Department of Earth Sciences

University of Kashmir, Srinagar-I90006, J & K

Course Structure, Marks Scheme & Syllabus

For

Under-Graduate Course

in

GEOLOGY

Effective from Academic Session 2013

University of Kashmir,
Srinagar-190 006

Course Structure for Under- Graduate Course in Geology

Effective from Academic Session 2013

B.Sc. Part I

Theory

Paper	Course Title	Marks
Theory	**Fundamental Geology**	100

Practical

Related to	Marks
Crystallography and Mineralogy; fieldwork	50

B.Sc. Part II

Theory

Paper	Course Title	Marks
Theory	**Advanced Geology**	**100**

Practical

Related to	Marks
Petrology& Paleontology	50

B.Sc. Part III

Theory

Paper	Course Title	Marks
Theory	**Applied Geology**	100

Practical

Related to	Marks
.Structural Geology and Geological Mapping; Fieldwork and Project Assignments	50

Examination Scheme:

Single Paper scheme at UG level

I. The question paper shall be of three hours duration.
II. Each subject shall have internal as well as external components of examination.

Internal Examination at College Level

This test shall be called as Internal Assessment Test, it shall consist of two components:-

a. Attendance
b. Assignment/ Project work/Midterm test

The distribution of marks in the Project work is reflected in the table as under:-

Component	**Theory Paper Carrying 100 marks**
Attendance	**5 marks** 1mark (75-80%) 3marks (80-90%) 5 marks (90-100%)
Midterm test/Project Work / assignment	**20 marks**
	Total: 5+20=25

i. Number of units to be covered under Internal Assessment Test shall be left to College concerned.
ii. Composition of marks among three components of part (b) i.e. project work / assignment shall be decided by the college.
iii. Internal Assessment Test shall be conducted in the first fortnight of August each year.
iv. The topics for written test, project work and assignments will be assigned and evaluated by the concerned teacher.
v. Both components of internal assessment test shall be compulsory; students failing in any component shall not be allowed to sit in the external examination.
vi. Students must have a minimum 75% of attendance in each subject.
vii. Student has to secure minimum of 36% percent marks in project work / assignment/midterm tests. If college offers all these, the 36% pass percentage in each component shall be applicable.

External Examination

i. There will be two types of questions in the question paper i.e. medium and long answer type of questions comprising of section A and section B.

ii. In Section A there will be five medium type questions, one question with internal choice from each unit. All the five questions will be compulsory.

iii. There will be five long answer type questions in Section B, one from each unit and the student will be required to attempt any three questions.

iv. The distribution of marks for theory paper is reflected in the table as under:-

Theory Paper carrying 100 marks
Section A
5 medium answer type questions each carrying 7 marks (5x7) = 35
Section B
3 long answer type questions each carrying 13 marks(3x13) = 39 (approx. 40marks)
Internal examination =25 marks
External examination=75 marks
Total (25+75)= 100 marks

v. Pass percentage shall remain unchanged i.e 36% for both internal and external examinations.

