

**NATIONAL COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI – 1**

**M.Sc., APPLIED GEOLOGY – Course Structure under CBCS**

**(Applicable to the candidates admitted from the academic year 2013-2014 onwards)**

Semester	Paper No.	Title of the Paper	Instr Hrs/ Week	Credit	Exam Hrs.	Marks			Total
						Internal	External		
							W	O	
I	<b>CC I</b>	Geomorphology and Marine Geology	6	5	3	25	75		100
	<b>CC II</b>	Geotectonics and Structural geology	6	5	3	25	75		100
	<b>CC III</b>	Stratigraphy and Palaeontology	6	5	3	25	75		100
	<b>CC IV P</b>	PRACTICAL I - Palaeontology, Structural Geology & Remote Sensing	6	5	4	25	70	5	100
	<b>EC I</b>	Remote sensing	6	4	3	25	75		100
		<b>Total</b>	<b>30</b>	<b>24</b>					<b>500</b>
II	<b>CC V</b>	Advanced crystallography and Mineralogy	6	5	3	25	75		100
	<b>CC VI</b>	Engineering Geology, Mining Geology & Ore Dressing	6	5	3	25	75		100
	<b>CC VII</b>	Hydrogeology and Groundwater Management	6	5	3	25	75		100
	<b>CC VIII P</b>	PRACTICAL II -Crystallography, Mineralogy, Mining Geology and Hydrogeology	6	5	4	25	70	5	100
	<b>EC II</b>	Environmental Geology & Disaster Management	6	4	3	25	75		100
		<b>Total</b>	<b>30</b>	<b>24</b>					<b>500</b>
III	<b>CC IX</b>	Igneous and Metamorphic Petrology	6	5	3	25	75		100
	<b>CC X</b>	Sedimentology and Sedimentary Petrology	6	5	3	25	75		100
	<b>CC XI P</b>	PRACTICAL III – Petrology	6	5	4	25	70	5	100
	<b>EC III</b>	Geoexploration	6	4	3	25	75		100
	<b>EC IV</b>	Computer Applications, GIS and Geo statistics	6	4	3	25	75		100
		<b>Total</b>	<b>30</b>	<b>23</b>					<b>500</b>
IV	<b>CC XII</b>	Economic Geology, Mineral Economics and Ore Microscopy	6	5	3	25	75		100
	<b>CC XIII P</b>	PRACTICAL IV - Geoexploration and Computer Applications	6	5	4	25	70	5	100
	<b>EC V</b>	Fuel Geology	6	4	3	25	75		100
		<b>Project (Dissertation 75 marks &amp; Viva Voice – 25 Marks)</b>	<b>12</b>	<b>5</b>	<b>-</b>	<b>75</b>	<b>-</b>	<b>25</b>	<b>100</b>
		<b>Total</b>	<b>30</b>	<b>19</b>					<b>400</b>
				<b>90</b>					<b>1900</b>

There will be oral test for all practical examinations. The oral test will carry 5 marks in the external component.

## GEOMORPHOLOGY AND MARINE GEOLOGY - P13GY1

Semester : I

Core Course: I

Instruction Hours/Week: 6

Credit: 5

**UNIT 1: Geomorphology:** Scope of Geomorphology – Fundamental concepts – Significance of structure, process and time – A brief account of concepts of Davis and Penck in the evolution of landforms – Characteristic features of landforms – Characteristics and types of fluvial landforms – Fluvial cycle – Concept of peneplains – Stream rejuvenation, causes and effects.

**UNIT 2:** Aeolian landforms – Characteristics and types; Arid Cycle of erosion – Glacial landforms, periodicity of glaciations and its causes – Geomorphology of the coasts, classification of shorelines and their evolution. Eustatic changes and causes. Landforms produced by volcanoes.

**UNIT 3:** Influence of lithology on relief, Karst topography - Relationship of geologic structures to topography. Development of landforms of flat lying, tilted, folded, dome and faulted structures. Development of drainage systems and drainage patterns. Drainage analysis through geological interpretation.  
Geomorphic features of India. Geomorphologic applications in exploration for groundwater, mineral and oil: and in engineering projects.

**UNIT 4 :Marine Geology:** Introduction to Marine Geology – Nomenclature and dimensions bathymetric features - Oceanographic instruments pertaining to geological operations. Van veen grab, Peterson grab, Corers, Boomerang grab, Water sampler – Nansen water sampler – Reversing thermometer, Bathy thermograph - Probing the sea floor:- Echo sounding, Seismic shooting, Seismic refraction and reflection.

Physical and chemical properties of ocean water. Factors affecting general oceanic circulation of water – A note on surface currents in Pacific, Atlantic, Indian and Polar Regions - Anatomy of waves, breaker and its types, wave refraction, Long shore rip and turbidity currents. Tides and other motions related to the sea-upwelling, estuaries, fjords, turbidity and its origin. Tsunami – origin and their prediction.

**UNIT 5** Distribution and Classification of ocean sediments. Coral reefs and their characteristics; Theories of atoll formation; Impact and evidences of Eustatic change in sea-level. Beaches and coastline formation. Marine mineral resources – lithogenous, terrigenous, hydrogenous and biogenous deposits. A brief note on Ocean Thermal Energy Conversion (OTEC); Marine pollution and its control – Coastal zone management. Laws of the sea and their implications.

**TEXT BOOKS**

1. Thornbury, W. D. 1969 Principles of Geomorphology, Wiley.
2. Worcester, P. G. 1948 A text book of Geomorphology.
3. Kuenen, Ph. H. 1950 Marine Geology, Wiley.
4. Shepard, F.P., 1973 Submarine Geology, Harper and Row.
5. Shepard, F.P., 1960 Earth, beneath the sea, OUP.
6. Petti John, F.S., 1965 Sedimentary Rocks.

**REFERENCE BOOKS**

1. Bloom, A. L., 2004, Geomorphology, Printice Hall
2. Fairbridge, R. W., 1968 The Encyclopedia of Geomorphology, Reinhold Book Corp.
3. Lobeck, A.K.- 1932 Geomorphology, McGraw Hill.
4. Ordway, R.J. – 1971 Earth Sciences, Affiliated East – West.
5. Pitty, A.F. – 1972 Introduction to Geomorphology, Methuen.
6. King, C. A., 1959 Beaches and Coast, London
7. King, L.C. – 1962 Morphology of the Earth, Oliver and boyd.
8. Woolridge S.W. & Margan R.S. – 1952 – An outline of Geomorphology, Longmans
9. Sparks, B.W. – 1961 Geomorphology, Longmans.
10. Turekian 1968 Oceans, Prentice Hall.
11. Menard, H.W., 1977 Ocean Sciences – Readings from Scientifica American, Freeman.
12. Kind, A.H., 1979 Introduction to Marine Geology and Geomorphology, Edward Arnold.

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**GEOTECTONICS AND STRUCTURAL GEOLOGY -P13GY2**

**Semester : I**

**Core Course: II**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT 1 Geotectonics:** Study of seismic waves – structure and composition of the earth – Radioactivity – Radiometric dating. Volcanism and Volcanic zones of the earth. Major tectonic features of the earth; shield areas, mobile, zones, rift valleys, mid oceanic ridges and submarine canyons.

