

Centre for Geography and Geology
Central University of Punjab, Bathinda

ANNEXURE-I

Syllabus for M.Sc. Geology											
Course Code	Course Title	Credit Hours				% Weightage				E	CBSC
		L	T	P	Cr	A	B	C	D		
Semester – I											
Core courses											
EGS.501	Mineralogy and Crystallography	4	1	-	4	25	25	25	25	100	C
EGS.502	Palaeontology	4	1	-	4	25	25	25	25	100	C
EGS.503	Sedimentology	4	1	-	4	25	25	25	25	100	C
EGS.504	Geomorphology & Geotectonic	4	1	-	4	25	25	25	25	100	C
EGS.505	Lab – I (EGS.501)	-	-	4	2	-	-	-	100	100	C
EGS.506	Lab – II (EGS.502 and EGS.503)	-	-	4	2	-	-	-	100	100	C
EGS.507	Computer application and Basic Statistics*	2	-	-	2	25	25	25	25	100	F
Elective courses: Select any one of the interdisciplinary courses listed below											
IC.	Interdisciplinary course from other discipline A/B/C/D.....N	2	-	-	2	25	25	25	25	100	E
Total		20	4	8	24					800	
Semester – II											
Core courses											
EGS.511	Geochemistry and Isotope Geology	4	1	-	4	25	25	25	25	100	C
EGS.512	Igneous and Metamorphic Petrology	4	1	-	4	25	25	25	25	100	C
EGS.513	Structural Geology	4	1	-	4	25	25	25	25	100	C
EGS.514	Lab – III (EGS512)	-	-	4	2	-	-	-	100	100	C
EGS.515	Lab – IV (EGS 513)	-	-	4	2	-	-	-	100	100	C
EGS.516	Academic activities/Assignment based Seminar – I	2	-	-	1	-	-	-	100	100	F
EGS.517	Field training – I (~10days), report writing and presentation†	2	-	-	2	-	-	-	100	100	F
EGS.518	Field Geology	2	-	-	2	25	25	25	25	100	F
Elective Course: Select any one											
EGS.521	Natural Resource Management	2	-	-	2	25	25	25	25	100	E
EGS.522	Oceanography	2	-	-	2	25	25	25	25	100	E
EGS.523	Watershed Management	2	-	-	2	25	25	25	25	100	E
EGS.524	Environmental Geology and Natural Hazards	2	-	-	2	25	25	25	25	100	E
Total		20	3	8	23					900	

* Offered by Centre for Computer Sciences and Technology, and Computational Science.

† Field work will be conducted in the beginning of 2nd semester. This field work will be focused on the sedimentological and paleontological aspect. Evaluation of this course will be based on the field activity, daily field report, final report submission and presentation.

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Semester – III											
Core courses											
EGS.601	Geophysics	4	1	-	4	25	25	25	25	100	C
EGS.602	Ore Geology	4	1	-	4	25	25	25	25	100	C
EGS.603	Remote Sensing and GIS in Geology	4	1	-	4	25	25	25	25	100	C
EGS.604	Hydrogeology	4	1	-	4	25	25	25	25	100	C
EGS.605	Lab – IV (EGS.601, 602)	-	-	4	2	-	-	-	-	100	C
EGS.606	Lab – V (EGS.603, 604)	-	-	4	2	-	-	-	-	100	C
EGS.607	Academic activities/Assignment based Seminar- II	2	-	-	1	-	-	-	-	100	F
Elective courses: Select any one from the followings:											
EGS.621	Petroleum Geology	2	-	-	2	25	25	25	25	100	E
EGS.622	Climatology	2	-	-	2	25	25	25	25	100	E
EGS.623	Mineral Exploration and Mineral Economics	2	-	-	2	25	25	25	25	100	E
EGS.624	Palaeobotany	2	-	-	2	25	25	25	25	100	E
Total		20	4	8	23					800	
Semester – IV											
Core courses											
EGS.611	Principle of Stratigraphy and Indian Stratigraphy	4	1	-	4	25	25	25	25	100	C
EGS.612	Engineering Geology and Environmental Geology	4	1	-	4	25	25	25	25	100	C
EGS.613	Lab – VI (EGS. 611, EGS. 612)	-	-	4	2	-	-	-	-	100	C
EGS.614	Field training – II (~10days), report writing and presentation ††	2	-	-	2	-	-	-	-	100	F
EGS.699	Dissertation/ Project work/ Academic activities and Viva voce	-	-	10	10	-	-	-	-	-	C
Total		10	2	14	22					400	
Grand total		70	13	38	92					2800	

†† Field work will be conducted in the beginning of 4th semester. This field work will be focused on the lithological and structural mapping/ ore geology. Evaluation of this course will be based on the field activity, daily field report, final report submission and presentation during the 4th semester.

<p>L: Lectures, T: Tutorial, P: Practical, Cr: Credits</p> <p>CBCS: Credit Based Choice System, C, F & E – Core, Foundation & Elective Subject respectively</p> <p>A: Continuous Assessment: Based on Objective Type Tests</p>	<p>B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test</p> <p>C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test</p> <p>D: End-Term Exam (Final): Theory - Based on Objective Type Tests. Lab – Experiment/Subjective + Viva + Lab Record</p> <p>E: Total Marks</p>
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SEMESTER-I

Course Title: Mineralogy and Crystallography	L	T	P	Cr	Marks
Course Code: EGS. 501	4	1	-	4	100
Unit I:					
Mineralogy: Introduction to mineralogy, broad classification, properties of minerals & environments of formation. Crystal chemistry: chemistry of elements, bonding and packing in mineral, coordination number, chemical analysis of minerals, general and structural mineral formulae. Polymorphs/structural states, rules of substitution, introduction to phase diagram and solid solution series. (12 Lectures)					
Unit II:					
Crystallography: Crystal systems, introduction to symmetry, derivation of 32 classes of symmetry. 2D and 3D lattice, 14 Bravais lattice, introduction to space group. International system of crystallographic notation and study of stereogram. Different types of crystal projections – spherical and stereographic and their uses. Crystal defects, twinning and twin laws: common types of twins and their examples in minerals. Liquid crystals. Introduction to X-ray crystallography, and Bragg's equation. Powder method in X-ray crystallography. (12 Lectures)					
Unit III:					
Optical Mineralogy: Introduction to optics, Isotropic and anisotropic minerals, optical crystallography of uniaxial and biaxial crystals, indicatrix, pleochroism, interference figures, crystal orientation, 2V and 2E. (12 Lectures)					
Unit IV:					
Systematic Mineralogy: A detailed study of the important silicates (listed below) and non-silicate mineral with reference to general and structural formulae, classification, atomic structure, polymorphs/structural states, solid solution and experimental work on pressure-temperature stability of the minerals, modes of occurrence and alterations.					
<ul style="list-style-type: none"> (a) Nesosilicates/Orthosilicates: olivine group, garnet group, aluminosilicate group (kyanite, andalusite, sillimanite), humite group, zircon. (b) Sorosilicates: melilite, axinite and epidote group. (c) Cyclosilicates: beryl, tourmaline, cordierite, eudialyte (d) Inosilicates: pyroxene group, amphibole group and wollastonite (e) Phyllosilicates: mica group, kaolinite-serpentine group, talc-pyrophyllite, chlorite, smectite. (f) Tectosilicates: silica group, feldspar group, zeolite and feldspathoid 					
Suggested readings:					
<ol style="list-style-type: none"> 1. Mineralogy and Optical Mineralogy by Dyar M. D., Gunter M. E., Tasa D., 2008, Mineralogical, Society of America, ISBN 978-0-939950-81-2. 2. Mineralogy by Perkins Dexter, 3rd edition, 2012, Pearson Education. 3. Dana's Textbook of Mineralogy (With Extended Treatise on Crystallography and Physical Mineralogy), by William E. Ford, 4th edition, 2006, CBS Publishers & Distributors Pvt. Ltd., ISBN 10: 8123908091. 					
Further readings:					
<ol style="list-style-type: none"> 4. Optical Crystallography by Bloss, 1999, Mineralogical Society of America. 5. Crystallography and Crystal Chemistry by Bloss, 1994, Mineralogical Society of America. 6. Introduction to Mineralogy by William Nesse, 2nd edition, 2011, Oxford University Press, 					

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ISBN: 9780199827381.

7. Introduction to Optical Mineralogy by William Nesse, 4th edition, 2012, Oxford University Press, ISBN: 9780199846276.
8. Minerals and Rocks-Exercises in Crystallography, Mineralogy and Hand Specimen Petrology by Cornelius Klein, 3rd edition, 2007, Wiley publisher.
9. Mineralogy by Berry, L.G., Mason, B. and Dietrich, R.V., 2004, CBS Publishers, ISBN 10: 8123911483, ISBN 13: 9788123911489.
10. Introduction to the Rock-Forming Minerals by Deer W. A., Howie R. A. and Zussman J., 3rd edition, 2013, Mineralogical Society of America.
11. Rutley's Elements of Mineralogy, by Gribble, 27th edition, 2005, CBS Publishers, ISBN-10: 8123909160.

Course Title: Palaeontology	L	T	P	Cr	Marks
Course Code: EGS. 502	4	1	-	4	100
Unit I					
Scope of paleontology; Origin and evolution of life through age; species concept and speciation. Techniques in palaeontology: mega fossils, microfossils, nanno-fossils and ichno-fossils—mode of collection and illustration; binomial nomenclature. Study of Invertebrate paleontology with special reference to functional morphology: trilobites, brachiopods, gastropods and cephalopods general morphology and Indian occurrence. (14 Lectures)					
Unit II:					
Micropalaeontology: Classification and uses of micro fossils. Detailed study of microfossils such as Foraminifera, Radiolaria, Conodonta, Ostracoda and Charophyta. Plant fossils: Gondwana flora and their significance. (14 Lectures)					
Unit III:					
Vertebrate palaeontology: General characters, classification, evolution of Fishes including Agnaths, Placoderms, Chondrichythis and Osteichthytes. General characters, age of Amphibians, Reptiles and Mammals. General characters, classification, evolution, age and extinction of Dinosaurs. General characters, classification and evolution of Horse, Elephant and Man. Vertebrate fossil records of Siwaliks. A brief study on the Mesozoic reptiles of India. (14 Lectures)					
Unit IV:					
Applied Palaeontology: Use of palaeontological data in stratigraphy, biostratigraphy, palaeoecology, evolution, palaeoclimate and sea level changes; Principle of palaeobiogeography. Use of microfossils in interpretation of sea floor tectonism. Application of micropalaeontology in hydrocarbon exploration; oxygen and carbon stable isotopes studies of microfossils and their use in palaeoclimate interpretation. (14 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Invertebrate Palaeontology & Evolution by Clarkson, E. N. K., 4th edition, 1998, Wiley-Blackwell. 2. Vertebrate Palaeontology, by Michael Benton, 3rd edition, 2004, Wiley-Blackwell. 3. Microfossils, by Howard A. Armstrong, Martin D. Brasier, 2nd edition, 2004, Blackwell Publishing Ltd. 					