Course Details follow

SYLLABUS FOR UNDER-GRADUATE COURSES IN GEOLOGY

FOR B.Sc. Part I
To be implemented from 2013

Paper: Fundamental Geology 100 Marks 150L

Unit I	FUNDAMENTALS OF GEOLOGY 40 L
1.0	Introduction to the science of geology: Definition, branches, scope and importance, Relation with other branches of sciences, History of geology.
1.1	Contribution of physics and chemistry in the development of ideas about earth. Physics-for example, crystallography, gravity, magnetic, isostasy, earthquakes and microscopy. Chemistry – about minerals chemical bonds, crystal chemistry, solution chemistry, chemical energetic. Various geospheres. Physical properties and chemical composition of the earth and earth's crust.
1.2	Geochronology and age of Earth. Relative and absolute techniques for age determination. Radioactivity and concept of half-life, decay constant, natural radioactive isotopes. Evolution of the life through ages; Preliminary idea about faunal succession. Concept of vastness of time in Geology.
2.0	Introduction to rocks and minerals.
2.1	Rocks as natural mineral aggregates; types of rocks: igneous-plutonic and volcanic rocks; sedimentary-clastic and non-clastic rocks; metamorphic-foliated and non foliated rocks
2.2	Preliminary knowledge about the most common rock forming and economic minerals: quartz, feldspar, calcite, gypsum, olivine, augite, hornbelende, muscovite, biotite, haematite, pyrite, chalcopyrite, sphalerite, and galena.
3.0	Geology as the history of Earth. How the rocks record history – (a) Fossils (b) Mineralogy and the texture; (c) Structures; (d) Palaeogeography, Paleoclimate. Surface relief of the earth. Exogenous and endogenous process.
3.1	Weathering: definition and types, agents of weathering. Products of weathering.
3.2	Rivers: Definition, Run off, velocity, gradient and discharge. Geological work of river erosion: Corrosion, hydraulic action, attribution and related features. River transport: Solution, suspension, saltation and traction. River deposition: related features-floods plains, alluvial fans, cones, rivers terraces, delta and estuary, point bars and natural levees. Types of drainage patterns.
4.0	Groundwater: origin, occurrence and distribution of Groundwater; springs and seepages.
4.1	Zone of aeration and saturation. Water table, perched water table, porosity and Permeability, artisan water
4.2	Erosion and Deposition work by the groundwater.

Unit II	**GEOMORPHOLOGY 35L**
5.0	Glaciers: Definition and types, snowline, glacial movements and crevices.
5.1	Geological work of glacial erosion: plucking, abrasion, and erosional features cirques, horns, arêtes, Coles and Roche moutonnee. Modification of valleys by the glacial erosion-hanging valleys, fjords.
5.2	Glacial deposits: unstratified-till moraines, drumlins, erratic and boulder trains; stratified –outwash sand and gravels, rattles, eskers, crevasse fillings, varve Aeolian processes: Wind erosion: deflation, abrasion, Wind deposition: loess, dunes, barchans, yardung, pedestal rocks.
6.0	Oceans: Topography of sea floor. – Continental shelves, slope, abyssal plains, Ocean ridges and, submarine valleys, canyons, deep-sea trenches and guyots.
6.1	Oceanic erosion: Wave action and related features. Marine deposition: submarine bars, ridges and the features of shoreline. Coral reefs: types fringing, barrier and atolls.
6.2	Epeirogenesis and orogenesis. Volcanoes: types, distribution and eruptional features and products.
7.0	Fundamental concepts. Catastrophism, uniformitarianism, cycle of erosion, and base level of erosion.
7.1	Mass wasting: Definition, factors favouring mass wasting-Lithology, stratigraphy, structure, topography, climate, organisms.
7.2	Slope flowage: creep, solifluction; rapid flowage – earth flow, mudflow, debris flow, avalanche, landslides, and slumps.
8.0	Karst topography – Terra Rosa, lapis, sink holes, blind valleys, Caverns, Stalactites, stalagmites, natural bridges and tunnels
8.1	Structural landforms: Fault scarps, cuesta, hogback, horst, graben, structural domes, inversion of topography.
9.0	Climate and landforms: humid, sub-humid, arid, semi-arid.
9.1	Soils: Soil profiles, Soil types of India.
Unit III	**GLOBAL TECTONICS 25L**
10.0	Introduction; Features and divisions of Earth's crust; Physical characters of continental and oceans, continental shelf, slope and abyssal plains, island arcs, rift valleys, mid-ocean ridges, mountain chains.
10.1	Important concepts about Earth dynamics: outline description of Contraction, Expansion, Plate tectonics - basic concepts and definitions, types of plate margins, important characters of plate margins.
10.2	Mechanism of plate movement; Mantle plumes vis-à-vis island chains.
11.0	Plate tectonics in relation to the distribution seismic, volcanic and island arc belts.
11.1	Plate tectonic models for the origin of mountain belts: Pacific type and Andean type.
11.2	Some fundamental problems with Plate tectonics - Antipodal positions of continents and ocean basins, geographic restriction of island arcs, size of ocean basins vs. possible size of mantle convection, variable depth of asthenosphere,

	absence of subduction zones around Antarctic plate, absence of required boundary between North and South American plates