**UNIT 2** Geosynclines, Isostasy, Island arcs, Deep sea trenches, Continental drift, Sea floor spreading and Plate tectonics. Orogeny and orogenic cycles – Epeirogeny and evolution of plateaus. Structural and tectonic features of India–Quaternary tectonics

**UNIT 3 Structural geology:** Mechanical principles – three stages of rock deformation – elastic, plastic and rapture. Concept of stress, strain and the resulting ellipsoids. Mechanics of deformations. Factors controlling behavior of rock material. Folds –Description and Classification, Recognition, mechanics and causes of folding – Recognition of top and bottom of beds.

**UNIT 4:** Faults – Description, classification, recognition criteria and mechanics of faulting. Quantitative and qualitative classifications of joints. Modes of representation of joints – Histograms, Rose diagrams and preparation of stereogram. Unconformities – types, recognition, significance, distinction from faults and their use in dating structural events.

**UNIT 5:** Cleavage, Schistosity and Lineation – their description origin and relation to major structures. Petrofabric analysis – Field and laboratory techniques –petrofabric diagrams and their interpretation. Classification and characteristics of Tectonites, Diapirs and related structural features. Method of writing the geological report.

**TEXT BOOKS**

1. Billing, M.P. (1974)– Structural Geology, prentice Hall
2. Hobbs, R.F.et.al.1976 – An outline of structural geology, Woiley
3. Hills, E.L.1965 – Elements of Structural Geology, Asia Publication House.
4. Belousov, v.V. 1954 – Basic problems in Geotectonics, McGraw Hill.
5. De Sotter. :U. 1956 – Structural geology, McGraw Hill
6. Navin, C.M. 1953 – Principles of Structural Geology, wiley.

**REFERENCE BOOKS**

1. Hudson, J. N., 1963- Earthquakes and Earth Structure
2. Jeffrey's, H., 1969 - The Earth, Cambridge University Press
3. Ragan, D.M. – 1973 – Structural Geology, Wiley
4. Ramsay, J.G. 1967 – Folding and fracturing of Rocks. McGraw Hill
5. Philips, F.C.1954 – The use of Stereographic projection in Structural Geology, Arnold Publishers
6. Belosov, V.V., 1962- Basic problems in Geotectonics, McGraw Hill
7. Condie, K.C., 1976- Plate Tectonics and Crustal evolution
8. Spencer, E.M., 1977- Introduction to structure of the earth, McGraw Hill
9. Wilson, T.J., 1976- Continent Adrift and Continents Aground Readings from Scientific American
10. Windley, B.F., 1977- The evolving continents
11. Compton, R.R. – 1962 – Manual of field geology, Wiley
12. Runcorn, S. K., 1962- Continental Drift, Academic press

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**STRATIGRAPHY AND PALAEOLOGY-P13GY3**

**Semester : I**

**Core Course: III**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT 1 Stratigraphic Principles:** Study of standard European stratigraphic scale – methods of correlation – Homotaxis and Contemporaneity – Stratigraphic, terminology, nomenclature and classification – Applications of Lithostratigraphy, Biostratigraphy, chronostratigraphy and stratotypes;– causes of imperfections of geological records.

**Sequence Stratigraphy:** Para-sequence Sets and Stacking Patterns – Progradational Stacking, Aggradational Stacking, Retrogradational Stacking. Depositional Sequence: Low-stand System Tract (LST), Transgressive System Tract (TST), High-stand system Tract (HST); Sequence Boundary, Transgressive Surface, Maximum Flooding surface. A note on applications of **Chemo-stratigraphy**.

**UNIT 2 Indian Geology:** Pre Cambrian formations in India – Cuddapah and Vindhyan super groups – Cambrian of Salt Range – Permo–Carboniferous of Salt Range – Gondwana super group – Studies pertaining to Triassic of Spiti, Jurassic of Kutch and Cretaceous of Tiruchirappalli

**UNIT 3** Deccan traps – inter and infra traps – Siwalik super group. Age problems pertaining to Indian stratigraphy:- a) Saline series b) Deccan trap. Study of the following boundary problems with reference to India:- a) Precambrian – Cambrian, b) Permian – Triassic c) Cretaceous – Tertiary.

**UNIT 4 Organic evolution:** History of the concept of evolution – Preformation theory; Baer's law; Biogenetic law; Lamarckism; Darwinian principles- Natural, Sexual and Artificial selections; Theory of pangenesis; Mutation theory (De Vries and Modern version); Orthogenesis; Isolation. Detailed morphology, evolution and stratigraphic importance of the following groups: Corals, Graptolites, Trilobites, Brachiopods and Ammonites. Evolution of plants through ages: Gondwana flora and their stratigraphic significance.

**UNIT 5** Brief accounts on the principal groups of vertebrates through geologic time – Devonian fishes and Mesozoic reptiles. Evolutionary trends of Horse, Elephant and Man. Micropaleontological techniques: Sampling methods, separation of microfossils from matrix, thin sectioning. Types of microfossils; General morphology, stratigraphic importances: Ecological as well as palaeoecological significances of foraminifera, ostracoda and spores and pollens. Micropaleontologic applications related to environmental interpretation, petroleum exploration, and marine geological studies.

### **TEXT BOOKS**

1. Krishnan, M.S. 1956– Geology of India and Burma, Higgin bothams.
2. Wadia, D.N. 1953 – Geology of India , Mc Millan
3. Rayner, D. H., 1976- Stratigraphy of the British Isles, Cambridge Univ. Press
4. Wells, A.K., 1956- Outlines of Historical Geology, McGraw Hill, London
5. Krumbein and Sloss 1956- Stratigraphy and Sedimentation, McGraw V Hill
6. Ravindharakumar, 1988- Historical Geology and Stratigraphy of India, Wiley Eastn
7. International Stratigraphic Guide – A guide to stratigraphic classification, Terminology and procedure-H.D Hedberg-John wiley and sons, New York

8. Colbert, E.M., 1960- Evolution of the vertebrates, Wiley Eastern
9. Easton - Invertebrate Paleontology
10. Jain, P.C.and Anatharaman, M.S.-An introduction to Paleontology, Vishal Publications.
11. Woods, H. 1959 –Invertebrate Palaeontology, Cambridge.
12. Romer, A.S. 1960 – Vertebrate Palaeontology, Chicago press.
13. Amold, C.A. – 1947 – An introduction to palaeobotany.
14. Shrock. R.R. and Twenhofel , W.H – 1953 – Principles of invertebrate Palaeontology, Amold publication
15. Moore, R.C. Lalieker, C.D. and Fischer, A.G, 1952 – Invertebrate Fossils Mc Graw Hill.
16. Jones. D.J – 1958 – An introduction to Microfossils, Harper brothers
17. B.U. Hag and A. Boersma (1978) Introduction to Marine Micropalaeontology. Elsevier, Netherlands, 376 P.

