimorphism, polymorphism, and pseudomorphism, isomorphism and solid solutions.	6	
Chemical properties of minerals	Minerals as a chemical system; native elements, sulphides, halides, oxides, silicates, titanates, phosphates, arsenates and vanadates, nitrates, borates and uranates, sulphates and chromates, tungstates and molybdates, oxalates and hydrocarbons. Rock-forming (silicate) minerals and their classification.	4	
	Introduction to economic minerals of Nepal	4	
Introduction to optical mineralogy	Elements of optics, optics of isotropic medium– refractive medium, Snell's law; critical angle; anisotropic media, polarisation and interference of light, Polaroid, polarising microscope–construction and use, magnification and resolving power, construction and use of mica and gypsum plates and quartz wedge, pleochroism and birefringence, optical indicatrices – uniaxial and biaxial indicatrices, behaviour of light in uniaxial and biaxial crystals, optic sign, optical properties of minerals – form, cleavage, fracture, and parting, refractive index and relief, Bécké line and its use, twining, colour, and pleochroism, pleochroic forms of common minerals, properties under crossed polarisers –	4	**12**

	interference colour, twining, and extinction angle, anomalous interference colours, Michael Lévy chart and its use in determining thickness, path difference, birefringence, and order of interference colour, interference figures, optic sign of anisotropic medium, dispersion of optic axes in biaxial crystals.		
Mineral Genesis & Mineral classification	Formation of minerals by different endogenous and exogenous processes. Rock-forming (silicate) minerals and ore-forming (non-silicate) minerals. Silicate Classifications. Physical and optical character, mode of occurrence and important rock-forming minerals.	4	

Structural Geology

Total marks: 30 **Total period: 44**

Main Topics	Contents	Periods	Marks
Introduction	Introduction: Definition, scope of structural geology, concepts of detailed structural analysis: descriptive, kinematic, and dynamic analysis.	4	12
Geological map and cross-section	Geological map and cross-section, orientation of a line (trend and plunge) and a plane (dip and strike), use of a geological compass in measuring orientation of a line and a plane.	4	
Stereographic projection	Introduction to stereographic projection and its application in structural geology, plotting a line and a plane, finding the intersection of two planes, apparent and true dips.	4	
Stress and strain	Concepts of stress and strain, their definitions, stress in two dimensions, Mohr circle and its use.	4	
Unconformity	Bedding, conformity, and unconformity, types of unconformity, recognition of various unconformities in maps and cross-sections.	2	16
Intrusive contacts	Main features of intrusive contacts, sills and dykes, batholiths.	2	
Diapirs	Main features of diapirs and salt domes.	2	

Primary structures	Types of primary sedimentary and igneous structures and their application in structural geology, cross-cutting relationships and younging directions.	4	
Folds	Definition, classification of folds: anticline and syncline, antiform and synform, cylindrical and non-cylindrical folds, drag folds, criteria of recognition of folds in the field.	6	
Faults	Definition, classification of faults: strike slip, normal, and reverse faults, thrust faults, horst and graben, criteria of recognition of faults in the field.	6	16
Joints	Definition and classification of joints, study of joints in the field.	4	
Foliation and lineation	Cleavage, schistosity, and foliation, lineations and their classification, relationship of foliation and lineation with other structures in the field.	3	
Concepts of field geology	Topographic and geological map reading, use of geological compass, methods of plotting geological data on the maps and preparation of cross-sections.	3	

Text and Reference books

Fundamentals of Geology:

Brian J. Skinner, Stephen C. Porter and Jeffrey Park, 2004, 5th Edition. Dynamic Earth: An introduction to Physical Geology. John Wiley and Sons. Inc.

Dahal, R.K., 2006. Geology for Technical Students. Bhrikuti Academic Publications.

Donald Duff, 2004. Holme's Principles of Physical Geology, Routledge, UK.

E. J. Tarbuck and F.K. Lutgens, 2005. Earth - An introduction to Physical Geology (8th Edition). Pearson Prentice Hall, New York

J. E. Sanders, 1981. Principles of Physical Geology, John Wiley and Sons, New York.

Paudyal, K.R., 2005. Geology for Civil Engineers. Oxford International Publications.

Strahler and Minzt, Physical Geology, Harper and Raw, New York (recent issue).

Tamrakar, N.K and Acharya, K.K., 2012. Environmental Earth Science. Dikshyanta Prakashan, Kirtipur, 398p.

Tamrakar, N.K. and Bajracharya, R., 2011. Handbook of Engineering Geology. Budha Academic Enterprises Pvt. Ltd., Kathmandu, 260p.