Unit IV	**MINERALOGY** **25 L**
13.0	Mineralogy: Introduction to mineralogy: definition of mineral, scope of determinative mineralogy, examples of rock forming (Silicates) minerals and ore forming (oxide/ sulphide) minerals.
13.1	Scalar properties of minerals: Colour, luster and streak-their definition and verities with examples. Specific gravity: definition and mineral examples. Fusibility. Flourescence and phosphorescence Magnetic property: ferromagnetic paramagnetic and diamagnetic minerals.
13.2	Vector properties of minerals: Cleavage, parting and fracture-their definition, mineral examples. Hardness: definition, Moho's scale of hardness, determination of hardness of minerals.
13.3	Important rock-forming minerals: their classification; Physical and optical characters and mode of occurrence of the characteristic members from following groups: Quartz, Feldspar, Mica, Amphibole, Pyroxene, Olivine, Garnet, Chlorite, and Carbonate.
14.0	Mineral optics: Elements of optics. Optics of isotopic medium – refractive index, Snell's law of critical angle, anisotropic media.
14.1	Polarization and interference of light. Polaroid, polarizing microscope-construction and use. Use of accessory plates. Pleochroism and Birefringence.
14.2	Optical indicatrix: Uniaxial and Biaxial indicatrix. Behavior of light in uniaxial and biaxial crystals. Optic sign.
14.3	Optical properties of minerals: Forms, cleavage, fractures and parting, refractive index and relief, Becke line and its use. Colour and Pleochroism: Pleochroic scheme of common minerals.
14.4	Properties under crossed polarisers: Interference colours, Michel Levy chart and its use in determining thickness, path-difference, birefringence or order of interference Colour.
Unit V	**CRYSTALLOGRAPHY** **25 L**
15.0	Crystallography: Introduction to crystallography, geometrical nature of order of crystals. Translation vectors, planar and space lattices. Concept of point group and 32 classes.
15.1	Morphology of crystals: Definition of crystal. Face, edge and solid angle. Law of constancy of interfacial angles. Axial system and axial ratios. Parameter systems of Weisis, Miller indices. Law of Rationality of indices.
16.0	48 symmetry and twining: Growth of crystals showing combination of forms. Study of normal classes of crystal systems {vis-a-vis crystallographic axes, symmetry elements & general forms}.
16.1	Crystal growth and twining: Growth of crystals from solutions and from a melt under controlled conditions, crystal growth in open fractures, solution cavities and vesicles.

16.2	Twining in crystals: Types and causes, different twin laws with examples.
17.0	Crystallinity and forms of minerals: Crystallized, crystalline and cryptocrystalline and amorphous. Habit of minerals–elongated, tabular, flattened and equant. Form of crystalline and cryptocrystalline aggregates–types, examples and use in mineral identification.
17.1	Crystal chemistry of minerals: Concept of crystal structure of minerals: Dimorphism, polymorphism and pseudomorphism, isomorphism and solid solution.

Suggested Readings:

Holmes, A., 1996: Principles of Physical Geology, EUBS, Chapman.
Judson, S. and Kaufman, M. E., 1990: Physical Geology, Prentice Hall.
Press, F. and Seiver, R., 1989: The Earth, W. H. Freeman.
Terrly, G. W., 1958: Principles of Petrology, Mathuen.
Gribble, D. D., 1988: Rutley's Elements of Mineralogy, DBS Publications.
Tarbuck, E. J. and Lutgens, F. K., 1997: Earth Science, Prentice Hall.
Lutgens, F. K. and Tarbuck, E. J., 1998: Essentials of Geology, Prentice Hall.

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Note for paper setter

The format of the question papers shall be as per the revised format in vogue in the university since 2013. A sample copy of the question paper shall be provided to the examiner for reference and guidance.