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4. Principles of Paleontology by Michael Foote, Arnold I. Miller, 3rd edition, 2006, W. H. Freeman.
5. Applied Palaeontology by Jones, R.W. 2002, Natural History Museum, London.

Further readings:

6. Principles of Invertebrate Paleontology by Shrock, N., 2nd edition, 2005, CBS Publisher & distributor Private Ltd.
7. Paleontology Invertebrate by Henry Wood, 8th edition, 2004, CBS Publication & distributor Private Ltd.
8. Bringing Fossils to Life: An Introduction to Palaeobiology, by Donald R. Prothero, 2nd edition, 2003, McGraw-Hill Higher Education.
9. Modern foraminifera by Sen Gupta, B.K. 2003, Springer Netherlands.

Course Title: Sedimentology	L	T	P	Cr	Marks
Course Code: EGS. 503	4	1	-	4	100
Unit I					
Origin of terrigenous clastic and non-clastic grains; weathering and its products; chemical weathering of granite and basalt, submarine weathering. Major carbonate minerals; carbonate grains of biological origin. Simple fluid flow concepts and sediment transport; sediment gravity flows and their deposits. (14 Lectures)					
Unit II					
Important bed forms and sedimentary structures – their genesis and stratigraphic significance. Application of sedimentary structures in palaeocurrent analysis; Diagenesis of clastic and non-clastic rocks; Stages and processes of diagenesis, compaction and cementation by silica, carbonate and iron-oxide, dolomitization. Heavy minerals and their importance in determination of provenance. (16 Lectures)					
Unit III:					
Grain size, textural parameters and their significance. Textural and compositional maturity. Petrography and origin of sandstones, limestones and mudrocks. Sedimentary facies, methods of their analysis and interpretation of depositional environments. Processes and characteristics of aeolian, fluvial, barrier-beach, tidal-flats and deep sea environments. (16 Lectures)					
Unit IV:					
Tectonic and sedimentation; Review of concept of geosynclines and plate-margins, major types of basins and distribution of environments and lithofacies within basins, evolution of basins with time. Sedimentary basins of India and their economic importance. (10 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Principles of sedimentology & stratigraphy by Sam Boggs, Jr., 5th edition, 2011, Prentice Hall. 2. Sedimentary Geology, by Donald R. Prothero and Fred Schwab; 3rd edition, 2013, W. H. Freeman. 3. Carbonate Sedimentology by Tucker, M.E. and Wright, V.P., 1991, Wiley Publisher. 4. Sedimentary Environments: Processes, Facies and Stratigraphy by Reading, H.G., 3rd edition, 1996, Wiley-Blackwell. 					
Further readings:					
<ol style="list-style-type: none"> 5. Sedimentology and stratigraphy by Gary Nichols, 2nd edition, 2009, Wiley-Blackwell, ISBN: 978-1-4051-3592-4. 					

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6. Atlas of Sedimentary Rocks Under the Microscope by Adams, A. E., MacKenzie, W. S., Guilford, C., 1st edition, 1984, Prentice Hall.
7. Sedimentary Rocks in the Field: A Practical Guide (Geological Field Guide), by Maurice E. Tucker, 4th edition, 2011, Wiley-Blackwell.
8. Principles of Sedimentary Basin Analysis by Miall, A.D., 2000, Springer-Verlag.
9. Sedimentary Basins by Einsele, G., 1992. Springer Verlag.
10. Depositional Sedimentary Environments by Reineck, H.E. and Singh, I.B., 1980, Springer-Verlag.
11. Introduction to Sedimentology by Sengupta, S., 1997, Oxford-IBH.

Course Title: Geomorphology and Geotectonic	L	T	P	Cr	Marks
Course Code: EGS. 504	4	1	-	4	100

Unit I

Development in geomorphology, Historical and process geomorphology, The geomorphic systems, Geomorphic materials and process: weathering, sediment production, pedogenesis, mass movement, erosion, transportation and deposition, landforms in relation to climate, rock type, structure and tectonics. (10 Lectures)

Unit II:

Geomorphic processes and landforms-fluvial, glacial, aeolian, coastal and karst. River forms and processes-stream flow, stage-discharge relationship; hydrographs and flood frequency analysis, Submarine relief, Environmental change-causes, effects on processes and landforms. Extra-terrestrial geomorphology. (16 Lectures)

Unit III:

Physiography, drainage, climate, soils and natural resources of the Himalaya, Ganga Brahmaputra plains, and peninsular India, climate zones of India. Geomorphology and topographic analysis including DEM, topographical maps, map reading, geomorphic mapping, slope analysis and drainage basin analysis, applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. (14 Lectures)

Unit IV:

Planetary evolution of the earth and its internal structure. Heterogeneity of the earth's crust. Major tectonic features of the oceanic and continental crust. Seafloor spreading and plate tectonics. Island arcs, Oceanic islands and volcanic arcs. Continental drift-geological and geophysical evidence, mechanics, objections, present status. Gravity and magnetic anomalies at mid-oceanic ridges, deep sea trenches, continental shield areas and mountain chains. Isostasy, orogeny and epiorogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate. (16 Lectures)

Suggested readings:

1. Principles of Geomorphology by W.D. Thornbury, 2nd edition, 2004, CBS publisher & distributor private Ltd.
2. Global Tectonics by Philip Kearey, Keith A. Klepeis, Frederick J. Vine, 3rd edition, 2009, Wiley-Blackwell.
3. Fundamental of Geomorphology by Richard John Huggett, 2nd edition, 2007, Taylor & Francis.

Further readings:

4. Geological Field Techniques by Angela L. Coe (edt), 2010, Wiley-Blackwell.

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5. Basic Geological Mapping (Geological Field Guide), by Richard J. Lisle, Peter Brabham, John W. Barnes, Wiley-Blackwell; 5th edition, 2011, ISBN-13: 978-0470686348
6. Geomorphology and Global Tectonics, Michael A. Summerfield (Editor), 2000, Wiley, ISBN: 978-0-471-97193-1,
7. Principles of Physical Geology by Holmes, and edited by P. McL. D. Duff., 4th edition, 1993, Chapman and Hall, London.
8. Applied Geomorphology: Theory and Practice, by R. J. Allison, 1st edition, 2002, Wiley.
9. Tectonic Geomorphology by Douglas W. Burbank, Robert S. Anderson, Wiley-Blackwell; 2nd edition, 2011, ISBN-13: 978-1444338867
10. Geomorphology: The Mechanics and Chemistry of Landscapes by Robert S. Anderson, Suzanne P. Anderson, 1st edition, 2010, Cambridge University Press.
11. Key Concepts in Geomorphology by Paul R. Bierman, David R. Montgomery, 2013, W. H. Freeman.
12. Indian Geomorphology by H.S. Sharma, 1991, Concept Publishing Co. New Delhi.
13. Text book of Physical Geology by G.B. Mahapatra, 1st edition, 2008, CBS Publishers & Distributors Private Ltd.
14. Plate Tectonics and Crustal Evolution by Condie, Kent. C., 4th edition, 1997, Butterworth-Heinemann.

Course Title: Lab- I (Mineralogy and Crystallography)	L	T	P	Cr	Marks
	-	-	4	2	100
Course Code: EGS. 505					
Unit I					
Mineralogy and crystallography: Identification of rock-forming minerals in hand specimens. Introduction to crystal models, Goniometer and its use in measuring interfacial angle of crystals and calculation of axial ratio. Representation of symmetry elements of crystals belonging to 32 classes of symmetry and study of their stereograms. Analysis of XRD spectrum.					
Unit II:					
Optical Mineralogy: Determination of length fast and length-slow characters of minerals. Determination of order of interference colours. Scheme of pleochroism and absorption of a given mineral in thin section. Determination of extinction angle and composition of plagioclase. Study of interference figures of uniaxial and biaxial crystals, determination of optic signs. Identification of rock forming minerals using optical properties.					
Suggested readings:					
1. Minerals and Rocks-Exercises in Crystallography, Mineralogy and Hand Specimen Petrology by Cornelius Klein, 3 rd edition, 2007, Wiley.					
2. Mineralogy by Perkins Dexter, 3 rd edition, 2012, Pearson Education.					
3. Dana`s Textbook of Mineralogy (With Extended Treatise on Crystallography and Physical Mineralogy), by William E. Ford, 4 th edition, 2006, CBS Publishers & Distributors Pvt. Ltd.					
Further readings:					
1. Mineralogy and Optical Mineralogy by Dyar MD, Gunter ME, Tasa D, 2008, Mineralogical, Society of America.					

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2. Optical Crystallography, by Bloss, 1999, Mineralogical Society of America.
3. Crystallography and Crystal Chemistry by Bloss, 1994, Mineralogical Society of America.
4. Introduction to Mineralogy by William Nesse, 2nd edition, 2011, Oxford University Press.
5. Introduction to Optical Mineralogy by William Nesse, 4th edition, 2012, Oxford University Press.
6. Mineralogy by Berry, L.G., Mason, B. and Dietrich, R.V., 2004, CBS Publishers.
7. Introduction to the Rock-Forming Minerals by W.A. Deer, R.A. Howie and J. Zussman, 3rd edition, 2013, Mineralogical Society of America.
8. Rutley's Elements of Mineralogy, by Gribble, 27th edition, 2005, CBS Publishers.

