BHARATHIDASAN UNIVERSITY  **TIRUCHIRAPPALLI - 620 024.**

M.Sc. APPLIED GEOLOGY: CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

Sem.	Courses	Title	Ins. Hrs	Credit	Exams Hrs	Marks		Total
						Int.	Ext	
I	Core Course I (CC)	Geomorphology and Marine Geology	6	5	3	25	75	100
	Core Course II (CC)	Geotectonics and Structural Geology	6	5	3	25	75	100
	Core Choice Course I (CCC) (Any one)	1. Stratigraphy 2. Palaeontology	6	5	3	25	75	100
	Core Practical I (CP)	Palaeontology, Structural Geology and Remote Sensing	6	3	3	40	60	100
	Elective Course I (EC) (Any one)	1. Remote Sensing 2. Environmental Geology	6	4	3	25	75	100
	Value Added Course I (VAC)	Water Resources Management	-	2*	3	25	75	100*
	Total		**30**	**22**	**-**	**-**	**-**	**500**
II	Core Course III (CC)	Advanced CrystallOgraphy	6	5	3	25	75	100
	Core Course IV (CC)	Mineralogy and Mineral Optics	5	5	3	25	75	100
	Core Choice Course II (CCC) (Any one)	1. Geophysical Exploration Techniques 2. Geochemical Exploration Techniques	5	5	3	25	75	100
	Core Practical II (CP)	Crystallography and Mineralogy	6	3	3	40	60	100
	Elective Course II (EC) (Any one)	1. Mining Geology 2. Engineering Geology and Ore Dressing	5	4	3	25	75	100
	Non-Major Elective Course I	Geology for Competitive Examination I	3	2	3	25	75	100
	Total		**30**	**24**	**-**	**-**	**-**	**600**
III	Core Course V (CC)	Igneous Petrology	6	5	3	25	75	100
	Core Course VI (CC)	Sedimentary and Metamorphic Petrology	5	5	3	25	75	100
	Core Choice Course III (CCC) (At least Two)	1. Hydrogeology 2. Geological Oceanography	5	5	3	25	75	100
	Core Practical III (CP)	Petrology	6	3	3	40	60	100
	Elective Course III (EC) (At least Two)	1. Computer Applications and GIS 2. Geostatistics	5	4	3	25	75	100
	Non-Major Elective Course II	Introduction to Minerals, Rocks and Fossils	3	2	3	25	75	100
	Total		**30**	**24**	**-**	**-**	**-**	**600**
IV	Core Course VII (CC)	Economic Geology and Ore Microscopy	6	5	3	25	75	100
	Core Course VIII (CC)	Fuel and Industrial Geology	6	5	3	25	75	100
	Entrepreneurship / Industry Based Course	Surveying Techniques	6	5	3	25	75	100
	Project	Dissertation work	12	5	-	20	80	100
	Value Added Course II (VAC)	Water Quality Analysis	-	2*	3	25	75	100*
	Total		**30**	**20**	**-**	**-**	**-**	**400**
Grand Total			**120**	**90**	**-**	**-**	**-**	**2100**

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES

Sl. No.	Types of the Courses	No. of Courses	No. of Credits	Marks
1.	Core Courses	8	40	800
2.	Core Choice Courses	3	15	300
3.	Core Practicals	3	9	300
4.	Elective Courses	3	12	300
5.	Entrepreneurship/ Industry Based Course	1	5	100
6.	Project	1	5	100
7.	Non-Major Elective Courses	2	4	200
	Total	**21**	**90**	**2100**
	Value Added Courses *	2*	4*	200*

***The value added courses credit will not be included in the total CGPA.**
These courses are extra-credit courses.
Instruction hours for these courses is 30 hours.

First Year **CORE COURSE I** **Semester I**

GEOMORPHOLOGY AND MARINE GEOLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To study the eustatic changes and its causes
- To understand the evolution of landforms
- To know about the applications of geomorphology in different fields
- To understand the different geological operations in an oceanic basin
- To study the topography of the oceanic basin

UNIT – I:

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 – II:

Aeolian landforms – Arid Cycle of erosion – Glacial landforms, periodicity of glaciations and its causes – Geomorphology of the coasts, classification of shorelines and their evolution. Evidences of eustatic changes and their causes – Landforms produced by volcanoes.