Course content and no. of Lectures for Practical course:

1. Field work Minimum 10 days

1. Study of landforms, erosional and depositional features
2. Handling of Clinometer and Brunton compass for Measuring dip and strike, and plotting of field data on toposheets.

3. Laboratory work 23 Lectures:

Practical work related to	**No. of Lectures**
1.Crystallography **a)** Demonstration of space lattice, model-Galena, Fluorite, Sphalerite, Pyrite and Calcite. **b)**Clinographic projection of the following crystals form: Cube,Octahedron,Zircon,Beryl,Calcite and Gypsum	**06**

2.Mineralogy Megascopic: Study of the physical properties (habit, color, hardness, cleavage, luster, streak and specific gravity) of important rock-forming minerals as included in the theory paper. **Optical mineralogy:** **a)**Petrological microscope: Neat drawing, labeling its parts and their functions. **b)** Study of optical properties (Form, color, Cleavage, Relief, Pleochroism, Isotropism, interference colors extinction, twinning and alteration) of important rock forming minerals as included in the theory paper. Clinographic projections of the following crystals forms: Cube, Octahedron, Zircon Beryl, calcite and Gypsum.	**17** **04** **13**

Marks distribution for Practical:

Maximum Practical marks : 50

- **Internal Practical 25 marks**

(This will include fieldwork of 15 marks, and internal laboratory work of 10 marks)

- **External Practical 25 marks**

Note:

- Fieldworks will form a compulsory component of the practical and should be of a least 10 days duration. The assigned 15 marks will be given internally by the teacher in-charge of the fieldwork, and will be added to the marks secured in internal laboratory work to pass the internal practicals.

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SYLLABUS FOR UNDER-GRADUATE COURSES IN GEOLOGY

FOR B.Sc. Part II
To be implemented from 2014

Paper:Advanced Geology 100 Marks 150L

Unit I	**STRATIGRAPHY 25**
1.0	Stratigraphy: Brief knowledge of Stratigraphic classification and terminology: Principles of Stratigraphy.
1.1	Geological timescale; stratigrapahic correlation; imperfection of geological record.
1.2	A brief knowledge of the following Precambrian geological system/groups of India with special reference to their classification, distribution, lithology and economic importance in their e localities: Dharwar, Aravalli, Cuddapa and Vindhyan.
2.0	Straitgraphy of the following Phanerozoic sgeological system/groups with special reference to their lithology and fossil content: Paleozoic succession of Kashmir. Triassic of Spiti, Jurassic of Kuch, Cretaceous of Trachnapalli. The Siwalik; and the Karewas of Kashmir.
Unit II	**PALAEONTOLOGY45L**
3.0	Paleontology: Elementary ideas about origin of life, classification of organisms
3.1	Fossils, their characters, conditions necessary for fossilization; types of preservation and occurrence. Application of Paleontology.
3.2	Linnaean or Binomial code of nomenclature of organisms.
4.0	Elementary concept of vertebrates Paleontology with special reference to siwaliks vertebrate fauna.
4.1	Introduction to micropaleontology and microfossils and their application.
4.2	Introduction to Paleobotany with special reference to Gondwana plant fossils
5.0	Theories of evolution and palaeontological data on evolution.
5.1	Detailed morphology, classification, geological and geographical distribution of the following: (1) Brachiopoda (2) Bivalvia (3) Gastropoda (4) Cephalopoda (5) Graptoloida (6) Anthozoa (7) Echinoidea (8) Trilobita
5.2	Elementary ideas about Forminifora, Ostracoda, Radiolarian and Conodonts.
6.0	Evolution of Man, Horse & Elephant.
7.0	Causes of migration and dispersal.
7.1	Extinction of organisms with special reference different hypothesis for the extinction of dinosaurs.
7.2	Introduction of Palynology and its applications.
7.3	Application of Paleontological data in paleogeographic reconstructions. Paleontological evidence in favor of continental drift.
Unit III	**IGNEOUS PETROLOGY25 L**
8.0	Introduction to Petrology: Nature and scope of petrology: Difference between Petrology, petrography and petrogenesis.
8.1	Texture and structure of igneous rocks: Large structures- block lava, amygdaloidal