Course Title: Lab- II (Sedimentology and Paleontology)	<table border="1"> <thead> <tr> <th>L</th> <th>T</th> <th>P</th> <th>Cr</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">100</td> </tr> </tbody> </table>	L	T	P	Cr	Marks	-	-	4	2	100
L	T	P	Cr	Marks							
-	-	4	2	100							
Course Code: EGS. 506											
Unit I:											
Study of clastic and non-clastic rocks in hand specimens. Microscopic examination of important rock-types. Grain-size analysis by sieving method: plotting of size-distribution data as frequency and cumulative curves; Computation of statistical parameters and interpretation. Heavy mineral separation; their Microscopic characters, graphic representation and interpretation. Assemblages of sedimentary structures and their palaeo-environmental significance. Palaeo-current analysis. Study of vertical profile sections of some selected sedimentary environment.											
Unit II:											
Study of morphology of brachiopods, bivalves and gastropods, cephalopods, echinoids. Separation, processing, wet sieve analyses, preparation of slides of microfossils (demonstration only). Morphology and morphological descriptions of planktonic & benthonic foraminifera, ostracods. Morphology of radiolaria, diatoms, pollen and spores. Construction of range charts.											
Suggested readings:											
<ol style="list-style-type: none"> 1. Atlas of Sedimentary Rocks Under the Microscope by A. E. Adams, W. S. MacKenzie, C. Guilford, 1st edition, 1984, Prentice Hall. 2. Principles of Invertebrate Paleontology by N. Shrock, 2nd edition, 2005, CBS publication. 3. A Practical approach to Sedimentology by Roy C. Lindholm, 1987, Allen and Unwin, London. 4. Microfossils by M.D. Braiser, 1980, George Allen and Unwin. 											
Further readings:											
<ol style="list-style-type: none"> 5. Elements of Micropaleontology by Bignot, G., 1985, Grahm and Trotman, London. 6. Introduction to Marine Micropaleontology, by Haq and Boersma, 1978, Elsevier. 7. Systematics & Fossil Record-Documenting Evolutionary Patterns by Smith, A.B., 1994, Blackwell publisher. 8. Micropaleontology in Petroleum exploration by R.W. Jones, 1996, Clarendon Press Oxford. 9. Paleontology Invertebrate by Henry Wood, 8th edition, 2004, CBS Publication. 10. Introduction to Sedimentology by Sengupta, S., 1997, Oxford-IBH. 											

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Course Title: Computer Application and Basic Statistics	L	T	P	Cr	Marks
Course Code: EGS. 507	2	-	-	2	100
Unit I					
Introduction to computer and its block, Computer Configuration, Networking and data sharing, WWW, Software structure. Introduction to MS Paint, Notepad and Word, Creating and Saving Documents, Text Formatting, Tables, Document Review Option, Mail Merge, Inserting Table of Contents, Reference Management. (6 Lectures)					
Unit II:					
Introduction to Word Processing and Microsoft Office, Spreadsheet applications, Presentation applications, Internet browsers and Image processing applications. Application of Coral Draw, Sigma plot, Surfer software's, Map info, Google terrain image in geology. Use of GW kit, GCD kit, Rock ware and NORM calculation using spread sheet. (8 Lectures)					
Unit III:					
Descriptive Statistics: Meaning, need and importance of statistics. Attributes and variables. Measurement and measurement scales. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, frequency polygon, frequency curve, ogives, stem and leaf plot, pie chart. (8 Lectures)					
Unit IV:					
Measures of central tendency, dispersion (including box and whisker plot), skewness and kurtosis. Data on two attributes, independence and association of attributes in 2x2 tables. Linear regression and correlation (Karl Pearson's and Spearman's) and residual plots. (6 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. MS Word for Dummies by Gookin, D., 2007, Wiley. 2. MS Excel for Dummies by Harvey, G., 2007, Wiley 3. Computer Fundamentals by Sinha, P.K., 2004, BPB Publications. 4. Understanding Basic Statistics by Charles Henry Brase and Corrinne Pellillo Brase, 2013, 6th edition, Brooks/Cole, Cengage Learning, USA. 5. Introductory Probability and Statistical Applications by Meyer, P.L., 1975, Oxford & IBH Pub. 6. Introduction to mathematical statistics by Hogg, R.V. & Raise, A.T., 1978, Macmillan Pub. Co. Inc. 7. Applied General Statistics by Croxton, F.E. & Cowden, D.J., 1975, Prentice-Hall Inc. 8. Introduction to Mathematical Statistics by Hoel, P.G., 1997, John Wiley & Sons, Inc. 					

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Semester II

Course Title: Geochemistry and Isotope Geology	L	T	P	Cr	Marks
Course Code: EGS. 511	4	1	-	4	100
Unit I					
<p>Geochemistry Introduction of geochemistry and cosmochemistry. Abundance of elements in the solar system and chemical composition and properties of Earth's layers. Atmosphere: its layers, chemical composition and evolution of atmosphere. Meteorites, classification, mineralogy, origin, significance and phenomena of fall. (10 Lectures)</p>					
Unit II:					
<p>Geochemical classification of elements. Periodic table with special reference to rare earth elements and transition elements. Principles of ionic substitution in minerals; Geochemistry of uranium and lithium. Elemental mobility in surface environment. Concept of geochemical-biogeochemical cycling: Minor cycle and major cycle. (14 Lectures)</p>					
Unit III:					
<p>Isotope Geology Introduction and physics of the nucleus; radioactive decay; the law of radioactive decay; review of mineral structure; principles of mass spectrometry; K-Ar method: principles, methods and applications; Ar-Ar method: principles, method and advantages; Rb-Sr method: principles, Rb-Sr isochron and limitations. Sm-Nd Method: decay scheme, evolution of Nd with time, Nd model ages and application of Nd to petrogenesis; U-Th-Pb Method: decay schemes, U-Pb isochron, U-Pb mineral dating and application. (20 Lectures)</p>					
Unit IV:					
<p>Stable isotopes and their fractionation; ratio Mass Spectrometry; principles of oxygen, carbon and sulphur isotope geochemistry and their application in Geology. Application of Cosmogenic radionuclides in the geosciences. Principles and application of Fission Track and Radiocarbon methods of dating. (12 Lectures)</p>					
Suggested readings:					
<ol style="list-style-type: none"> 1. Principles and applications of Geochemistry by Gunter Faure, 2nd edition, 1998, Prentice Hall. 2. Essentials of Geochemistry by John V. Walther, 2010, Jones and Bartlett Publication. 3. Isotope Geology by Claude Allegre, 2008, Cambridge University Press. 4. Radiogenic Isotope Geology by Dickin, A.P., 2005, Cambridge University Press. 5. Stable Isotope Geochemistry by Jochen Hoefs, 7th edition, 2015, Springer International Publishing. 					
Further readings:					
<ol style="list-style-type: none"> 6. Principles of Isotope Geology by Gunter Faure, 2nd edition, 1986, Wiley. 7. Isotopes: Principles and Applications by Gunter Faure and Teresa M. Mensing, 3rd edition, 2004, Wiley 8. Geochemistry, An introduction by Francis Albarede, 2003, Cambridge University Press. 9. Geochemistry by William M. White; 1st edition, 2013, Wiley-Blackwell. 					

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10. Geochemistry: Pathways and Processes by H.Y. Mc Sween Jr., S.M. Richardson and M.E. Uhle, 2003, Columbia University Press,
11. Introduction to Geochemistry by Mason, B. and Moore, C.B., 1991, Wiley Eastern.
12. Introduction to Geochemistry by Krauskopf, K. B., 1967, McGraw Hill.

Course Title: Igneous and Metamorphic Petrology	L	T	P	Cr	Marks
Course Code: EGS. 512	4	1	-	4	100

Unit I

Magma: nature of magma, factors affecting magma and evolution, melting of mantle. Generation of magmas in different tectonic environments. The phase equilibrium of unary, binary and ternary systems and its relation to magma genesis and crystallization in the recent experimental works. (14 Lectures)

Unit II:

Interpretation of igneous textures in terms of rate of nucleation and crystal growth. IUGS classification of the Igneous rocks. CIPW Norm. Petrology and petrogenesis of ultramafic, basaltic, granitic, alkaline igneous rocks including ophiolite, carbonatite, nephelinite-ijolite, lamproites, and layered igneous rocks with Indian examples. Plume magmatism and hot spots. Mantle metasomatism. Mantle heterogeneities. Partial melting (batch and fractional melting), crystal fractionation, contamination (AFC process) and dynamic melting. (14 Lectures)

Unit III:

Mineralogical phase rule for closed and open systems. Nature of metamorphic reactions, concept and classification of metamorphic facies, Introduction to ultrahigh temperature and ultrahigh pressure metamorphism, description of each facies of low – Pressure, medium to high – pressure and very high pressure with special reference to characteristic minerals, subdivision into zones/sub-facies, Mineral assemblages, Metamorphic reactions and pressure – temperature conditions of metamorphism. (14 Lectures)

Unit IV:

Isograds and reaction isograds, Schriener's rule and construction of petrogenetic grids, Metamorphic differentiation, anatexis and origin of migmatites in the light of experimental studies, Regional metamorphism and paired metamorphic belts with reference to the theory of plate tectonics, Pressure – temperature – time paths. (14 Lectures)

Suggested readings:

1. An introduction to Igneous and Metamorphic Petrology by Winter, J.D., 2001, Prentice Hall.
2. Principles of Igneous and Metamorphic Petrology by Philpotts, A.R. 1994, Prentice Hall.
3. The Interpretation of Igneous Rocks by Cox, K.G., Bell, J.D. and Pankhurst, R.J., 1993, Chapman & Hall, London.
4. Igneous and Metamorphic Petrology by Turner, F. J., and Verhoogen, J., 2nd edition, 1987, CBS.