UNIT – III:

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, Drainage Pattens, Drainage analysis in Geological interpretation. Geomorphic features of India; Application of Geomorphology in groundwater, mineral and oil exploration and Engineering projects.

UNIT – IV:

Marine Geology: Introduction in marine Geology – Characteristics and origin of ocean basin, Oceanographic instruments pertaining to geological operations. Van been grab, petterson grab, gravity corer, piston corer, Boomerang grab, drag dredge, Water sampler – Nansen water sample – Reserving thermometer Bathy thermograph - secchi Disk. Probing the sea floor – Echo sounding, Seismic shooting, Seismic refraction and reflection, satellite imagery. Physical and chemical properties of ocean water. General oceanic circulation of water-waves and currents, Long shore, rip and turbidity currents. Geological work of waves and currents – Tsunami, origin and their prediction. Ocean pollution. Natural mineral resources of the ocean.

UNIT – V:

Topography and origin of the continental shelf and continental slope. Characters and origin of submarine canyons, characteristics of oceanic trenches and mid oceanic ridges. Seafloor Spreading Seamounts and Guyots, Classification of coral reefs and their characteristics. Theories atoll formation. Eustatic changes of sea-level (Plate tectonics and origin of ocean basin. Law of the sea and its implications.

REFERENCES:

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. Fleming, Jhonsons & Strurup Oceans
6. Shepard, F.P., 1960 Earth, beneath the sea, OUP.
7. Petti John, F.S., 1965 Sedimentary Rocks.
1. Lobeck, A.K.- 1932 Geomorphology,McGraw Hill.
2. Ordway, R.J. – 1971 Earth Sciences, Affiliated East – West.
3. Pitty,A.F. –1972 Introduction to Geomorphology, Methuen.
4. King.L.C. – 1962 Morphology of the Earth, Oliver and boyd.
5. Woolridge S.W. & Margan R.S. 1952 – An outline of Geomorphology, Longmans
6. Sparks, b.W. – 1961 Geomorphology, Longmans.
7. Bloom, A.L. –1979 Geomorphology, Prentice Hall.
8. Turekian 1968 Oceans, Prentice Hall.
9. Menard, H.W., 1977 Ocean Sciences – Readings from Scientifica American, Freeman.
10. Kind, A.H., 1979 Introduction to Marine Geology and Geomorphology, Edward Arnold.
11. Richard John Huggett,2016, Fundamentals of Geomorphology,Taylor and francis, Fourth edition
12. Shrikant karlekar, 2019, An introduction to Physical Geography ; Geomorphology, Diamond Publications
13. Vishwas kale Avijit Gupta 2018 Introduction to Geomorphology, The orient black swan Publications
14. Michael A. Summerfield, 2011 Geomorphology and global tectonics, John Willey Publications
15. Siva Nand Jha,2021, A Handbook of Geomorphology, Shree Navman Publications
16. Andrew Goudie and Heather Viles, 2010, Landscapes and Geomorphology, Oxford University Press
17. Ajit kumar sil, 2021, Global tectonics and Geomorphology, Himalayan books
18. KeenM.J., 2011, An introduction to marine Geology, Pergamon press
19. Eugen seibold,Wolfgangberger, 2018, The seafloor:an introduction to marine Geology, Springer, Berlin

COURSE OUTCOMES:

- Get an idea about the morphological characters in the marine environment
- Fundamental ideas about the formation of different morphological features in marine environment
- Discuss about scope, fundamental concepts and significance of Geomorphology
- Describe about the characteristic features of land forms and its origin
- Application of Geomorphology in ground water, mineral and oil exploration and Engineering projects
- Discuss about the natural mineral resources of ocean
- Able to understand the importance of lands forms and its interaction with various geological agents.
- Able to understand the usage of recent developments in marine science research and Geomorphic concepts.