	lava, and vesicular structures, pillow structures, pillow structure, flow structures, sheet and platy structures, prismatic and columnar structures. Crystallinity, granularity (phaneric and aphanitic), shapes of crystals, mutual relations of crystals, equigranular and unequigranular textures, porphyritic, poikilitic, opthitic, intersertal and intergranular textures, directive textures, intergrowth textures. Reaction textures. Reaction structures – corona and kelyphitic borders.
8.2	Composition and constitution of magma: Definition of magma, composition of magma, types of magma, physico-chemical constitution of magma, primary magma.
9.0	Processes resulting in diversity in igneous rocks: Fractionation and differentiation – Gravity settling, filter-press differentiation, flow diffusion and gaseous transfer within magma; liquid immiscibility, mixing of magmas. Assimilation.
9.1	Nomenclature and description of common igneous rocks: Granite, pegmatite, syenite, diorite, gabbro, granodiorite, norite, anorthosite, peridotite, pyroxenite, dunite, lamrophyry, nephelinesynite, granite porphyry, diorite porphyry, dolerite, rhyolite, Trachyte, dacite, andesite, basalt, phonolite.
9.2	Classification of igneous rocks: Principles of classification, CIPW classifications, IUGS classification and tabular classification.
Unit IV	**SEDIMENTARY & METAMORPHIC PETROLOGY 25 L**
10.0	Sedimentary rocks: Processes involved in formation of sedimentary rocks: erosion, transportation, deposition, and diagenesis and lithification.
10.1	Texture: size, roundness, sphericity. Surface texture, fabric, porosity and permeability. Grain size, grade scale, and methods of size analysis by sieving. Use of textural properties. Structure: primary, secondary and biogenic structures. Major primary structure, i.e; cross bedding, cross lamination, horizontal bedding, graded bedding, sole marks, ripple marks, rain-imprints and dunes.
10.2	Classification of sedimentary rocks: Folk's classifications of carbonate rocks. Classification of sandstones, greywacke and arkose.
11.0	Metamorphic rocks: Definition of metamorphism Controls of metamorphism – bulk composition and motivating forces in metamorphism- heat, pressure and chemically active fluids. Types of metamorphism – Contact, cataclastic, regional. Metasomatism, anataxis, palingenesis, migmatization.
11.1	Texture and structure of metamorphic rocks: Shape of minerals, growth and mutual relation of minerals in metamorphic rocks, crytalloblastic, maclose, granulose, schistose, gneissose and augen structures.
11.2	Nomenclature and description of metamorphic rocks: Phyllite, slate, schist, gneiss, amphibolite, marble, quartzite, granulite, eclogite.
Unit V	**ECONOMIC GEOLOGY 30L**
12.0	Ore minerals and gangue. Examples of common ore minerals. Concept of metallogenic epochs and provinces.
12.1	Classification of minerals deposits – genetic an associational parameters.
12.2	Ore – forming fluids, means of transport and minerals deposits.
12.3	Pegmatite and pegmatite deposits. Deposits of mica with special reference of India.
12.4	Oceanic mineral resources (manganese nodules).
12.5	Elementary idea of hydrothermal deposits with reference to: a) Porphyry copper deposit b) Vein deposits of tin and tungsten.
12.6	Ores formed by metamorphic processes.

12.7	Supergene enrichment deposits.
12.8	Mode of occurrence of following minerals deposits in India: Banded iron formation, Gold, Thorium deposits. Exploration, evaluation, exploitation and mining of minerals resources: metallic, non metallic, radioactive and fossil fuels and ground water. Placer & residual deposits.