Crystallography and Mineralogy

H. H. Read, Rutley's Elements of Mineralogy (26th ed). CBS Publishers and Distributors.

L. G. Berry and Brian Mason, Mineralogy (2nd ed or latest) 2000, CBS Publishers and Distributors.

L. P. Paudel, 2011. Study of Minerals and Rocks in Thin Sections. Geo-Science Innovations (P.) Ltd.

N. K. Tamrakar, 2011, Practical Mineralogy. Central Department of Geology, Tribhuvan University.

P. R. Joshi, H. R. Khan, D. R. Khadka and D. K. Napit, 2004. Mineral resources of Nepal, Published by Department of Mines and Geology, Lazimpat, Kathmandu.

S. M. Rai, 2011. Study of Minerals and Rocks in Hand Specimens. Tara Rai, Kathmandu Nepal.

W. E. Ford, 2005, Dana's Textbook of Mineralogy (4th ed or latest edition). Wiley Eastern Limited.

Structural Geology:

B. E. Hobbs, W.D. Means and P. E. Williams, 1976. An Outline of Structural Geology. John Wiley and Sons, New York.

M. P. Billings, 1984, Structural Geology (3rd Ed.), Prentice-Hall of India Pvt. Ltd.

N.W. Gokhale, 1996. Theory of Structural Geology. Satish Kumar Jain for CBS Publishers and Distributors, New Delhi, India.

B.Sc. I Year

Geology

Subject: Fundamentals of Geology, Crystallography and Mineralogy, Structural Geology

Nature of course: Practical
Full marks: 50
Pass marks: 20

Course No.: GEO102
Total period: 180

Fundamentals of Geology

14 hrs

Lab 1: Study of geomorphic features using contour maps, and preparation of topographical profiles.

Lab 2: Study of structural block diagrams.

Lab 3: Study of some common igneous, sedimentary and metamorphic rocks

Crystallography

28 hrs

Lab 1: Study of space lattice models..

Lab 2: Study of crystal systems, crystallographic axes, interfacial angle, and measurement with a contact goniometer.

Lab 3: Study of forty-eight crystal forms.

Lab 4: Study of symmetry elements of thirty-two classes.

Lab 5: Construction of forms and stereographic projections of normal classes of the Triclinic and Monoclinic Systems.

Lab 6: Construction of forms and stereographic projections of normal classes of Orthorhombic And Hexagonal Systems.

Lab 7: Construction of forms and stereographic projections of normal classes of the Tetragonal and Isometric Systems.

Mineralogy

68 hrs

Lab 1: Study of physical properties of minerals. Crystal habit, hardness, cleavage, crystal form, streak and luster of quartz varieties, k-feldspars, plagioclase, micas, amphibole, pyroxene, Al-silicates, tourmaline, olivine, garnet.

Lab 2: Introduction of petrological microscope: Mechincal parts, optical parts, adjustment of microscope.

Lab 3: Observation of minerals in plane-polarized light: External morphology, cleavage, fracture, relief, color, pleochroism.

Lab 4: Observation of minerals in crossed-nicols: Isotropic or anisotropic, Extinction, interference color, birefringence.

Lab 5: Identification of essential rock-forming minerals in thin-section (Colourless minerals): Quartz, Feldspars, Pyroxene (Enstatite), Muscovite.

Lab 6: Identification of essential rock-forming minerals in thin-section (Colourless minerals): Calcite, Olivine, Kyanite, Sillimanite, Garnet.

Lab 7: dentification of essential rock-forming minerals in thin-section (Coloured minerals): Biotite, Chlorite, Pyroxnene (Hypersthene), Amphiboles.

Lab 8: Identification of essential rock-forming minerals in thin-section (Coloured minerals): Tourmaline, Staurolite, Epidote.

Structural Geology

68 hrs

Lab 1: Drawing of various geological structures and determination of their history of formation from block diagrams.

Lab 2: Study of geological maps: outcrop pattern of horizontal, inclined and vertical beds. Rule of V's. Inliers and outliers true and apparent dip of beds, true and apparent thickness, width of outcrop, horizontal and vertical thickness of beds. Relation between true thickness and width of outcrop.

Lab 3: Study of geological maps: determination of strike, true dip, and apparent dip of beds from geological maps measurement of thickness and width of outcrop from geological maps, completion of outcrops in geological maps.

Lab 4: Study of geological maps: Preparation of topographic profile, consequences of horizontal and vertical scale exaggeration in the profile. Preparation of geological cross-sections of horizontal, inclined, vertical, and folded beds. Geological map interpretation

Lab 5: Three-point problems and determination of attitude of beds.

Lab 6: Stereographic projection: principle of projection of a line and a plane, projection of inclined, horizontal, and vertical lines, projection of horizontal, inclined, and vertical planes.

Lab 7: Determination of intersection line of two planes; determination of apparent and true dips from given data, plotting trend, plunge, and pitch of a line.