Further readings:

5. Igneous and Metamorphic Petrology by Best, Myron G., 2002. Blackwell Science.
6. Origin of Igneous Rocks – The Isotopic Evidence by Faure, G., 2001, Springer.
7. Igneous Petrology by Hall A., 1997, Longman.
8. Igneous Rocks: A Classification and Glossary of Terms by Le Maitre, R.W., 2002, Cambridge University Press.

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9. Igneous Petrology by McBirney, 1994, CBS Publishers, Delhi.
10. Modern Igneous Petrology by Sood, M. K., 1982, Wiley-Interscience Publ., New York.
11. Magmatism in Relation to Diverse Tectonic Settings by Srivastava Rajesh, K., Chandra, R. and Balkema, A.A., 1997, Oxford University Press.
12. Petrogenesis of Metamorphic Rocks by Bucher, K. and Martin, F. 7th edition, 2002, Springer – Verlag.
13. An introduction to Metamorphic Petrology by Yardley, B.W.D., 1989, Longman Scientific & Technical, New York.
14. Mineralogical Phase Equilibria and pressure – temperature – time Paths by Spear, F. S. 1993, Mineralogical Society of America.
15. Equilibrium thermodynamics in Petrology: An Introduction by Powell, R. 1978, Harper & Row Publishers, London.
16. Igneous Petrology by Bose, M.K., 1997, World Press, Kolkata.

Course Title: Structural Geology	L	T	P	Cr	Marks
Course Code: EGS. 513	4	1	-	4	100
Unit I					
Stress and analysis of stress in two and three dimension. Plane stress analysis and Mohr stress circle, and its relationship with faulting and fracture mechanics. Mechanical principle, properties of rocks and their controlling factors. Theory of rock failure: brittle failure – shear and tensile failures. Role of fluid pressure and effective pressure in brittle failure. Strain analysis – finite and infinitesimal, homogeneous and inhomogeneous strains. Strain and deformation paths. Determination of strain in naturally deformed rocks. (14 Lectures)					
Unit II:					
Description and geometric classification of folds. Mechanics of folding. Fold development and distribution of strains in folds. Brittle and ductile shear zones, Geometry and products of shear zones, Mylonites and Cataclasites; buckling of single layer, multilayer and anisotropic materials. Analysis and interpretation of superimposed folding. Fault bent folds, gravity induced structures and salt diapirism. (14 Lectures)					
Unit III:					
Planar and linear fabrics (Foliation and Lineation) in deformed rocks: description, classification, genesis and significance. Basic idea about petrofabrics and use of Universal stage. Stereographic and equal area projections for representing different types of fabrics, π and β diagrams. Non-diastrorphic structures: significance in the study and analysis of deformed rocks. (14 Lectures)					
Unit IV:					
Description and classification of faults and joints. Mechanics of faulting and jointing, and stress conditions for thrust, normal and strike-slip faults. Mechanics and geometric aspects of thrust, normal and strike-slip faults, and associated structural features. Thin-skinned deformation; Decollement. Geometrical analysis of simple and complex structures on macroscopic scale. Identification of top and bottom of the strata/rock. (14 Lectures)					
Suggested readings:					
1. Structural Geology by Marland P. Billings, 3 rd edition, 2000, Phi Learning.					

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2. Structural Geology by Robert J. Twiss, Eldridge M. Moores, 2nd edition 2006, W. H. Freeman publisher.
3. Structural Geology by Haakon Fossen, 1st edition 2010, Cambridge University Press.
4. Structural Geology: An Introduction to Geometrical Techniques by Donal M. Ragan 4th edition, 2009, Cambridge University Press.

Further readings:

5. Techniques of Modern Structural Geology. Vol. I. Strain Analysis by Ramsay, J.G. and Huber, M.I., 1983, Academic Press.
6. Techniques of Modern Structural Geology. Vol. II. Folds and Fractures by Ramsay, J.G. and Huber, M.I., 1987, Academic Press.
7. Folding and fracturing of rocks by Ramsay, J.G., 1967, McGraw Hill.
8. Basic Methods of Structural Geology by Stephen Marshak and Gautam Mitra. 1988, Prentice Hall.
9. An outline of Structural Geology by Hobbs, B.E., Means, W.D. and Williams, P.F., 1976, John Wiley and Sons. New York.
10. Structural Geology: Fundamental and Modern Developments by Ghosh, S.K., 1993, Pergamon Press.

Course Title: Lab- III (Igneous and Metamorphic Petrology)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 12.5%;">L</th> <th style="width: 12.5%;">T</th> <th style="width: 12.5%;">P</th> <th style="width: 12.5%;">Cr</th> <th style="width: 12.5%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">100</td> </tr> </tbody> </table>	L	T	P	Cr	Marks	-	-	4	2	100
L	T	P	Cr	Marks							
-	-	4	2	100							
Course Code: EGS. 514											
Unit I											
Rock analyses (rapid method of silicate analysis). Determination of Loss on Ignition (LOI) of rock samples. Preparation of classificatory and variation diagrams and their interpretation. Study of non-silicate minerals and elements. Megascopic and microscopic study of different igneous rocks. Calculation of CIPW Norms.											
Unit II:											
A detailed study of textures in Rock Sections with reference to time relations between the phases of deformation and recrystallization of minerals, Calculation of ACF, AKF and AFM values from chemical and structural formulation of minerals and their graphical representation. Study of Metamorphic Rocks in hand specimens and thin sections belonging to different facies with emphasis on texture/structure, mineral composition, parent rock, metamorphic facies / subfacies .											
Suggested readings:											
<ol style="list-style-type: none"> 1. Igneous Rocks: A Classification and Glossary of Terms by LeMaitre, R.W., 2002, Cambridge University Press. 2. An introduction to Igneous and Metamorphic Petrology by Winter, J.D., 2001, Prentice Hall. 3. Principles of Igneous and Metamorphic Petrology by Philpotts, A.R. 1994, Prentice Hall. 4. The Interpretation of Igneous Rocks by Cox, K.G., Bell, J.D. and Pankhurst, R.J., 1993, Chapman & Hall, London. 											

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Course Title: Lab- IV (Structural Geology)	L	T	P	Cr	Marks
Course Code: EGS. 515	-	-	4	2	100
Unit I					
Preparation and interpretation of Geological maps and sections. Structural problems based on orthographic and stereographic projections, concerning economic deposit. Recording and plotting of the structural data on base map.					
Unit II:					
Study of the hand specimen of deformed structures, Strain estimation from the data already collected from the field. Study of dip-isogons from the fold profiles.					
Suggested readings:					
<ol style="list-style-type: none"> 1. Basic Methods of Structural Geology by Stephen Marshak and Gautam Mitra. 1988, Prentice Hall. 2. Structural Geology: Fundamental and Modern Developments by Ghosh, S.K., 1993, Pergamon Press. 3. Techniques of Modern Structural Geology. Vol. II. Folds and Fractures by Ramsay, J.G. and Huber, M.I., 1987, Academic Press. 					

Course Title: Field Geology	L	T	P	Cr	Marks
Course Code: EGS 518	2	-	-	2	100
Unit I:					
Field Geology: Introduction to toposheets, Scale definition; small scale and large scale maps; reading various components of a toposheet. Geological map-definition, various components of a geological map including scale, legend, structures and, etc. Studies of outcrop pattern, topographic law and rules of 'V'. (7 Lectures)					
Unit II:					
Instruments used in geological field studies; techniques and use of geological tools during field work-use of clinometer compass, Brunton compass, GPS, altimeter; strike and dip measurements; measurement of true thickness and distance, section measurement techniques and significance. (7 Lectures)					
Unit III:					
Techniques for sample collection: Sampling and oriented sampling, its significance; sampling for isotopic, geochronological and geochemical studies and its significance. Sampling strategies for micropalaeontological and biostratigraphic studies and recording of palaeontological informations. (7 Lectures)					
Unit IV:					
<i>Geological mapping procedures:</i> Geological mapping of igneous terrains, geological mapping of sedimentary terrains, geological mapping of metamorphic terrains and recording of structural information, preparation of Geological Cross-section. (7 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Geological field techniques by Angela L. C. 2010, Blackwell Publishing Ltd. 2. Basic Geological Mapping (Geological Field Guide) by Lisle, R. J., Brabham, P. and Barnes, J. W., 5th edition, 2011, Wiley-Blackwell. 3. Guide to Field Geology by Mathur, S.M., 2001, PHI Learning Private Limited-New Delhi. 4. Field geology (Illustrated) by Maley, T.S., 1994, Mineral Land Publications. 5. Field geology by Lahee, F. H., 6th edition, 1961, McGraw-Hill. 					

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Elective Course: Select any one					
Course Title: Natural Resource Management	L	T	P	Cr	Marks
Course Code: EGS. 521	2	-	-	2	100
Unit I					
Natural resources: Definition; Resource and Reserve; Classification of natural resources; natural resource degradation and conservation; Environmental impacts of resource depletion. (7 Lectures)					
Unit II:					
Forest Resources: Forest cover of India and world; forest types, functions of forest – production and protection; Conservation of forests; forestry programmes – social forestry, farm forestry, urban forestry, community forestry; deforestation; Exploitation of forest resources; Afforestation; Desertification; Forest policy. (7 Lectures)					
Unit III:					
Water Resources: Surface, ground water, marine and brackish water resources - assessment and utilization; Rivers and Lakes in India; hydrological cycle; Ground water depletion; Water logging and salinity; Water Conservation and management techniques; Rain water harvesting; Watershed management; Eutrophication; Restoration of Lakes; River cleaning, River action plans - Ganga and Yamuna action plan, Interlinking of rivers; conflicts over water. (7 Lectures)					
Unit IV:					
Land resources: Land degradation due to mining, exploration, industrialization, irrigation and natural disasters; Soil Erosion, Loss of soil fertility, Restoration of soil Fertility, Soil Conservation Methods; restoration of degraded land; Wasteland reclamation, Organic farming, green manuring, Wetland – definition, classification, functions, ecological importance and conservation. (7 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Environmental economics and natural resource management by Anderson, David A., 4th edition, 2013, Routledge. 2. Land resource management by Gurdev Singh and Vinod Ahuja, 1992, Oxford & IBH Pub. Co. 3. Natural resources and sustainable developments by Kathy Wilson Peacock, 2008, Facts on file Inc. 4. Sustainable natural resource management for scientists and engineers by Lynch, Daniel R., 2009, Cambridge University press 5. Natural resources in 21st century by Jaidev Somesh, 2010, ABD Publisher 6. Essential Environmental Studies by Panday, S.N. and Misra, S.P. (Eds.), 2008, CRC Press. 					