**Reference Books:**

1. Gignoux, M., 1960- Stratigraphical Geology, McGraw Hill
2. Kummel, B., 1961 - History of the Earth, S.Chand and Company
3. Pascoe, E.S. – 1968 – A manual of the geology of India and Burma, Government of India, Pub.
4. Gregory, J.N and Barrot, B.H – General stratigraphy, Methuen.
5. Boggs, S.Jr., 1987 - Principles of Sedimentology and Stratigraphy, Merrill Publishing Co.
6. Weller, A.K., 1958 - Principles of Stratigraphy, Asia Publishing House
7. Black, R.M., 1972 - The Elements of Paleontology, Cambridge
8. Carroll and Stearns 1988 - Paleontology, Wiley
9. Raup & Stanley, 1985- Principles of Paleontology, CBS Publications
10. G.Bignot (1985)- Elements of Micro palaeontology Graham Trotman,
11. ClarksOn, 1985- Invertebrate Paleontology and Evolution, ELBS
12. Dunbar, C.O., and Rodgers 1960 - Principles of Stratigraphy-McGraw Hill

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**PRACTICAL 1: PALAEONOTOLOGY, STRUCTURAL GEOLOGY AND REMOTE SENSING - P13GY4P**

**Semester : I**

**Core Course: IV**

**Instruction Hours/Week: 6**

**Credit: 5**

**PALAEONTOLOGY:** Magascopic study of corals, Graptolites, Triobites, Brachiopous, Lamellebranchs, Gasterpous, Ammonites and Echinoderms with special reference to their evolutionary characters. Study of plant fossils. Microscopic study of some forams and ostracods.

**STRUCTURAL GEOLOGY:** Interpretation or complex geological maps, study of actual field geological maps; problems relating to depth and thickness; use for stereographic projection for solution of problems in structural geology. Borehole problems involving determination of attitude of tabular bodies and interpretation of lithological data from inclined boreholes, preparation of Latitudinal vertical sections

**REMOTE SENSING:** Problems relating to photogrammetry, from Aerial Photographs and Satellite data.

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**ELECTIVE COURSE I : REMOTE SENSING - P13GY5E**

**Semester : I**

**Elective Course: I**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit 1:** Fundamentals of Remote Sensing: Definition, types - Energy sources and radiation principles – Electromagnetic spectrum – Divisions - Stefan Boltzman’s law – Blackbody – Wien’s displacement law - Active and passive remote sensing system – various platforms of remote sensing

Energy interaction in the atmosphere: Scattering, absorption, transmission, atmospheric window; Energy interaction with the earth’s surface features – spectral reflectance curve; Data Acquisition, Receiving and recording – PIXEL –Path and Row – Swath; Ideal and real remote sensing system; Thermal and Microwave remote sensing

**Unit 2 :** Aerial Remote Sensing: History of aerial photography; Parts of aerial camera, aerial film camera and their types, electronic imaging, Multi band imaging; Types of aerial photographs; Photographic scale – causes for variation; Flight planning; Parallax, Vertical Exaggeration; Stereoscopy - Stereovision – stereoscopes: Lens and mirror stereoscopes – precision study of aerial photos using stereoscope, stereo-plotting instruments; Mosaics – Types and construction of mosaics; Annotation - Factors affecting results

**Unit 3:** Satellite Remote Sensing: History of space imaging; Types of satellites: Polar orbiting, geostationary and spy satellites; Scanning systems and Detectors: Across-track and along-track scanning systems, FOV & IFOV, charge couple devices; Sensors and their resolutions: spatial, spectral, radiometric and temporal; Data products: photographic and digital; Sensor characteristics of LANDSAT, SPOT, IRS series of satellites and other high resolution satellites; Indian space programme: past, present and future

**Unit 4:** Remote Sensing Data Interpretation : Visual interpretation: Elements of photo and image interpretation, interpretation strategies and keys – Digital interpretation – Elements of digital data – Digital image processing and an outline of various DIP techniques – Description of image restoration and rectification: Geometric and radiometric corrections, and noise removal – Description of image enhancement: contrast, spatial feature and multi-image manipulation – Description of image classification: supervised, unsupervised and hybrid classification – Description of data merging and GIS integration, hyper spectral image analysis and biophysical modelling.

**Unit 5:** Remote Sensing Applications in Earth Sciences: Remote sensing interpretation for lithological and structural mapping, geomorphological studies, mineral exploration, groundwater exploration, land use / land cover mapping, hazard zonation mapping: earthquakes, volcanoes, landslides, floods, soil erosion and for pollution studies

**TEXT BOOKS:**

1. Lillesand, T.M and R.W. Kiefer (2000). Remote sensing and image interpretation. John Wiley & Sons, New York
2. Sabins, F.F (1987). Remote sensing principles and interpretation. Freeman Publishers, New York
3. Miller, V.C (1961). Photogeology. McGraw-Hill Publishers, New York
4. Siegal, B.S and R. Gillespie (1980). Remote sensing in Geology, John Wiley & Sons, New York
5. Curran, P (1988). Principles of remote sensing. Corgman Publishers, London
6. Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd., New Delhi

**REFERENCES:**

1. Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford
2. Barrett, E.C and C.F. Curtis (1982). Introduction to environmental remote sensing. Chapman & Hall Publishers, New York.
3. Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
4. Bruno Marcolongo and Franco Mantovam (1997). Photogeology – Remote sensing applications in earth sciences, Oxford & IBH Publishers Co. Pvt. Ltd., New Delhi
5. Rampal, K.K (1999). Handbook of aerial photography and interpretation. Concept Publishers Company, New Delhi
6. Jean Yves Scanvic (1997). Aerspatial remote sensing in geology. Oxford & IBH Publishers Co. Pvt. Ltd.
7. Agarwal, C.S and Garg, P.K (2000). Textbook on remote sensing in natural resources monitoring and management, Wheeler Publishing Company Ltd., New Delhi
8. Narayan, L.R.A (1999). Remote sensing and its application. Universities Press Ltd., Hyderabad.

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**ADVANCED CRYSTALLOGRAPHY AND MINERALOGY - P13GY6**

**Semester : II**

**Core Course: V**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT 1 ADVANCED CRYSTALLOGRAPHY:** Derivation of 32 Crystal classes and their symmetry projections – Spherical, Stereographic and Gnomonic projections of crystals belonging to normal classes. 14 Bravais space lattices. X-ray Crystallography: Derivation of Bragg’s law and its application; Powder diffraction method.



**UNIT 2 OPTICAL MINERALOGY:** Polarization – double refraction in calcite – Nicol prism. Ray velocity surface of Uniaxial and biaxial minerals, Optic axis - primary and secondary optic axes, Indicatrix - uniaxial and biaxial minerals. Interference figure, sign of elongation, optic sign.

**UNIT 3 POLARIZING MICROSCOPE AND ITS ACCESSORIES** - Quartz wedge, mica plate, gypsum plate, berek compensator, micrometer ocular and their uses. Optical Properties of uniaxial and biaxial minerals – Mineral orientation, dispersion, pleochroic scheme, birefringence, twinning, extinction angle, determination of optic sign using interference figures, sign of elongation and optic axial angle, optical anomalies and irregularities in minerals.