Suggested Readings:

Shork, R. Rand, Twenholf, W. H., 1987: Principles of Invertebrate Palaeontology, CBS Pubs. New Delhi.
Nicholson, H. A., 1993: Principles and History of Palaeontology, Discovery Pubs. Home, New Delhi.
Wood, H., 1998. Paleontology–Invertebrate. CBS Pub. New Nelhi.
Stearn, C. Wand Carroll, R. L., 1994: Palaeontology–The Record of Life, John Wiley.
Krishnan, M. S., 1997: Geology of India and Burma, CBS Pubs, New Delhi.
Wadia, D. N., 1996: Geology of India, Macmillan & Co.
Waller, J. M., 1960: Stratigraphy–Principles and Practices. Harpar& Row Pubs

Note for paper setter

The format of the question papers shall be as per the revised format in vogue in the university since 2013. A sample copy of the question paper shall be provided to the examiner for reference and guidance.

Course content and No.of Lecture distribution for practicals

Practical work related to	**No. of Lectures**
1.Paleontology Study of morphological characters of the selected genera- Brachiopoda, Bivalvia, Gastropoda, Cephalopoda, Trilobita, Echinoidea, Graptoloidea and Anthozoa.	**15**
2.Petrology Study in hand specimen and under microscope of the mineral composition, textures and structures of important igneous sedimentary and metamorphic rocks as included in theory paper.	**22**
3. Megascopic study of : i) Ore minerals of cu, Fe, Al, Mn, Pb and Zn. ii) Industrial minerals- refractory and radioactive. iii)Precious and semi-precious stones-diamond, ruby, sapphire, emerald, opal, jasper, agate and garnet.	**15**

Marks Distribution for practicals

Internal Practicals: **25 Marks**
External Practicals: **25 marks**

SYLLABUS FOR UNDER-GRADUATE COURSES IN GEOLOGY

FOR B.Sc. Part III
To be implemented from 2015

Paper: Applied Geology 100 Marks 150L

Unit I	**GEOCHEMISTRY& GEOPHYSICS 35 L**
1.0	Introduction to geochemistry: Crystal chemistry-Chemical bonds, coordination number, radius ratio, ionization potential, electro-negativity. Polymorphism, isomorphism, atomic substitution.
1.1	Colloids in geological systems: kinds of colloids, ion exchanges, and geological evidence for earlier colloids.
1.2	Cosmic abundance of elements; Silicate structures - Introduction.
2.0	Gold Schmidt's geochemical classification of elements.
2.1	Distribution of the elements in igneous, metamorphic and sedimentary rocks.
3.0	Introduction to geophysics: The science and domains of Geophysics; Spheroidal shape of earth, magnetic field of the earth. Exploring Earth's interior with geophysical techniques
3.1	The utility of geophysics: How to locate the deposits of the minerals, energy resources.
3.2	Earth's thermal history: Heat conduction and factors controlling heat flow. Thermal gradient of the earth. Convection currents-evidence and models.
4.0	Gravitational Field: The concept of gravity; its variation with latitude, altitude, topography, and subsurface density variations. Gravity instruments: Pendulum gravimeters Ship borne measurements
4.1	Units of gravity, gravity anomaly - definition, types (Free- air, Bouguer), local and regional concepts. Use of gravity method for locating mineral resources and petroleum reservoirs. Detection of cavities at engineering sites.
5.0	Isostasy: Observation; Pratt and Airy schemes of the isostatic compensation, elastic crust on viscous mantle.
Unit II	**SEISMOLOGY &HYDROGEOLOGY 25 L**
6.0	Seismology: What is an earthquake? Effects of an earthquake-seismic waves and damage to structures and natural objects. Seismographs Basic features of seismograms; Magnitude and intensity of an earthquake.
6.1	Types of earthquake - tectonic, volcanic and man made. Tectonic earthquake and creation of new faults. Elastic rebound theory - statement and geodetic evidence.
6.2	Earthquake location: Focus, epicentre and hypocenter; Earthquake belts; Focal depth of earthquakes. Earthquake focal mechanisms - how these are obtained.
7.0	Seismic wave reflection and refraction. Structure of the Earth: Crust, mantle; Outer core, inner core; wave speed and density distribution.
7.1	Earthquake Prediction: Need, definition, possibility, results; Seismic gap theory.
8.0	Introduction to hydrogeology: occurrence of groundwater, water table, aquifer and its types (unconfined, confined and perched).