Course Title: Oceanography	L	T	P	Cr	Marks
Course Code: EGS. 522	2	-	-	2	100
Unit I:					
Origin, evolution of ocean basins and their environmental response; Topographic features of the ocean floor; continental margin provinces, ocean basin provinces; coral reefs. Classification of marine sediments, sediment budget, transport and its accumulation in the ocean; sedimentation processes on continental shelves - physical processes, sediment response; deep-sea sediments. (7 Lectures)					
Unit II:					
Wave dynamics, deep water waves, shallow water waves; Ocean circulation: forces driving currents;					

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surface currents, effects of surface currents on climate; thermohaline circulation - thermohaline circulation patterns, global heat connection and atmospheric Circulation. Wind induced vertical circulation - equatorial upwelling, coastal upwelling, downwelling; Coastal upwelling - its physical, chemical, biological characteristics, Tides - equilibrium theory of tides, dynamical theory of tides, tidal currents in coastal areas, observation and prediction of tides. (7 Lectures)

Unit III:

Seawater chemistry: salinity - components, sources and processes controlling the composition of sea water; dissolved gases - Nitrogen, Oxygen, Carbon dioxide; Density structure of ocean; inputs of organic carbon, concept of food chain; primary production, measuring productivity, factors limiting productivity, Role of light, temperature, nutrients, physiological adaptations; Marine resources: Petroleum and Natural Gas, sand and gravel, magnesium and magnesium compounds, salts, manganese and phosphate nodules, metallic sulfides and muds. (7 Lectures)

Unit IV:

Origin and evolution of the Indian Ocean, structure and physiography of the Indian Ocean, bathymetry and bottom characteristics, sediment distribution on the Indian Ocean floor. Introduction to Marine exploration methods, petroleum potential of sea-bed provinces beyond the continental slope; petroleum occurrences and exploration activity around the margins of the Indian Ocean. India's Exclusive Economic Zone (EEZ); marine minerals in the EEZ of India. (7 Lectures)

Suggested readings:

1. Oceanography-An invitation to Marine Science by Garrison T., 1996, Wadsworth Publishing Company
2. Oceanography - A view of the Earth by Gross, M.G., 1972, Prentice-Hall.
3. Introductory Oceanography by Thurman, B.Y., 1978, Charles E. Merrill Publishing Company

Further readings:

4. Principles of Oceanography by S. Davis, R.A. Jr. 1972, Addison - Wesley Publishing Company.
5. The Indian Ocean: Exploitable mineral and petroleum Resources by Roonwal, G.S., 1986, Narosa Publishing House.
6. Geological Oceanography: Evolution of coasts, continental margins & the deep-sea floor by Francis P. Shepard, 1977, Pan Publication.
7. Oceanography – Exploring the planet Ocean by Bhatt J.J., 1978, D. van Nostrand Company.

Course Title: Watershed Management	L	T	P	Cr	Marks
Course Code: EGS. 523	2	-	-	2	100

Unit I

Concept of watershed, introduction to watershed management, different stakeholders and their relative importance, watershed management policies and decision making, problems, approach and components. Structure and relief, physiographic divisions, drainage systems and watersheds. (7 Lectures)

Unit II:

Concept of small dams waste disposal practices and management; rainwater harvesting; Wetland and concept of Micro Watershed Management; Watershed Management using Geo-spatial technologies (7 Lectures)

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Unit III:
Community participation, private sector participation, Institutional issues, Socio-economy, Integrated development; Watershed Management in India, Water legislation and implementations, policies and decision making. Community participation, Private sector participation, Case studies. (7 Lectures)
Unit IV:
Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies on flood damage. Drought assessment and classification, drought analysis techniques, drought mitigation planning. Perspective on recycle and reuse, Waste water reclamation. (7 Lectures)
Suggested readings
<ol style="list-style-type: none"> 1. Watershed Management in India by Murthy, K.S. 1998. 3rd Edition, Wiley Eastern Ltd. / New Age International Ltd. 2. Watershed Management: Guidelines for Indian Conditions by Tideman, E.M., 1996, Omega, New Delhi. 3. Water of Hope: Integrated Water Resource Development and Regional Co-operation within the Himalayan-Ganga-Brahmaputra-Barak Basin by Verghese, B.G., 1990, Oxford-IBH.

Course Title: Environmental Geology and Natural Hazards	L	T	P	Cr	Marks
	2	-	-	2	100
Course Code: EGS. 524					
Unit I					
Introduction to Environmental Geology: Fundamental concepts of environmental geosciences, its scope and necessity; Definition, structure, composition and general characteristics of lithosphere, hydrosphere, atmosphere and biosphere; Concept of ecology, ecosystem, its structure and functions, types of ecosystem; Biogeochemical cycles of carbon, nitrogen, phosphorus and sulfur; Physiography, drainage, climate, soils and natural resources of India. (7 Lectures)					
Unit II:					
Environmental issues: Water pollution : types of water pollution, groundwater pollution sources, pathways and mechanism, attenuation processes, case histories of natural (arsenic and fluoride poisoning) and man-made water pollution; water logging, causes, effects and remedial measures, aquifers; declining groundwater tables, subsidence and compaction of aquifers ; Soil pollution-sources, causes and effects; Soil pollution control measures; Air pollution : definition, terminology, sources and classification of air pollutants; effects of air pollution- acid rain, green house effects and ozone layer depletion; Air pollution control and management. (7 Lectures)					
Unit III:					
Introduction to Disasters: Introduction to natural and manmade disasters; Dimensions of natural and anthropogenic disasters; Floods –nature and frequency of flooding, flood hazards, urbanization and flooding, flood hydrographs, Dams barrages and river diversions; Landslides; Coastal hazards – tropical cyclone, coastal erosion, sea level changes, coastal zone management; Earth quakes - Seismic waves, quake resistant buildings and dams; Tsunamis; Volcanoes; Wild fires; Oil spills; Urban hazards and disasters. (7 Lectures)					

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Unit IV:

Risk Assessment and Preparedness: Pre-Disaster Management activities; Hazard and vulnerability analysis; Hazard zonation maps : preparation and utilization; capability assessment; emergency / contingency planning and post-disaster management activities; Development planning, planning environment, types of plans, MBO, SWOT analysis; Mitigation strategy : Relief measures, community health, casualty management Role of Government, Non-Governmental and media agencies, Reconstruction and Rehabilitation; Awareness through print and electronic media, involving youth in field observations. (7 Lectures)

Suggested readings:

1. Environmental Geology by Barbar W. Murk et al., 1996, John Wiley & Sons, New York.
2. Introduction to Environmental Geology by Edward A. Keller, 5th Edition, 2011, Pearson Education publisher.
3. Environmental Geology by K. S. Valdiya, 2nd Edition, 2013, McGraw-Hill Education (India)
4. Disaster Management and Preparedness by Collins Larry R. and Schneid Thomas D., 2000, Taylor and Francis.

Further readings:

5. Earth Science and the Environment by Graham Thompson and Jon Turk, 4th Edition, 2007, Thomson and Brooks/cole.
6. Disaster Management by Goel S.L. and Kumar Ram, 2001, Deep and Deep Publications.
7. Living with Risk: A globalreview of disaster reduction initiatives, 2004 Vision, United Nations.
8. India Disasters Report: Towards a Policy Initiatives by Parasuraman S., 2004, Oxford University Press.

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SEMESTER III

Course Title: Geophysics	L	T	P	Cr	Marks
Course Code: EGS. 601	4	1	-	4	100
Unit I					
Introduction to geophysics; shape and size of earth; gravitational field of the earth; variation of gravity on the earth surface; principles of gravity methods and instrument used; gravity field surveys; corrections applied to gravity data; The Bouguer anomaly; regional and residual anomalies; gravity anomaly maps and their interpretation. Relative motion of plates, Stability of triple junction. (14 Lectures)					
Unit II:					
Geomagnetic field of the earth; magnetic properties of rocks; principles of magnetic methods; Variation of gravitational and magnetic fields over earth's surface, Densities and magnetic susceptibilities of rocks and minerals. Instruments of magnetic surveying; fluxgate magnetometer, proton-precision magnetometer, alkali vapor magnetometer; Field procedure in conducting gravity and magnetic surveys and data reductions; aeromagnetic surveys; profiling and sounding. (14 Lectures)					
Unit III:					
Seismic methods: principles and instruments used; seismic velocity and interpretation of seismic data; Seismic refraction and reflection methods. Geometry of refraction and reflection paths in a layered earth. Seismic noise Reflection and refraction field methods. Conventional and modern (CDP) methods of acquisition of seismic reflection data. Applications of Seismic methods to oil exploration, groundwater exploration and engineering problems. (14 Lectures)					
Unit IV:					
Electrical methods: basic principles and various types of electrode configuration; Electrical resistivity method, self-potential and resistively surveying; field procedures and interpretation of field data. Applications of electrical and electromagnetic methods in solving geological problems. Brief outline of various well logging techniques: self-potential and resistivity logs, radioactive logs, induction logs, caliper logs, sonic logs, borehole video; well logging applications in petroleum, groundwater and mineral exploration. (14 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Introduction to Geophysical Prospecting by Dobrin, M.B. and Savit, C.H., 4th edition, 2014, Mcgrawhill Exclusive. 2. The Solid Earth: An Introduction to Global Geophysics by CMR Fowler, 2nd edition, 2005, Cambridge University Press. 3. Exploration Geophysics by Gadallah, Mamdouh R. and Fischer, R.L., 2009, Springer-Verlag Berlin Heidelberg. 4. Applied Geophysics by Telford, W.M., Geldart, L.P. and Sheriff, R.E., 2nd edition, 1990, Cambridge University Press. 5. Principles of Applied Geophysics by D. S. Parasnis, 4th edition, 1986, Chapman and Hall. 6. Fundamental of Geophysics by Lowrie, W., 1997, Cambridge Univ. Press. London. 					
Further readings:					
<ol style="list-style-type: none"> 7. Introduction to Seismology, by Peter Shearer, 1999, Cambridge University Press, Cambridge. 8. Looking Into the Earth: An Introduction to Geological Geophysics By Alan E. Mussett, M. Aftab 					

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Khan, 2000, Cambridge University Press.