U stage techniques for determination of anorthite content and twin laws in plagioclase

**UNIT 4 DESCRIPTIVE MINERALOGY: MINERAL PROPERTIES** - Isomorphism, polymorphism, pseudomorphism, exsolution, order and disorder relations, fluorescence in minerals, metamict state, staining techniques and micro chemical tests. Structural classification of silicate minerals and their compositional variations, optical and physical properties, and paragenesis of the following mineral groups and minerals: Isolated tetrahedral-silicate – Olivine Group; Single chain silicates - pyroxene group; Double chain silicates – amphibole group; Sheet silicates – mica, chlorite groups and clay minerals

**UNIT 5 FRAMEWORK SILICATES (TEKTO SILICATES)** – Quartz, Feldspar Feldspathoid and Zeolites groups; Miscellaneous silicates - Ortho and ring silicates - Garnet Group, Epidote group, Spinel group, Alumino-silicates, zircon, sphene, topaz, staurolite, beryl, cordierite, tourmaline, wollastonite, apatite, fluorite, corundum and calcite.

#### TEXT BOOKS

1. Dana, E.S. – 1955 – Text Book of mineralogy, wile
2. Philips, P.C. – 1956 – An introduction to Crystallography, Longmans Green & co.
3. Winchell, A.N. – 1968 – Elements of optical Mineralogy, parts, I & II Eiley Eastern
4. Wahiatrom, E.E, - 1960 – Optical Crystallography, Wiley.
5. Deer, W.A. Howie, R.A. & Zussman, J-1962 – Rock forming Mineralogy Vols. 1 to 5, Longmans.
6. Naidu, P.R.J. – 1958 – 4-Axes universal stage, commercial printing and publishing house.
7. Heinrich, E.W. – 1965 – Microscopic identification of Minerals McGraw Hill.
8. Grim,R.N. – 1953 – Clay Mineralogy, McGraw Hill.
9. Kerr,, P.F. – optical Mineralogy, McGraw Hill.

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#### ENGINEERING GEOLOGY, MINING GEOLOGY AND ORE DRESSING - P13GY7

Semester : II

Core Course: VI

Instruction Hours/Week: 6

Credit: 5

**UNIT 1 ENGINEERING GEOLOGY:** Applications of Engineering Geology. Role of Geologists in Civil Engineering, Engineering properties and characteristics of soils. Engineering performance of rocks – Strength and elastic properties. Properties of building stones, concrete aggregates and rail road ballast.

Elementary concepts of Rock mechanics and rock engineering. Soil Mechanics.

Geological reconnaissance, site investigation, characterization and problems related to civil engineering projects. Ground investigation (Bore holes and trial bits; drilling, sampling and logging etc.) Geotechnical report.

Geological and geotechnical investigations for the control/preventive/ remedial measures of Land slides. Slope stability - Geosynthetics. Geological investigations pertaining to the foundation of bridges, buildings, highways and airfields.

**UNIT 2** Types of Dams – Geological investigations of Dam sites. Dam construction - problems – remedial measures. Spill ways and reservoir problems. Tunnels: problems relating to tunneling in hard and soft grounds. Geological investigations preceding tunneling. Geological investigations pertaining to control/preventive measures of coastal erosion. Geotechnical investigations pertaining to the construction of harbour and docks. A note on earthquake resistant structures.

**UNIT 3 MINING GEOLOGY:** Mining terms and their descriptions. Sampling - Principles – Types of sampling – Collection & preparation of samples. Drilling: Types of drills and methods of drilling. Geological logging. Explosives and Blasting Methods. Rock excavations: Methods of stoping; Ventilation, Haulage, Shafts and shaft sinking. Assaying and evaluation of ore-bodies and their extensions-ore reserve estimation. Alluvial mining: panning, sluicing, hydraulicking, drift mining and dredging. Opencast mining: Mine machinery-power shovel, bucket wheel excavator, conveyor and spreader. Types of mining- Glory hole, Kaolin mining, Granite mining, sand mining, stripping.

**UNIT 4** Subsurface mining / Underground mining;- Stoping: Open stopes – supported stopes, shrinkage stopes. Caving;- Top slicing-sub level caving –block caving. Ground water control – Mine ventilation  
Coal Mining: Prospecting and planning – underground mining –Room and pillar method – long wall (advancing & retreating) method –Pillar robbing- Hydraulicking – Power source roofing – transportation; strip mining of coal – Augering-cleaning –Grading – Shipping – Future trends in India. Mining and environment, Mitigation of mining hazards. Factors controlling the choice of various mining methods.

**UNIT 5 ORE DRESSING:** Principles and scope of mineral dressing; Physical and chemical properties of minerals as applied to mineral dressing. Size reduction Fundamentals – Preliminary breaking – Jaw crushers – Gyratory crushers and Stamping; - Fine grinding – Wet and dry – Ball Mills;- Size separation –Screening –Sieve scale, Grizzlies , Vibrating screens;- Settling- Principles of settling, free settling hindered settling, gravity concentration;- Jigs;- Rakes Classifiers; - shaking tables – Wilfley tables – principles of magnetic separation and Electrostatic

separation; - Floatation – Definition, principle and application, –Frothing agents – collecting agents – Dispersing agents –floatation Machines – Floatation practice and Filtration.

**TEXT BOOKS:**

1. Krynine, D. P. and Judd, W. R. 1957 principles of Engineering Geology and Geotechniques, McGraw Hill.
2. Legget, R. F. 1962 Geology and Engineering, McGraw Hill.
3. Gokhale, K.V.G.K & Rao, D.M.1981 Experiments in Engineering Geology, McGraw Hill.
4. Arogyaswamy, R. N. P. 1973 Courses in Mining Geology, Oxford & IBH, New Delhi.
5. Higham, S 1951 An introduction to Metalliferous mining, Lord
6. Gokhale, K.V.G.K and Rao, T.C. 1978 Ore deposits of India distribution and processing, Thomson.
7. Mc Kinstry, H.E 1960 Mining Geology, New York.

**REFERENCE BOOKS**

1. Fox, C. S. 1949 Engineering Geology, New York.
2. Blyth, F. C. 1979 A Geology for Engineers, ELBS.
3. Venkat Reddy, D. 2010 Engineering Geology, Vikas publ. House Pvt. Ltd., New Delhi.
4. Gauding, A.M. 1939 Principles of Mineral Dressing , McGraw Hill.
5. Thamus, P.J. 19790 An introduction to mining, Methun.
6. Taggart, A.E. Elements of ore dressing.
7. Stanton, R.L. 1972 Ore Petrology, Mcrew Hill.

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**HYDROGEOLOGY AND GROUNDWATER MANAGEMENT -P13GY8**

**Semester : II**

**Core Course: VII**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT I HYDROGEOLOGY:** - Introduction - Hydrogeological Cycle: Groundwater occurrence in igneous, sedimentary and metamorphic rocks – Vertical distribution of groundwater in hard rock regions – Water bearing properties of rocks. Geologic formations as aquifers; Types of aquifers; Movement of Groundwater – Laminar and turbulent flow – Darcy’s law and its applications; Determination of Permeability in the laboratory and in the field.