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First Year **CORE COURSE II** **Semester I**

GEOTECTONICS AND STRUCTURAL GEOLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To study in detail on origin of earth and its structure
- To get an idea on structural and tectonic features
- To understand the mechanical principles of rock deformation
- To understand the modes of representation of rock structure
- To know about the petrofabric analysis

UNIT – I:

Geotectonics: Study of seismic waves – structure and composition of the earth – Radioactivity – radiometric dating. Volcanism – Volcanic zones of the earth. Major tectonic features of the earth-shield areas, mobile, zones, rift Valleys, mid oceanic ridges, continental shelves and slopes, submarine Canons.

UNIT – II:

Geosynclines, Isostacy, Island arcs, deep Sea trenches, continental drift, plate tectonics and sea floor spreading. Orogeny and orogenic cycles – Epeirogeny and evolution of plateaus. Structural and tectonic features of India. Quaternary tectonics

UNIT – III:

Structural geology: mechanical principles – three stages of rock deformation – elastic, plastic and rupture. Concept of stress, strain and the resulting ellipsoids. Mechanics of plastic and ruptural deformation. Factors controlling behavior of rock material. Folds – Brief resume of terminology, Classification and description – Recognition, mechanics and causes of folding – Recognition of top and bottom of beds.

UNIT - IV:

Faults – Description, classification, recognition criteria and mechanics of faulting. Joints in Quantitative and qualitative classification of joints. Modes of representation of joints – Histograms, Rose diagrams and preparation of stereo grams. Unconformities – types, recognition, significance, distinction from faults and their use in dating structural events.

UNIT – V:

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 chacteristics of Tectonites, Diapirs and related structural features. Writing of field Geological report.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

To discuss about Neotectonics and its impacts

REFERENCES:

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. Beloussov, 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.
7. Lahee, H. 1959 – Field Geology, McGraw Hill.
8. Ragan, D.M. – 1973 – Structural Geology, Wiley
9. Ramsay, J.G. 1967 – Folding and fracturing of Rocks. McGraw Hill
10. Philips, F.C.1954 – The use of Stereographic projection in Structural Geology, Arnold Publishers
11. Compton, R.R. – 1962 – Manual of field geology, Wiley
12. Allan Cox 1973 - Plate tectonics, Freeman &co.
13. Ajit k sil,2018, Geotectonics and geomorphology vol 1,The himalyan books
14. Tarling,1981, Economic Geology and geotectonics,Halstead Press
15. Palmer andredw ,2022 , Structural Geology and tectonics , Oxford book company
16. Hatcher, Robert d Christopher Bailey, 2019 ,Strtuctural Geology, principles, concepts and problems , Oxford univ press
17. Pearson , 2017,Basic methods of structural geololgy, Pearson education

COURSE OUTCOMES:

- Give an idea about the various structural features associated with different tectonic process
- Structural Geology will help to find out the engineering problems mainly in the case of Dams,Reservoirs,bridges,roads
- Describe the nature and principles of plate tectonics and related crustal deformation.
- Critically evaluate the evidence for the operation of plate tectonics, e.g. in the Archaean Superior and Nain Provinces, in the Palaeoproterozoic Lapland-Kola Orogen, Lewisian Complex and Svecofennian Province and in the Meso- to Neoproterozoic of Laurentia-Baltica.
- Discuss about the different stages of rock deformation,origin of different natural hazards.
- Describe the main tectonic features and processes associated with a selection of orogenic belts.
- To demarcate the underground water resources.
- able to understand the concept of hydraulic conductivity and hydraulic head sufficiently in order to construct a water table map and interpret the basic physics of groundwater flow based on a water table map.

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First Year **CORE CHOICE COURSE I** **Semester I**

1. STRATIGRAPHY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know about the stratigraphic principles
- To understand the geology of India
- To know the stratigraphic importance of Precambrian formations
- To understand the stratigraphic formations Vs Geological Time
- To study the importance of Age and boundary problems.

UNIT – I:

Principles of Stratigraphy, Geological Time Scale – methods of correlation – Homotaxis and Contemporeinity – Stratigraphic, terminology, nomenclature and classification – Concepts of Stratotypes – causes of imperfections of geological records. Global Stratotype Section and Point (GSSP).