9. Whole Earth Geophysics: An Introductory Book for Geologists and Geophysicists by Lillie, R.J., 1998, Pearson Education.
10. Inverse Problem Theory and Model Parameter Estimation, by Albert Tarantola, 2005, SIAM.
11. Modern Global Seismology by Thorne Lay and Terry Wallace, 1995, Academic Press.

Course Title: Ore Geology	L	T	P	Cr	Marks
Course Code: EGS.602	4	1	-	4	100

Unit I

Modern concept of ore genesis; Concept of ore bearing fluids, their origin and mode of occurrence of ore bodies – morphology and relationship of host rock and Migration, Wall-rock alteration. Structural, physicochemical and stratigraphic controls of ore localization. Paragenesis, paragenetic sequence and zoning in metallic ore deposits. Spatial and temporal distribution of ore deposits – a global perspective. Earth's evolutionary history and evolutionary trends in ore deposits. Ore deposits in relation to plate tectonics. (14 Lectures)

Unit II:

Mineralogy, classification and genesis of petrological ore associations: Orthomagmatic ores of ultramafic-mafic association, ores of felsic-silicic igneous rocks: ores related to submarine volcanism, biochemical, chemical and clastic sedimentation; placers and residual concentration deposits. Ores of metamorphic affiliations. Principle of Fluid inclusions in ore: assumptions, limitations and applications. Geothermometry, geobarometry and isotope studies in ore geology. (14 Lectures)

Unit III:

Study of ore minerals related to the following metals such as Fe, Mn, Cr, Cu, Pb, Zn, Al, Mg, Au, Sn, W with special reference to their mineralogy, genesis, uses in important industries and their distribution in India. Strategic, critical and essential minerals. Importance of minerals in national economy and mineral policy. Mineral concessional rules of India. Law of the Sea. (14 Lectures)

Unit IV:

Fundamentals of coal petrology, peat, lignite, bituminous and anthracite coal. Microscopic constituents of coal. Indian coal deposits. Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Geographical and geological distributions of onshore and offshore petroliferous basins of India. Methods of petroleum exploration. Surface and subsurface exploration, gas hydrate and coal bed methane. Nuclear and Non-conventional source of energy. (14 Lectures)

Suggested readings:

1. Introduction to Ore-forming processes by Robb, L., 2005, Blackwell Publ., Oxford.
2. Ore geology and industrial minerals by Evans, A.M., 1992, Blackwell Science.
3. Understanding mineral deposits by Misra, K.C. 1999, Kluwer Academic Publishers.
4. Mineral economics by Sinha, R. K. and Sharma, N.L., 1970, Oxford & IBH.
5. Ore Genesis – A Holistic Approach by Mookherjee, A., 2000, Allied Publisher.

Further readings:

6. Economic mineral deposits by Jensen, M.L. and Bateman, A.M., 1981, John Wiley & Sons.
7. Ore Petrology by Stanton, R. L., 1972, McGraw Hill.

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8. The Geology of Ore Deposits by Guilbert, J. M. and Park, Jr. C. F., 1986, Freeman.
9. Hand Book of Stratabound and Stratiform Ore Deposits by Wolf, K. H., 1976-1981, Elsevier.
10. Economic Geology and Geotectonics by Torling, D.H., 1981, Blackwell Sci. Publ.
11. Geochemistry of Hydrothermal Ore Deposits by Barnes, H.L., 1979, John Wiley:
12. Time and Strata Bound Ore Deposits by Klemm, D.O. and Schneider, H.J., 1977, Springer Verlag.

Course Title: Remote Sensing and GIS in Geology	L	T	P	Cr	Marks
Course Code: EGS 603	4	1	-	4	100
Unit I					
Remote sensing: Fundamentals of Remote Sensing; Electromagnetic spectrum; Electromagnetic radiations; Spectral reflectance; Sensors; Active and passive remote sensing; Types of platform; Types of orbits (Geostationary, Polar, Sun-synchronous); Scanning Systems (Pushbroom and Whiskbroom); Types of Sensors; Data collection, Aerial Photography, Visual Image Interpretation, Digital image processing. (14 Lectures)					
Unit II:					
Introduction to Global Positioning System (GPS); Satellite remote sensing; Types of Satellites; Space Agencies in India; Global and Indian space missions. Different satellite exploration programs and their characteristics: LANDSAT, METEOSAT, MODIS, SPOT and IRS Satellite Series. Google Earth; Bhuvan; GPS; GAGAN. (14 Lectures)					
Unit III:					
Concepts of GIS: Elements of GIS; Map Projection; Data structures in GIS: Raster and Vector data; GIS softwares; Hierarchical, Network and relational data; Geo-relational and object oriented vector data structure; Vector and Raster based analysis; Overlays operations; Map algebra; Network Analysis; Spatial analysis. (14 Lectures)					
Unit IV:					
Applications of Remote Sensing and GIS in Geology: Thermal Infra-red remote sensing in geological studies; microwave remote sensing for geological applications; Applications of remote sensing - identification of rocks, mineral explorations, geological surveys; alteration zones mapping; geomorphology applications, volcanic eruptions, surfacial deposit / bedrock mapping; lithological mapping; structural mapping; sand and gravel (aggregate) exploration/ exploitation; hydrocarbon exploration; environmental geology; geobotany; sedimentation mapping and monitoring; event mapping and monitoring; geo-hazard mapping. (14 Lectures)					
Suggested readings:					
<ol style="list-style-type: none"> 1. Remote sensing and image interpretation by Lillisand, T. M. and Keifer, R. W., 2007, John Willey and Sons, USA 2. Introduction to environmental remote sensing by Barrett, E. C. and Curtis L. F., 1999, Chapman and Hall Publishers, USA. 3. Fundamentals of remote sensing by Joseph G., 2003, Universities Press, Hyderabad. 4. Introduction to geographic information systems by Chang, Kang-taung, 2002, Tata McGraw-Hill, USA. 					

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Further readings:

5. Environmental impact assessment: Practical solutions to recurrent problems by Lawrence, DP. 2003, John Wiley and Sons.
6. Methods of Environmental Impact Assessment by Morris, P. and Therivel, R., 2001, Spoon Press.
7. Remote Sensing: Principles and Interpretation by Sabbins, Jr. F.F. 1986, WH Freeman & Co.
8. Aerial photography and Image Interpretation for Resource Management by Paine, D.P., 1981, John Wiley.
9. Principles and Applications of Photogeology by Pandey, S.N., 1987, Wiley Eastern, New Delhi.
10. Remote Sensing Geology, by Gupta, R.P., 1990, Springer Verlag.

Course Title: Hydrogeology	L	T	P	Cr	Marks
Course Code: EGS. 604	4	1	-	4	100

Unit I

Hydrosphere and Groundwater flow: Hydrosphere; Scope and importance of Groundwater; Factors that affect occurrence of groundwater - Climate, topography, geology; Principles of groundwater flow: concept of groundwater potential, validity of Darcy's law for laminar and turbulent flow – Tracing of groundwater movement with flow nets; Pumping tests-principles-types of pumping tests, procedures, concept of well hydraulics, determination of aquifer properties and well characteristics by simple graphical methods– significance of transmissivity and storativity data; Introduction to software in pumping tests. (14 Lectures)

Unit II:

Occurrence and distribution of Groundwater: Vertical distribution of groundwater; Hydrologic properties of Rocks – Porosity, Hydraulic conductivity, Derivation of Darcys Law; Aquifers – Characteristics of unconfined and confined aquifers; Aquifer properties – Concepts of Transmissivity and Storativity; Behaviour of sedimentary, crystalline and volcanic rocks as aquifers – factors controlling hydrologic, aquifer properties and yield of wells in different rock types; Impact of drought and groundwater overexploitation on aquifers; Groundwater exploration and water pollution. (14 Lectures)

Unit III:

Groundwater exploration: Exploration techniques - Integrated approach to groundwater prospecting; Role of toposheets and Remote sensing in groundwater exploration; Hydrochemical methods: surface and subsurface Geophysical methods, Tracer techniques, Exploratory Borewell programme. Groundwater regimes in India, Concept of groundwater legislation. (14 Lectures)

Unit IV:

Groundwater Recharge and Quality of groundwater: Measurement of groundwater recharge; Artificial recharge techniques; surface water harvesting Techniques; Conjunctive use of surface and groundwater; Quality of groundwater – Geochemical processes in the groundwater, water types and water quality classification- Interaction of water with its ambient environment, Types of interaction: chemical, physical, kinetic; Assessment of groundwater quality; Fresh and salt-water relationships in coastal and inland areas; Seawater intrusion– Ghyben Herzberg relation– remedial

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measures.	(14 Lectures)
<p>Suggested readings:</p> <ol style="list-style-type: none"> 1. Groundwater Hydrology by Todd D.K., 2007, John Wiley and Sons 2. Modern Hydrology and Sustainable Water Development by Gupta, S. K., 2011, Wiley-Blackwell. 3. Groundwater Assessment Development and Management by Karanth, K.R.,1987, McGraw Hill Publishers 4. Groundwater by Raghunath, H.M. 1985, Wiley Eastern Ltd. 5. Groundwater by Freeze and Cherry, 1979, Prentice-Hall. 	