8.1	Hydrological properties of rocks–porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, and storativity. Hydrological classification of geological formations.
9.0	Hydrological cycle and its components.Water quality standards for drinking purposes.
9.1	Fundamentals of groundwater exploration – geological and geophysical methods.
Unit III	**STRUCTURAL GEOLOGY 40 L**
10.0	Basic concepts of field geology: Maps – definition, Topograpahic and geological maps.
10.1	Dip and strike of stratified rocks: horizontal, inclined beds. True dip and apparent dip. Plunge and pitch of linear structures. Outcrop pattern of horizontal beds. Vertical beds and inclined beds, inliers and outliers. True thickness and vertical thickness. Width of the outcrop, relation betweens true thickness and the width of outcrop.
10.2	Nature of the problems of overturned strata. Use of different sedimentary features for determination of the overturned strata. Sedimentary structures – ripple marks, cross bedding, graded bedding, mud cracks, rain-imprints. Pillow lava, vesicular tops of lava beds; Relationship of cleavage with bedding. Paleontological methods.
11.0	Mechanical principles – Introduction about force, couple, stress & strain.
11.1	Stress; definition of force and stress. Normal and shear stress. Basic cosnept of stress ellipse. Strain definition and computation of changes in line length. Geological examples. Basic concept of strain ellipse.
11.2	Golds: Definition of folds, inflation, Classification of folds. Types of folds.
12.0	Unconformities: Definition, types of unconformities. Criteria for recognition of uncosnformities. Definition, concordant pluton: sills, laccoliths, lopoliths, and phacoliths. Discordant pluton: dykes, volcanic vents, ring dyskes.
12.1	Joints- Definition, attitude of joints, joint sets and joint system. Geometrical classification of joints-strike joints, bedding joints, dip joints. Oblique and diagonal joint.
13.0	Faults: Definition, attitude of fault planes and symbols. Components of fault – dip, hade, rake, hanging wall, footwall, fault line, fault zone, throw and heave.
13.1	Classification of faults (1) based on relative movements: thrust fault, gravity fault, strike-slip fault (wrench faults), sinistral and dextral faults, transcurrent and transform faults.
14.0	Criteria for recognition of faults: discontinuity of structures, repetition and omission of strata, features characteristic of fault plane: slickenside, gouge, fault breccias, mylonites, silicification and mineralization, differences in sedimentary facies. Physiographic criteria: scraps,s triangular facets. Offset streams.
14.1	Lineation and Foliation: Overview and basic concepts.
Unit IV	**GEOLOGY AND REMOTE SENSING 30 L**
15.0	Societal Geology: Fundamental concept (environment, population needs and planning.
15.1	Mineral resources vis-à-vis population needs, environmental impact of exploration and processing of mineral resources on air, soil and surface and subsurface water.
16.0	Water supply and water use - human, agriculture and industrial.
16.1	Societal implications of major hydroelectric, nuclear and industrial projects.

17.0	Earth processes and geological hazards -Introduction.
17.1	River flooding: magnitude and frequency of floods, urbanization and flooding, nature and extent of flood hazard.Coastal hazards: tropical cyclones,tsunamis and coastal erosion
18.0	Earthquakes: Scale of intensity related damage, preventive measures.Landslides: Slope stability, causes of landslides, anthropogenic activity and landslides, prevention and correction of landslides.
18.1	Volcanoes: Effects of volcanic activity, prediction of volcanic activity, adjustment to and perception of volcanic hazard.
19.0	Remote sensing: Concept and foundation of RS (Electromagnetic spectrum).
19.1	Overview of RS technology.Landsat,IRS,SPOT,MODIS
19.2	Interaction of Electromagnetic waves with Earth surface features (water, soil, rocks, vegetation) – Introduction.
20.0	Application of remote sensing: geomorphological mapping, geological hazards assessment, hydrology and land use planning.
20.1	Introduction to GIS and its applications.
Unit V	**FUEL GEOLOGY** **20L**
21.0	Origin of petroleum – Organic versus inorganic theories, transformation of organic matter into petroleum (geochemical aspects, pressure, temperature, depth of occurrence). Limiting conditions of petroleum occurrence.
21.1	Reservoir rocks – definition and types. Source rocks; definition and types.
21.2	Reservoir Traps, classification (structural, stratigraphic); Cap rocks – types.
23.0	Migration and accumulation of petroleum: primary and secondary migration.
23.1	Coal; Introduction; Two principal periods of coal formation; Constituents of coal: Rank and grade of coal; Varieties of coal (physical and chemical characters); Origin of coal.