**UNIT 2** Groundwater Detection: **Surface Methods:** Geomorphological, Structural and Biological evidences – **Subsurface Methods:** Applications and limitations of Geophysical methods in groundwater targeting - Detailed account of principles, field procedure, electrode arrangements, instruments and interpretation of resistivity data. Brief study of Electrical Well-logging method of groundwater detection - Application of Remote Sensing methods in groundwater exploration

**UNIT 3 Well Design and Well development:** Brief introduction about Dug wells, Tube wells, Jetted wells, Infiltration Galleries and Collector wells. Design of Tube well, Well Screening and Artificial Packing – Well development through pumping, Bridging, Surging with air, Back

washing, Acidizing – Method of sealing of poor quality wells, Sealing of top, intermediate and bottom zones in tube wells. Fluctuations of groundwater levels; causes and control, Features of Recharge and discharge areas; Recharge methods and practices.

**UNIT 4 Pump Tests:** Methodology and need for pump test – Testing of flowing wells: Theim's Method, Theis's method, Jacob's method, Chow's method - Evaluation of aquifer parameters through Pump Tests - Estimation of water flow from vertical and horizontal Well-pipes – Hydraulic conductivity and field methods for determining the Hydraulic conductivity below the water table.

Groundwater basins; data collection for basin investigations – Water balance studies – Safe yield and overdraft. Conjunctive use of surface and groundwater reservoirs in India; Sea water intrusion in Coastal areas and its prevention – Groundwater province of India.

**UNIT 5 WATER QUALITY:** Geochemical method of groundwater exploration - Quality of water in various rock types – Water quality parameters and their standards for domestic, industrial and irrigation purposes. Physical tests for determining water quality – Chemical tests for estimation of water quality – graphical representation of water quality – Diseases and Virological aspects of underground water and remedial measures. Groundwater problems in mining, a case study from Neyveli. Rainwater harvesting and management.

**Text Books:**

1. Todd, D.K. 1959: Ground water Hydrology. John Wiley & Sons.
2. Davis, S.N. & Dewiest 1966 Hydrogeology, John Wiley & Sons. Wiest R.J.M.
3. Raghunath, H.M. 1983 Ground water, Wiley Eastern.
4. Gautam Mahajan- 1989: Evaluation and Development of Groundwater, Ashish Publishing House.
5. Ramakrishnan. S: 1998 – Ground water –By Author.

**Reference Books:**

1. Tolman., G.F. 1937 Ground water McGraw Hill. New York.
  2. Walton, W.C. 1970 ground water Resources evaluation McGraw Hill.
  3. Karanath, K.R. 1987 ground water Assessment Development & management Tata McGraw Hill
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**PRACTICAL II : CRYSTALLOGRAPHY, MINERALOGY, MINING GEOLOGY AND HYDROGEOLOGY**  
**- P13GY9P**

**Semester : II**

**Core Course: VIII**

**Instruction Hours/Week: 6**

**Credit: 5**

**CRYSTALLOGRAPHY:** Sterographic and Gnomonic projections of natural crystals of normal classes-symmetry projections of 32 classes-calculation of crystal elements to test the knowledge of application of tangent relation . Anharmonic ratio, Napier's theorem and equation of the normal. Use of contact goniometer in measuring interfacial angles.

**MINERALOGY:** Megascopic and microscopic study of important rock forming silicates- determination of dichroic and pleochroic schemes, optic sign of uniaxial and biaxial minerals, sign of elongation, optic axial angle by Mallard's method and anorthite content of oriented sections of plagioclase. Identification of pinacoidal sections of pyroxenes and Amphiboles.

**MINING GEOLOGY:** Problems relating to evaluation of Ore reserves.

#### **HYDROGEOLOGY**

Study of hydrological data and their interpretations - Interpretation of pumping test data - Representation of water analysis data on different types of diagrams – Water quality analysis.

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#### **ELECTIVE COURSE II : ENVIRONMENTAL GEOLOGY AND DISASTER MANAGEMENT -P13GY10E**

**Semester : II**

**Elective Course: II**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit 1 Environmental Geology:** definition, scope, basic concepts - Earth in space and time - Energy sources of disasters: internal and external sources - Mass extinctions through geologic time – Major climatic changes through geologic time - Human fatalities from natural disasters.

**Unit 2 River flooding:** factors governing flood severity, flood characteristics, hazards of flooding, strategies for their reduction and the role of geology - **Mass movements:** factors influencing slope stability, types of mass movement, hazards of mass movement, strategies for their reduction and the role of geology - **Soil erosion:** Soil formation, soil classification, factors influencing soil erosion, hazards of soil erosion, strategies for their reduction and role of geology.

**Unit 3 Earthquakes:** Earthquake distribution, its relation to plate tectonics, hazards of earthquakes, strategies for their reduction and the role of geology: Tsunami - **Volcanic activity:** Distribution of volcanoes and its relation to plate tectonics, hazards of volcanic activity, strategies for their reduction and the role of geology - **Coastal hazards:** Coastal erosion, coastal flooding, sea water intrusion and their hazards, strategies for their reduction and the role of geology. Global warming and Climate changes

**Unit 4 Hydrology and Human Use:** Human activities and other factors affecting run off and sediment transport, sediment pollution, channelization, surface and groundwater pollution, strategies for their reduction and the role of geology - **Waste disposal:** Solid and liquid waste and their sources, radioactive wastes, their disposal strategies, role of geology in waste disposal planning - **Geologic aspects of environmental health:** Disease patterns and environment, geologic factors of environmental health, geologic occurrence and effects of trace elements on health, chronic diseases and geologic environment.

**Unit 5: Environmental impacts of mining activities:** surface, underground and coal mining, impacts of mineral processing – **Urbanisation:** causes, impacts, urban planning and role of geology - **Land use planning - Desertification,** causes, impacts, strategies for their control - **Human population:** nature and rate of growth, causes and impacts - **Outline of environmental laws.**

### Text Books & References

1. Abott, P.L (2000). Natural Disasters, McGraw Hill Publications, New York.
2. Coates, D.R (1985). Geology and Society, Chapman and Hall Publishers, New York
3. Keller, E.A (1976). Environmental Geology, Charles E. Merrill Pub. London.
4. Howard, A.D and Irwin Remson (1978). Geology in Environmental Planning, McGraw Hill Publications, New York.
5. Lundgren, L (1986). Environmental Geology, Prentice Hall Publishers, New Jersey.
6. Montgomery, C.W (2000). Environmental Geology, McGraw Hill Pub. New Delhi.
7. Valdiya, K.S (1987). Environmental Geology – Indian Context, Tata McGraw Hill Publications, New Delhi.

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### IGNEOUS AND METAMORPHIC PETROLOGY - P13GY11

**Semester : III**

**Core Course: IX**

**Instruction Hours/Week: 6**

**Credit: 5**

#### UNIT 1: IGNEOUS PETROLOGY

Igneous activity – magmatic evolution and magma types in Ocean Floor, Island Arcs, Orogenic Continental Margins and Intra-continental Orogenic Belts. Nature and Physical properties of Magmas. Igneous Textures and their petrogenetic significances. Classification of Igneous Rocks: Mode and Norm, CIPW Norm, IUGS Classification of plutonic, hypabyssal and volcanic rocks. Irvine and Baragar's Classification.