Course Title: LAB-IV (Ore geology and Geophysics)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 12.5%;">L</th> <th style="width: 12.5%;">T</th> <th style="width: 12.5%;">P</th> <th style="width: 12.5%;">Cr</th> <th style="width: 12.5%;">Marks</th> </tr> <tr> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">100</td> </tr> </table>	L	T	P	Cr	Marks	-	-	4	2	100
L	T	P	Cr	Marks							
-	-	4	2	100							
Course Code: EGS. 605											
<ol style="list-style-type: none"> 1. Megascopic study of Indian metallic ores and industrial minerals in hand specimens. 2. Study of optical properties and identification of important ore minerals under ore-microscope. 3. Preparation of maps showing distribution of metallic and industrial minerals in India and also classical world mineral deposits. 4. Estimation of grade, tonnage of ore deposits. 5. Interpretation of borehole logs. 6. Interpretation of seismic and resistivity data for exploration and structural purpose. 7. Study of gravity data maps and their interpretation. 8. Seismic wave propagation (<i>graphical</i>) problems. 9. Earthquake epicentral location from travel time data (<i>computer</i>). 10. Fault plane solution of an earthquake from teleseismic records. 											
<p>Suggested readings:</p> <ol style="list-style-type: none"> 1. Introduction to Seismology by Peter Shearer, 1999, Cambridge University Press. 2. Inverse Problem Theory and Model Parameter Estimation by Albert Tarantola, 2005, SIAM. 3. Mineral deposit evaluation by A.E. Annels, 1992, Chapman and Hall, London. 4. The Solid Earth: An Introduction to Global Geophysics by CMR Fowler, 2nd Edition, 2005, Cambridge University Press. 5. Ore geology and industrial minerals by Evans, A.M. 1992, Blackwell Science. 											

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Course Title: LAB-V (Hydrogeology and Remote Sensing)	L	T	P	Cr	Marks
	-	-	4	2	50
Course Code: EGS. 606					
<ol style="list-style-type: none">1. Determination of photo scale,2. Determination of height of objects, dip of bed, slope and thickness of beds by Parallax bar.3. Study of landforms and interpretation of lithology and structure from aerial photographs and satellite images4. Identification of landforms on toposheets, aerial photographs and satellite images5. Analysis of rainfall data6. Preparation of water level contour maps and their interpretation7. Analysis of pumping test data by simple graphical methods for determination of aquifer and well characteristics8. Plotting and analysis of hydrogeochemical data9. Hydrogeological significance of morphometric parameters of a watershed					
Suggested readings: <ol style="list-style-type: none">1. Groundwater Hydrology by Todd, D.K. 2007, John Wiley and Sons2. Remote sensing and image interpretation by Lillisand, T. M. and Keifer, R. W., 2007, John Willey and Sons, USA.					

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ELECTIVE COURSES

Course Title: Petroleum Geology	L	T	P	Cr	Marks
Course Code: EGS. 621	2	-	-	2	100
Unit I:					
<p>Occurrence and Source rocks: Classification and composition of Petroleum; Physical properties of petroleum; Occurrence of petroleum; Nature of source rock, composition of biomass; Kerogene: Composition and types; Reservoir rocks, pore space and fluids; Reservoir Traps; Origin, migration and accumulation of petroleum. Basin Analysis. (14 Lectures)</p>					
Unit II:					
<p>Indian Oil Fields- Prospecting and Drilling: Oil bearing basins of India and the world; India's position as regards to petroleum and natural gas future prospects; Geophysical prospecting for petroleum; Drilling, logging and subsurface correlation. Importance of micropaleontology in the field of petroleum exploration. (14 Lectures)</p>					
<p>Suggested readings:</p> <ol style="list-style-type: none"> 1. Geology of Petroleum by Levenson, 2nd edition, 2006, CBS. 2. Elements of Petroleum Geology by Selley, R.C., 1997, Atlantic publishers & distribution Pvt. Ltd, Delhi. 3. Geology of Petroleum by Emmons, W. H., 2015, Sagwan press. <p>Further readings:</p> <ol style="list-style-type: none"> 4. Introduction to geophysical prospecting by Dobrin, M. B. and Savit, C. H., 4th edition, 1988, McGraw-Hill Inc. 5. An Introduction to Geophysical Exploration by Kearey, P., Brooks, M. and Hill, I., 3rd edition, 2002, Wiley-Blackwell. 6. Principles of Applied Geophysics by Parasnis, D. S., 4th edition, 1986, Chapman and Hall. 7. Geochemistry in mineral exploration by Hawkes, H. E., Webb J. S., In eds., Croneis, C., 2012, Literary Licensing, LLC. 					

Course Title: Climatology	L	T	P	Cr	Marks
Course Code: EGS. 622	2	-	-	2	100
Unit I					
<p>Meteorology: Fundamentals of meteorology, Scales of meteorology, Parameters of meteorology- pressure, wind, temperature, humidity, radiation; Radiations: Radiation laws, short wave and long wave radiations; Albedo; Emissivity; Radiation Budget of Earth; Application of meteorological principles to transport and diffusion of pollutants, Topographic effects. (14 Lectures)</p>					
Unit II					
<p>Climatology: The boundary layer; Inversion; Local microclimate; Greenhouse effect; Radiation balance; Precipitation; Atmospheric movements; Distribution of radiation; Rotation of earth- Coriolis</p>					

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acceleration, angular momentum; General meridional circulations: Hadley cells; Middle latitudes; Circulation of water and energy in atmosphere; Weather, and Climate in India; El Nino, La Nina, seasons and monsoons; Climatic classification schemes; Biogeographical regions of the world; Climate change-Emissions and Global warming, impact on sea level in south Asian region; Environmental disruptions and their implications; Indian climatology with special reference to seasonal distribution and variation of temperature, humidity, wind and precipitation; Agro-climatic zones of India. (14 Lectures)

Suggested readings:

1. Climatology, by Lal, D. S., 2011, Sharda Pustak Bhavan.
2. General climatology by Critchfield, H. J., 2009, PHI Learning, New Delhi.
3. Introduction to geomorphology by Kale, V. S. and Gupta, A., 2001, Orient Longman, Bangalore.
4. Physical geography by Singh, S., 2011, Prayag Pustak Bhavan, Allahabad.
5. An introduction to physical geography by Strahler, A.N. and Strahler, 1996, John Wiley & Sons, UK.

Course Title: Mineral Exploration and Mineral Economics	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 12.5%; padding: 5px;">L</td> <td style="width: 12.5%; padding: 5px;">T</td> <td style="width: 12.5%; padding: 5px;">P</td> <td style="width: 12.5%; padding: 5px;">Cr</td> <td style="width: 12.5%; padding: 5px;">Marks</td> </tr> <tr> <td style="text-align: center; padding: 5px;">2</td> <td style="text-align: center; padding: 5px;">-</td> <td style="text-align: center; padding: 5px;">-</td> <td style="text-align: center; padding: 5px;">2</td> <td style="text-align: center; padding: 5px;">100</td> </tr> </table>	L	T	P	Cr	Marks	2	-	-	2	100
L	T	P	Cr	Marks							
2	-	-	2	100							
Course Code: EGS. 623											
Unit I											
<p>Mineral Economics : Distribution of mineral resources in India; Magmatic, hydrothermal and surface processes of ore formation; Active ore-forming systems; Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps; Petroliferous basins of India; Classification, rank and grading of coal; coal resources of India; Gas hydrates and coal bed methane. (14 Lectures)</p>											
Unit II:											
<p>Mineral Exploration Methods: Geological, geophysical, geochemical and geobotanical methods of surface and sub-surface exploration on different scales; Sampling, assaying and evaluation of mineral deposits; methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematic; ores and metamorphism- cause and effect relationships; Methods of petroleum exploration. (14 Lectures)</p>											
Suggested readings:											
<ol style="list-style-type: none"> 1. Mineral Exploration: Principles and Application by Haldar, S. K. 2013, Elsevier. 2. Introduction to Mineral Exploration by Moon C. J., Whateley, M. K. G. and Evans, A.M., 2nd edition, 2005, Blackwell Science. 3. Mineral deposits of India by Umathay, R. M., 2007, Printasia. 											
Further readings:											
<ol style="list-style-type: none"> 4. Introduction to geophysical prospecting by Dobrin, M. B. and Savit C. H., 4th edition, 1988, McGraw-Hill Inc. 											

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5. An Introduction to Geophysical Exploration by Kearey, P., Brooks M. and Hill, I., 3rd edition, 2002, Wiley-Blackwell.
6. Geology of Petroleum by Levenson, 2nd edition, 2006, CBS.
7. Geochemistry in mineral exploration by Hawkes, H. E., Webb J. S., In eds., Croneis, C., 2012, Literary Licensing, LLC.

Course Title: Palaeobotany	L	T	P	Cr	Marks
Course Code: EGS. 624	2	-	-	2	100
Unit I					
<p>Introduction to Paleobotany : Theories on origin of life; Introduction to Paleobotany; Formation of Plant Fossils; Application of fossils in age determination and correlation; Paleoecology, Life habitats and various ecosystems; Paleobiogeography; Modes of preservation of fossils and taphonomic considerations; Types of microfossils; Environmental significance of fossils and trace fossils; Use of microfossils in interpretation of sea floor tectonism; Application of micropaleontology in hydrocarbon exploration; Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation; Important plant fossils and microfossils in Indian stratigraphy.</p> <p style="text-align: right;">(18 Lectures)</p>					
Unit II:					
<p>Paleobotanical Methods : Fossil Classification- Nearest Living Relatives, Physiognomy and CLAMP ; Climate and Elevation analysis – Mean Annual Temperature, Lapse Rate, Moist static energy</p> <p style="text-align: right;">(10 Lectures)</p>					
Suggested readings:					
<ol style="list-style-type: none"> 1. An introduction to Paleobotany by Arnold, A. C., 2011, Agrobios (India) 2. Paleobotany: A sketch of the origin and evolution of floras by Berry, E. W., 2012, Nabu Press. 3. Paleobotany, Second Edition: The biology and evolution of fossil plants by Taylor, T. N., Taylor, E. L. and Krings, M., 2008, Academic Press. 4. Essential of Paleobotany by Shukla, A.C., 1982, Stosius Inc/Advent Books Division. 					