Suggested Readings:

Condie, K. C., 1997: Plate Tectonics and Crustal Evolution, Butterworth &Heimnemann.
Keary, P. and Vine, F. J., 2000: Global Tectonics, Blackwell Science.
Cox, A., 1996: Plate Tectonics. Blackwell Science.
Billings, M. P., 1972: Structural Geology, Prenticie Hall.
Davis, G. H. 1984: Strucutural Geology, John Wiley.
Ghosh, S. K. 1995: Structural Geology-Fundamentals and Modern Developments, Pergamon Press.
Meyerhoff, et al., 1996: Surge Tectonics, Kluwer Academics.
Bell, F. G., 1998: Environmental Geology, Blackwell.
Bell, F. G., 1999: Geological Hazards, Routledge, London.
Subramanian, V., 2001: Text Book on Environmental Science, Narosa International.
Gunter, F., 1991: Principles and Applications of Inorganic Geochemistry, Prentice Hall.
Albarede, F., 2003: Geochemistry - An Introduction, Cambridge.
Marshal, C. P. and Fairbridge, R. W., 1999: Encyclopaedia of Geochemistry, Kluwer Acadmic.
William, L., 1998: Introduction to Geophysics, Cambridge.
Todd, D. K., 1980: Groundwater Hydrology, John Wiley.
Karanth, K. R., 1987: Groundwater assessment, Development and Management, McGraw Hill.

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Note for Paper setter

The format of the question papers shall be as per the revised format in vogue in the university since 2013. A sample copy of the question paper shall be provided to the examiner for reference and guidance.

Course content an no of Lectures distribution for practical course

A. Field Work (C-1) Geological mapping, making structural and lithological data (Dip, Strike, lithology), Preparation of sketches lithologs and fossils collection if any available.	**Minimum 15 days**
B. Field Work (C-2) Preparation of Report (the assigned no of lectures will be utilized for guiding the students in the preparation of the field work report)	**5L**
C. Laboratory Work **Maps:** Strike, true dip and Apparent dip problems; Measurement of thickness and width of outcrops; Completion of outcrops in geological maps; and Drawing of profiles and study of geological maps (10 maps)	**10L**
D. Project assignment on any one of the following topics (the assigned no of lectures will be utilized for guiding students in the preparation of the assigned topics): I. Geochemical classification of elements II. Convection currents within earth. III. Gravity structure of the earth. IV. Seismic structure of the earth. V. Hydrological properties of the rocks. VI. Plate tectonics. VII. Tectonic structure of the Himalayas. VIII. Landslides. IX. Hydrological cycle.	**10L**

Marks Distribution for practical course

Internal Practical: 25 Marks

This will include field work of 10 marks, lab work of 5 marks and project assignment on any one of the above listed topics of 10 marks. Field work will have two components: C-1 will be the part of the work to be conducted in the field, and C-2 will be the preparation of the field work report.

External Practical 25 Marks

This will include laboratory work of 10 marks, fieldwork report (C-1 and C-2) of 10 marks, and viva voce of 5 marks. Duration of the examination will be four hours including viva-voce.

Field work will form a compulsory component of practical and should be of at least 15 days duration. The marks for C-1 of the fieldwork will be given internally by the teacher in-charge of the fieldwork and will be added to the marks secured in the project assignment to pass the internal practicals.

In case of regular students the internal assessment received from the college will be added to the marks obtained by a student in the university examination, and in the case of private candidates, marks obtained by a student in the university examination shall be increased proportionately in accordance with the statutes/ regulations.

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