Petrography and Petrogenesis of oceanic regions, convergent plate boundaries, continental flood basalts, continental alkaline rocks, ultra alkaline and silica poor rocks. Petrography of Lamprophyres, Kimberlites, Komatiites and Carbonatites.

**UNIT 2:** Introduction to principles and laws of thermodynamics. Gibb's Phase rule and its application to igneous petrogenesis. Derivation and application of Lever Rule.

Crystallization of binary magma - Simple Eutectic (Albite-Silica), Solid Solution (Forsterite-Fayalite) and incongruent melting (Forsterite-Silica). Ternary melt-systems of Diopside – Forsterite – Silica, Diopside- Albite – Anorthite and Anorthite – Forsterite – Silica. Effects of vapors (H<sub>2</sub>O, CO<sub>2</sub> and O<sub>2</sub>) on melting and crystallization – with reference to basaltic magma. Magmatic Differentiation and fractional crystallization.

**UNIT 3:** Liquid immiscibility, Soret effect, Assimilation, Application of trace elements in fractional crystallization. Chemistry of rocks: Brief outline of Analytical methods using Flame photometer, AAS, XRD, XRF, ICP and Wet chemical methods. Distribution and behavior of

major-oxide elements in rocks. Application of Bivariate (Harker Diagram) and Triangular (AFM Diagram) variation diagrams. REE distribution in rocks and their application to igneous systems.

#### **UNIT 4: METAMORPHIC PETROLOGY**

Agents of metamorphism, Types of metamorphism, Paired metamorphic belts, Metamorphic reactions (dehydration, decarbonation, exchange, solid-solid and oxidation-reduction reactions), Metamorphic textures and structures. Classification of metamorphic rocks based on chemical composition and mineralogy.

Metamorphism in relation to orogeny. Grades, Zones and facies of metamorphism – A critical review of facies concept – Facies of Contact Metamorphism, Facies of Regional (dynamothermal) metamorphism and Facies and Burial metamorphism.

**UNIT 5:** Compositional (Chemographic) diagrams - ACF, AKF and AFM diagrams. Mineralogical phase rule and its application to geothermometry and geobarometry. Continuous and discontinuous reactions. Metamorphic diffusion. Migmatites and granitisation. Metasomatism, Mineral Paragenesis in different metamorphic facies/grades of pelitic, basic and impure calcareous rocks.

#### **Reference and Text Books:**

1. Tyrrell. G.W.(1963)- Principles of Petrology – Asia Publishing House.
2. Turner.F.J and Verhoogen.J –1960.- Igneous & Metamorphic petrology – McGraw Hill.
3. MacKenzie.W.S. et.al.,-(1982); Atlas of Igneous rocks and their textures – Longman.
4. McBirney.A.R.(1994) – Igneous Petrology – CBS Publishers and Distributors.
5. Raymond.L.A.-2002- Petrology – McGraw Hill.
6. Hall- A (1992) – Igneous Petrology – ELBS.
7. Morse.S.A – (1980)- Basalts and Phase diagrams –Springer – Verlag.
8. Winter. J.D.- (2001) – Igneous and Metamorphic Petrology –Prentice Hall.
9. Winkler, H.G.F. – 1967 – Petrogenesis of Metamorphic Rocks, Springer and Verlog
10. Phillipots. R. Anthony (1994) – Principles of igneous and metamorphic petrology, Prentice-Hall of India, New Delhi.
11. Best. 12. Yardley

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### **SEDIMENTOLOGY AND SEDIMENTARY PETROLOGY - P13GY12**

**Semester : III**

**Core Course: X**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT 1** Sedimentation - Textures and structures of sedimentary rocks - Classification and composition of sedimentary rocks -- Study of residual deposits – Terra rosa, Clay with flint, Laterite, Bauxite, Residual clays. Study of Clastic rocks – Rudaceous – Conglomerate – Breccia – Arenaceous – Sandstones – Classification - Volcaniclastic deposits – Siltstones –

Mudstones. Study of Nonclastic rocks - Lime stones and Dolomites - Siliceous deposits – Ferruginous deposits – Carbonaceous deposits – Phosphatic deposits – Evaporites.

**Unit II** Techniques in Sedimentology – Collection and analysis of field data - Mechanical analysis of sediments – Graphical representation of size analysis data – statistical parameters and their geological significance. Microscopical techniques – Cathodoluminescence – X – ray diffraction – Scanning electron microscope - Application of trace element, rare earth element and stable isotope geochemistry to sedimentological problems. Heavy minerals and their significance- provenance of sediments –sedimentary differentiation, Lithification and Diagenesis.

**Unit III** Sedimentary facies and products: Non-marine continental, continental margin, oceanic facies.

Non marine environments – desert, fluvial, lake and glacial-environments. Climatic significance of red beds.

Transitional environments – coastal current, estuarine, deltas, shore fans, barrier complexes and pertidal complexes.

Marine environments – Continental shelf, slope and rise. Climatic significance of carbonates.

**Unit IV** Concept of plate tectonics and sedimentation: Classification and description of basins – Down-warp basins – Rift basins – Interior basins- Foreland basins – Subduction basins – Pull apart basins – Delta type basins – Composite basins ; Basin formation – Basins in compressional zones – Basins in Strike slip zones – Basins in transform fault zones.– Geosynclines Stratigraphy and Sedimentation – Lateral relationships and correlation of sedimentary strata.

**Unit V** Basin analysis- Basin and its lithic fill, palaeoslope, palaeocurrent, palaeo-fluvial channels and depositional environment. Diagnostic and maturation, sediment chemistry, basin evolution and tectonics.

### TEXT BOOKS

1. Williams, H. Turner, F.J. & Billbert, C.M. – 1954 – Petrography, Freeman.
2. Pettijohn, F.J.- 1967 – Sedimentary Rocks, Harpers and Bros
3. Bayly, B. – 1968 – Introduction to Petrology, Prentice Hall.

### REFERENCE BOOKS

1. Krumbein, W.C. & Pettijohn, F.J. – 1938 – Manual of Sedimentary Petrography, Appleton century co.
2. Krumbein, W.C. & Sloss, L.L. – 1951 – Stratigraphy and Sedimentation, Freeman.

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### PRACTICAL – III :PETROLOGY -P13GY13P

**Semester : III**

**Core Course: XI**

**Instruction Hours/Week: 6**

**Credit: 5**

Megascopic and Microscopic study of igneous, sedimentary and metamorphic rocks.

Mode to Chemistry of rocks.

Mechanical analysis of sediments and statistical studies of data.

Petrochemical calculations – C.I.P.W. Norm.



NiggLi values and Niggli Basis.

Von wolff plots and variation diagrams,

Harker's diagram and Niggli variation diagram, ACF diagram.

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### ELECTIVE COURSE III : GEOEXPLORATION - P13GY14E

**Semester : III**

**Elective Course: III**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit I: Geological Exploration:** Criteria controlling the choice of sites for geological prospecting- Marginal information of topo sheets and study of field equipment. Field documentation and basic field procedures. Pitting, trenching, drilling and exploratory mining. Mineralogical, structural, stratigraphical and geomorphological guides to ore search. Ore reserve estimation techniques.