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SEMESTER IV

Course Title: Principle of Stratigraphy and Indian Stratigraphy	L	T	P	Cr	Marks
Course Code: EGS. 611	4	1	-	4	100
Unit I:					
<p>Principle of Stratigraphy: History and development of stratigraphy; stratigraphic procedures (surface and subsurface), concept of lithofacies and biofacies; stratigraphic correlation (litho, bio- and chronostratigraphic correlation). Study of standard stratigraphic code (lithostratigraphic, biostratigraphic and chronostratigraphic); Concepts of magneto stratigraphy, chemo stratigraphy, event stratigraphy, and sequence stratigraphy. (10 Lectures)</p>					
Unit II:					
<p>Archaeans-Precambrian stratigraphy of India: Precambrian stratigraphic framework of India; Classification, structure and tectonics of the Dharwar craton; Ancient supracrustal (Sargur Type); Gold bearing schist belts of Eastern Karnataka (Kolar Type); Younger schist belts (Dharwar Type); Gneiss complex, granulites, charnockites; Structure, tectonics and stratigraphy of the OMG, OMTG, Iron Ore Group (Singbhum Craton); Stratigraphy of the Sukma, Bengpal, and Bailadila series from Central India; Ancient granites, viz. Singbhum, Chitradurga, etc.; Archaeans of the Extra Peninsular region; Archaean-Proterozoic boundary; Stratigraphy, geology, tectonics and evolution of the following Proterozoic basins / Purana formations in India - Delhi-Aravalli Supergroup, Singbhum Group, Sausar-Sakoli Groups, Vindhyaans, Cuddapah, Pranhita-Godavari, Bhima, Kaladgi. (20 Lectures)</p>					
Unit III:					
<p>Palaeozoic stratigraphy: Igneous activities and palaeogeography during the Palaeozoic Era. Stratigraphy, facies, and fossil contents of the Palaeozoic rock formations of Peninsular and extra-peninsular India. Permian-Triassic boundary.</p> <p>Gondawana stratigraphy: Concepts, classification, fauna, flora and age limits of Gondwana Supergroup and related palaeogeography, palaeoclimate, depositional characteristics and igneous activity.</p> <p>Mesozoic stratigraphy: Classification, depositional characteristics, fauna and flora, age limits, correlation of Triassic, Jurassic and Cretaceous systems in principal basins of Peninsular and extra-peninsular India. Stratigraphy of the Deccan volcanic province; Cretaceous-Tertiary boundary. (16 Lectures)</p>					
Unit IV:					
<p>Cenozoic stratigraphy: Classification, depositional characteristics, fauna and flora of the Palaeogene and Neogene systems in their type localities and their equivalents in India. Epoch boundaries of the Cenozoic in India. Quaternaries of Peninsular India; Neogene-Quaternary boundary. Stratigraphy and tectonics of the Siwalik. (10 Lectures)</p>					
Suggested readings:					
<ol style="list-style-type: none"> 1. Principles of sedimentology & stratigraphy by Sam Boggs, Jr., 5th edition, 2011, Prentice Hall. 2. Fundamentals of historical geology and stratigraphy of India by Ravindra Kumar, 1998, New Age, ISBN-13: 978-0852267455. 3. Geology of India by Ramakrishnan, M. and Vaidyanathan R., 2008, Vol. 1 & 2, Geological 					

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Society of India, Bangalore, ISBN No: 978-81-85867-98-4.

4. Precambrian Geology of India by Naqvi, S.M. and Rogers, J.J.W., 1987, Oxford University Press.
5. Geology of India and Burma by Krishnan, M.S., 1982, C.B.S. Publishers & Distributors, Delhi.

Further readings:

6. Sedimentology and stratigraphy by Gary Nichols, 2nd edition, 2009, Wiley-Blackwell, ISBN: 978-1-4051-3592-4
7. Introduction to stratigraphy and paleontology, in Indian ocean geology and biostratigraphy (eds J.R. Heirtzler, H.M. Bolli, T.A. Davies, J.B. Saunders and J.G. Sclater), by Bolli, H. M. and Saunders, J. B., 1977, American Geophysical Union, Washington, D. C.
8. Principles of Stratigraphy by Danbar, C.O. and Rodgers, J., 1957, John Wiley & Sons.
9. A Manual of the Geology of India & Burma (Volume I – IV) by Pascoe, E.H., 1968, Govt. of India Press, Delhi
10. The Cenozoic Era? Tertiary and Quaternary by Pomerol, C., 1982, Ellis Harwood Ltd., Halsted Press.
11. Stratigraphy: Principles and Methods by Schoch, R.M., 1989, Van Nostrand Reinhold, New York.
12. Unlocking the Stratigraphic Record by Doyle, P. and Bennett. M.R., 1996, John Willey.

Course Title: Engineering and Environmental Geology	L	T	P	Cr	Marks
Course Code: EGS. 612	4	1	-	4	100
Unit I					
Role of engineering geology in civil constructions. Various stages of engineering geological investigation for civil engineering projects. Soil mechanics – three phases of soil, consistency limits, particle size distribution, soil classification, consolidation and compaction, and shear strength of soil. Engineering properties of rocks; rock discontinuities. Physical characters of building stones. Metal and concrete aggregates. (14 Lectures)					
Unit II:					
Geological consideration for evaluation of dams, reservoir sites, highways, etc. Dam foundation rock problems. Geotechnical evaluation of tunnel alignments and transportation routes, method of tunneling; classification of ground for tunneling purposes; various types of support. (14 Lectures)					
Unit III:					
Mass movements with special emphasis on landslides and causes of hill slope instability. Earthquakes and seismicity, seismic zones of India. Aseismic design of building. Influence of geological conditions on foundation and design of buildings. Case history of engineering projects and geological causes for mishaps and failures of engineering structures. (14 Lectures)					
Unit IV:					
Environnemental Geology: Concepts and principles. Natural hazards - preventive/precautionary measures - floods, landslides, earthquakes, river and coastal erosion. Impact assessment of anthropogenic activities such as urbanization, open cast mining and quarrying, river-valley projects, disposal of industrial and radio-active waste, excess withdrawal of ground water, use of fertilizers,					

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dumping of ores, mine waste and fly-ash. Organic and inorganic contamination of ground water and their remedial measures. Soil degradation and remedial measures. Environment protection - legislative measures in India. (14 Lectures)

Suggested readings:

1. Fundamentals of Engineering Geology by Bell, F.G., 1992, Aditya Books Pvt. Ltd. Indian Edn.
2. Principles of Engineering Geology by Krynine, D.H. and Judd, W.R., 1998, CBS Edition. Delhi.
3. Environmental Geology by Bernett, M.R. and Doyle, P., 1999, John Wiley & Sons, N. York.

Further readings:

4. Fundamentals of Rocks Mechanics by Jaeger J., Cook N. G. and Zimmerman R., 4th edition, 2007, Wiley-Blackwell
5. Engineering Geology for Civil Engineers by Reddy, D.V., 1995, IBH Publishing Co. Pvt. Ltd.
6. Geology for Engineers by Arora, D.S., 1988, Mohindra Capital Publishers, Chandigarh
7. Environmental Geology by Lundgren, L., 1986, Prentice Hall of India Pvt. Ltd., New Delhi.
8. Geological Hazards by Bell, F.G., 1999, Routledge, London.
9. Natural Hazards by Bryant, E., 1985, Cambridge University Press. London.
10. The Dynamic Earth System by Patwardhan, A.M., 1999, Prentice Hall.
11. Environmental Hazards by Smith, K., 1992, Routledge, London.
12. Textbook in Environmental Science by Subramaniam, V., 2001, Narosa International.
13. Environmental Geology – Indian Context by Valdiya, K.S., 1987, Tata McGraw Hill. New Delhi.

Course Title: LAB – VI					
(Engineering Geology and Stratigraphy)	L	T	P	Cr	Marks
Course Code: EGS 613	-	-	4	2	100
Unit –I:					
Stratigraphy Practical					
Interpretation of palaeogeographic maps of all geological periods. Study of specimens of rock types of Indian formations showing typical characters (lithotype/structure/fossils) and geological age inference. Exercises on stratigraphic correlation and classification. Study and understanding of plate-movements through important periods during Phanerozoic Eon. Evolution of ocean systems during Phanerozoic.					
Unit –II:					
Engineering and Environmental Geology					
Study of properties of common rocks with reference to their utility in engineering projects. Study of maps and models of important engineering structures as dam sites and tunnels. Interpretation of geological maps for landslide problems. Various problems of soil and rock mechanical properties. Study of seismic and flood-prone areas in India. Evaluation of environmental impact of air pollution groundwater, landslides, deforestation, cultivation and building construction in specified areas.					
Suggested reading:					
<ol style="list-style-type: none"> 1. Fundamentals of Engineering Geology by Bell, F.G., 1992, Aditya Books Pvt. Ltd. Indian Edn. 2. Principles of Engineering Geology by Krynine, D.H. & Judd, W.R., 1998, CBS Edition, Delhi. 3. Earth Science and the Environment by Graham Thompson and Jon Turk, 4th edition, 2007, Thomson and Brooks/cole. 					

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Course Title: Dissertation/Project work	[Total Marks: As Satisfactory]
Course code: EGS 699	
<p>Each candidate required to submit a dissertation/ project report based on his/her research work carried out towards the fulfillment of his/her M.Sc. dissertation.</p> <p>It will have following components:</p> <ul style="list-style-type: none">(a) Origin of the research problem and literature review(b) Objective of the research work(c) Methodology of the work, field observations (if any) and data recorded by the candidate,(d) Details of laboratory investigation (if any) carried out by the candidate,(e) Synthesis of results and interpretation(f) Concluding remarks and future direction <p>The 60 % of the marks will be awarded by the teacher(s) who supervised the respective student. A board of examiners will conduct viva-voce, and would consist of the supervisor, faculty member(s) of the department, and other faculty members appointed by the competent authority. The committee will award the rest 40% of the marks including those of presentation and viva-voce. A candidate who does not submit the project report or fails to get pass marks in it will appear again in viva-voce examination of the same class M.Sc. II year in a subsequent year as per university rule.</p>	