**Unit II : Geophysical Exploration:** A concise account of limitations and applications of various geophysical exploration methods; The problem of ambiguity in geophysical interpretations; The principle, types, origin, instruments, field procedure and interpretations of self potential method. The principles involved, instruments used, field procedures adopted and interpretations applied in electrical resistivity methods. The principle, types, origin, field procedure and interpretation of induced polarization method. A brief account of electromagnetic, telluric, AFMAG techniques. A brief study of electrical well logging techniques.

**Unit III:** Geodesy of the earth. Newton's law and its application. The earth's gravitational field. Gravity corrections. The gravity measuring instruments. Density of rocks and the methods of density measurements. Gravitational effects over subsurface bodies of different shapes. Gravity survey at land and sea. Interpretation of gravity data and depth problems. Brief account of density logging. Elastic properties of the earth materials. Types of seismic waves, their propagation and characteristics. Geophones, types of shooting methods, seismic energy source. Principle of refraction – interpretation of - horizontal two layer, multilayer and dipping layers. Principle of reflection seismic survey. Problems in seismic survey. Brief outline of sonic logging.

**Unit IV:** Basic concepts and principles of magnetic prospecting. Magnetism of the earth and palaeomagnetism. Magnetic susceptibility of rocks. Magnetic effects from buried magnetic bodies. Instruments employed in magnetic prospecting. Magnetic survey on land and sea. Air-borne magnetic survey. Corrections and interpretation of magnetic data. Principles of radioactive prospecting. Radioactive decay, radioactivity of rocks and minerals. Instruments, field procedure and interpretations employed in radioactive survey.

**Unit V : Geochemical Exploration:** Origin and abundance of elements in the earth's crust. Mobility of elements; factors controlling mobility; mobility in surficial and deep seated environment; geochemical dispersion; recognition of surficial and deep seated dispersion pattern; geochemical anomaly; background and threshold values; recognition of anomaly; significant and non significant anomalies; bedrock and soil geochemical surveys. Geochemical explorations for gold, copper and base metals. Application of geochemistry in: Mineral exploration, Oil prospecting, Ground water targeting, Soil studies, Atmospheric pollution studies. Outline of biogeochemical exploration.

**Text Books:**

1. McKinsty H.E. (1960) - Mining Geology: Asia Publishing House
2. Mathur S.M. (2001) – Guide to Field Geology: Prentice Hall of India.
3. Ramachandra Rao M.B.(1975) – Outlines of Geophysical Prospecting - A manual for Geologist: University of Mysore.
4. Dohr.G. (1984): Applied Geophysics- English Book Depot.
5. Lowire. W. (1997) - Fundamentals of Geophysics. Cambridge Low price
6. Dobrin M.B.(1981) - Introduction to Geophysical prospecting. McGraw – Hill International Book Company.
7. Kearey.P and Brooks.M (1984) An Introduction to Geophysical Exploration- ELBS.
8. Hawkes H.E. and Webb. U.S - (1962)- Geochemistry in mineral Explo. Harer & Row.
9. Mason.B (1966);-Principles of Geochemistry – Willey Toppan.

**References:**

1. Burger. H.R. (1992)- Exploration Geophysics of the Shallow Subsurface: Prentice Hall
2. Robinson. E.S. and Coruh.C. (2002)- Basic Exploration Geophysics– John Wiley.
3. Gunter Faure. (1998) – Principles and applications of Geochemistry–prentice Hall.
4. Krauskope.B.K.- (1988) ;Introduction to Geochemistry.

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**ELECTIVE COURSE IV : COMPUTER APPLICATIONS, GIS AND GEO STATISTICS -P13GY15E**

**Semester : III**

**Elective Course: IV**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit I : COMPUTER FUNDAMENTALS** - Principles - Historical development - general characteristics - construction and organization of computers; Classification of computers – Computer hardware – input and output devices – storage devices – printers and plotters; Binary arithmetic and coding; Computer software – flow chart and algorithm; Computer language – machine language, assembly language and high level language; Operating System – MS-DOS and Windows. IT Act. System Security (Virus/firewall).

**Unit II: MS-Office: MS Word** – word processing – cursor navigation - functions – main menu and sub menu – tool bars – documents creating – editing, formatting and printing.

**MS Excel** – Electronic spread sheet – navigation - main menu and sub menu – tool bars – functions – worksheet and chart - database and data processing.

**MS Power point** – operations – main menu and sub menu – tool bars – slides creating – editing, templates - formatting and presentation.

**Unit III:** Structure of **C** – programme – character set, constant, variables and operators – arithmetic expressions – library functions. Classification of programme statements - input and output statements, control statements. Writing C programmes in basic statistical operation. Prologue to C \*\*

**Unit IV: GEOGRAPHICAL INFORMATION SYSTEM:** Introduction – definition of GIS, historical development; Basic principles – concepts and usefulness of GIS; Component of GIS – Hardware, software modules and user; Spatial data in GIS – vector and raster data – spatial data structure and data modeling – data sources; Projection and registration; Attribute data management - Data input and editing – Data analysis and manipulation in GIS; Surface modeling – TIN and DTM; Out put from GIS; Application of GIS in Geological studies and natural resource management.  
Global Positioning System – concepts – segments – its application.

**Unit V: GEOSTATISTICS:** Concepts – Definition - Merits and limitation – Geostatistical tools – collection of data, sampling techniques, precautions in the use of secondary data. Organisation of data – continuous and discrete frequency, tabulation. Presentation of data: Tabular and diagrammatic illustration: Bar diagram and pie diagram – histogram and frequency polygon; Measures of central tendency – Arithmetic mean , Median, Mode, Dispersion: Standard deviation – skewness, kurtosis – Karl Pearson’s coefficient of Skewness; Correlation and Regression-Concepts, Karl Pearson’s coefficient of correlation – Rank correlation Regression, lines of regression; Probability – Meaning and Uses. Addition and Multiplication theorems. Factor analysis. A brief note on statistical software- SPSS, GSTAT, GRADISTAT.

**(Note:** It is desirable that the software should be used for demonstrating visual, graphical and application oriented approaches.

#### **TEXT BOOKS**

1. John C.Davis - 1973 - Statistics and Data Analysis in Geology, John Wiley & Sons.
2. Krumbein and Graybill 1965 - An introduction to Statistical methods in Geology, Mc Graw Hill.
3. Burrough, P.A.-1986- Principles of Geographical information system for land resource assessment.
4. Rajaraman, V. Fundamentals of Computers, Fourth edition, PHI.

#### **REFERENCE BOOKS**

1. Rober L. Miller and James Stevenkahn -1962, Statistical analysis in the Geological Sciences, John Wiley & sons, Inc.

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**ECONOMIC GEOLOGY, MINERAL ECONOMICS AND ORE MICROSCOPY - P13GY16**

**Semester : IV**

**Core Course: XII**

**Instruction Hours/Week: 6**

**Credit: 5**

**UNIT 1 Economic geology:** Processes of formation of mineral deposits – Magmatic, sublimation, contact metasomatic, Hydrothermal (Cavity, filling and replacement) Sedimentation, evaporation, residual and mechanical concentration, Oxidation and supergene enrichment and metamorphism.

**UNIT 2** Classification of Mineral deposits, controls of Ore localisation – structural stratigraphic, physical and chemical; Metallogenic epochs and provinces – Plate tectonics and Ore genesis -Geologic thermometry- Geobarometry, stable and radiogenic isotopes of ores and the host rocks – Geological and Geochemical modeling of ore deposits

**UNIT 3** Study of the following ore deposits with regard to their mode of occurrence, distribution in India, Origin and uses; Asbestos, Barite, Bauxite, Chromite, Copper, Gold, Iron, Lead and Zinc, Magnesium, Manganese.

**UNIT 4 Mineral Economics:** Definition and scope – Significance of minerals in National economy, peculiarities inherent in mineral industry, Tenor, grade and specifications for minerals. Mines and Mineral legislation of India. India's National mineral policy. Strategic, Critical and essential minerals with reference to India. Mineral conservation and substitution.

**UNIT 5 Ore Microscopy:** Construction of ore Microscope. Polishing and mounting of ores, Physical properties of Ore minerals, Determination of micro hardness; Factors affecting micro-hardness.

Study of optical properties – Colour, reflectivity, bi-reflectance, Isotropism, Anisotropism, Polarization Colours, Rotation properties, Internal reflections and relation sense. Instrumentation and methods of determination of reflectivity, Polarization figures of Isotropic and anisotropic Ore minerals, Micro – chemical techniques, ore textures and paragenesis, application of Ore Microscopy.

**Text Books:**

1. Bateman, A.M. – 1995 – Economic Mineral Deposits, Willey.
2. Lindgren, W – 1993 – Mineral Deposits, McGraw Hill.
3. Cameron, E.N. – 1961 – Ore Microscopy, Wiley.
4. Sinha, R.K. & Sharma, N.L. – 1976 – Mineral Economics Oxford and IBH.
5. Graig, J.R. – Ore Microscopy and Ore Petrography.

**Reference books :**

1. Coggin, B & Dey, A.K. – 1995 – India's Mineral Wealth, OUP.
2. Park, C.F. & Macdiarmid, R.A. 1970 – Ore deposits, Freeman.
3. Deb, S, 1980 – Industrial Minerals and rocks of India, Allied.
4. Gokhale; K.V.G.K. & Rao, T.C. – 1978 – Ore deposits of India, their distribution and Processing, Thomson Press.
5. Stanton, R.L. 1972 – Ore Petrology, McGraw Hill.

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**PRACTICAL – IV : GEOEXPLORATION AND COMPUTER APPLICATIONS - P13GY17P**

**Semester : IV**

**Core Course: XIII**

**Instruction Hours/Week: 6**

**Credit: 5**

**ECONOMIC GEOLOGY, GEOPHYSICS AND GEOCHEMISTRY**

Megascopic identification of important ore minerals. Interpretation of geological maps. Interpretation of geophysical data in solving geological problems. Blow-pipe tests for selected ores. Volumetric analysis.

**ORE MICROSCOPY**

Study of optical properties and identification of selected ores by reflected light- Description and interpretation of ore textures. Etching and micro chemical techniques.

**COMPUTER APPLICATIONS**

GIS and writing of simple computer programme (Using C) pertaining to geological problems

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**ELECTIVE COURSE V : FUEL GEOLOGY - P13GY18E**

**Semester : IV**

**Elective Course: V**

**Instruction Hours/Week: 6**

**Credit: 4**

**Unit I Natural sources of energy: Coal Geology**

Definition and origin of coal. Sedimentology of coal bearing strata, types of seam discontinuities and structures associated with coal seams. Chemical analysis of coal (proximate and ultimate analysis).

Coal Petrology:- Classification and optical properties of macerals and micro-lithotypes. Techniques and methods of coal microscopy. Application of coal petrology. Classification of coal in terms of Rank, Grade and Type. Indian classification for coking and non-coking coals. International classifications (I.S.O. and Alpern's classification).

**Unit II:** Elementary Idea about coal preparation, coal carbonization, coal gasification, coal hydrogenation, coal combustion and fertilizer form coal. Coal as a source rock in petroleum generation. Coal exploration and estimation of coal reserves. Indian coal reserves and production of coal in India. Coal bed methane – a new energy resource. Elementary idea about generation of methane in coal beds, coal as a reservoir and coal bed methane exploration.

**Unit III: Petroleum Geology:** Petroleum – its composition. Origin (Formation of source rocks kerogen, organic maturation and thermal cracking of kerogen) and migration of petroleum. Reservoir rocks-porosity and permeability. Reservoir traps – structural, stratigraphic and combination traps. Oilfield fluids – water, oil and gas.

**Unit IV:** Methods of prospecting for oil and gas (geological modeling). Elementary knowledge of drilling and logging procedures. Oil shale. An outline of oil belts of the world. Onshore and offshore petroliferous basins of India. Geology of productive oilfields of India. Oil policy of India. Gas Hydrates: Exposure to gas hydrates and future prospective.

**Unit V: Atomic and Geothermal energy**

**Atomic Fuel:** Concept of atomic energy. Radioactive minerals. Mode of occurrence and association of atomic minerals in nature. Methods of exploration for atomic minerals. Productive geological horizons of atomic minerals in India.

Geothermal energy: Principles of utilization of Earth’s heat. Types of geothermal source. Applications, exploration, distribution of geothermal energy. Application of geothermal sources. Geothermal sources in India. Future scenario.

A debate on eco-friendly fuel or energy.

**Text books: Reference books**

1. Chandra, D., Singh, R.M. Singh, M.P., 2000: Textbook of Coal (Indian context). Tara Book Agency, Varanasi.
2. Singh, M.P. (Ed.) 1998: Coal and organic Petrology. Hindustan Publishing Corporation, New Delhi.
3. Scott, A.C., 1987: Coal and Coal-bearing strata: Recent Advances. The geological Society of London, Publication no. 32, Blackwell scientific Publications.
4. Stach, E., Mackowsky, M-Th., Taylor, G.H., Chandra, D., Teichmuller, M. and Teichmuller R., 1982: Stach Textbook of Coal petrology. Gebruder Borntraeger, Stuttgart.
5. Holson, G.D. and Tiratso, E.N., 1985: Introduction to Petroleum Geology. Gulf Publishing, Houston, Texas.
6. Tissot, B.P. and Welte, D.H., 1984: Petroleum Formation and Occurrence, Springer – Verlag.
7. North, F.K., 1985: Petroleum Geology. Allen Unwin.
8. Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press.
9. Durrance, E.M. 1986: Radioactivity in Geology-principles and application. Ellis Horwood.
10. Dahlkamp, F.J., 1993: Uranium Ore Deposits. Springer Verlag.
11. Boyle, R.W., 1982: Geochemical prospecting for Thorium and Uranium deposits, Elsevier.

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**PROJECT WORK - P13GYP19**

**Semester : IV**

**Project**

**Instruction Hours/Week: 12**

**Credit: 5**

**PROJECT WORK**

**(Dissertation 75 marks & Viva Voice – 25 Marks)**

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