UNIT – II:

Lithostratigraphy, Biostratigraphy, chronostratigraphY, seismic stratigraphy, chemo stratigraphy, Magneto stratigraphy, Sequence stratigraphy. Geomorphic and tectonic divisions of India.

UNIT – III:

Pre Cambrian formations in India – Cuddapah and Vindhyan Super Group – Cambrian of Salt Range – Permo–Carboniferous of Salt Range.

UNIT – IV:

Gondwana rocks with special emphasis on fossils,climate and economic importance. Triassic of Spiti, Jurassic of Kutch and Cretaceous of Trichinopoly. Tertiary of Assam. Siwalik rocks. Deccan traps – inter and infra traps – Tertiary and Quaternary formations

UNIT – V:

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 – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Recent researches in Stratigraphic studies.

REFERENCES:

1. Krishnan, M.S. 1956 – Geology of India and Burma, Higgin bothams.
2. Wadia, D.N. 1953 – Geology of India , Mc Millan

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. V.J. Gupta – Indian Paleozoic Stratigraphy
6. V.J. Gupta – Indian Mesozoic Stratigraphy
7. V.J. Gupta – Indian Cenozoic Stratigraphy
8. V.J. Gupta – Indian Precambrian Stratigraphy
9. Andrew miall, 2007, stratigraphy. a modern synthesis, springer
10. Wiley,2008 ,Principles of Stratigraphy, wiley
11. Eduardo oupsoukos, 2005, Applied Stratigraphy, springer science and business media
12. Paul ley, 2019 Introducing Stratigraphy, dunedin academic press
13. Omer elitok ,2012,stratigraphic analysis of layered deposits
14. Michael brookfield ,2004,Principles of Stratigraphy, wiley

COURSE OUTCOMES:

- Acquisition of technical vocabulary related to the Stratigraphy Acquisition of concepts related to the Stratigraphy
- Gaining knowledge about different stratigraphic principles and causes of imperfections of geological records
- Describe about geological formations in India and stratigraphic importance
- Able to understand recent developments in Stratigraphy

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First Year **CORE CHOICE COURSE I** **Semester I**

2. PALAEONTOLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To acquire knowledge on geological significance of fossils.
- To understand the concept of evolution
- To know the stratigraphic importance of different fossils
- To understand the Vertebrate evolution through Geological Time
- To study the importance of applications of Microfossils.

UNIT – I:

Fossilization and fossil record Fossil-definition and conditions of fossilization; Mode of preservation and geological significance of fossils.

UNIT – II:

History of the concept of evolution – Pre-formation theory; Baer's law; Biogenetic law; Lamarckism; Darwinian principles- Natural, Sexual and artificial selections; Theory of pangenesis; Mutation theory; Orthogenesis; Isolation.

UNIT – III:

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 – IV:

Principal groups of vertebrates through geologic time – Devonian fishes and Mesozoic reptiles. Evolutionary histories of Horse, Elephant and Man.

UNIT – V:

Types of microfossils – General morphology, Stratigraphic, ecological and palaeoecological significance of foraminifera, Ostracoda and spores and pollens – Procedures for Sampling and separation of microfossils. Use of micropalaeontology in environmental, oil and marine studies.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Recent researches in Stratigraphic studies.

REFERENCES:

1. Woods, H. 1959 – Invertebrate Palaeontology, Cambridge.
2. Romer, A.S. 1960 – Vertebrate Palaeontology, Chicago press.
3. Amold, C.A. – 1947 – An introduction to palaeobotany.

4. Shrock. R.R. and Twenhofel , W.H – 1953 – Principles of invertebrate Palaeontology, Amold publication
5. Moore, R.C. Lalieker, C.D. and Fischer, A.G – 1952 – Invertebrate Fossils Mc Graw Hill.
6. Jones. D.J – 1958 – An introduction to Microfossils, Harper brothers
7. G.Bignot (1985) - Elements of Micro palaeontology Graham Trotman, 1985.
8. B.U. Hag and A. Boersma (1978) Introduction to Marine Micropalaeontology. Elsevier, Netherlands, 376 P.
9. David bainbridge ,2022,paleontology and illustrated history, Princeton university press
10. Charles eastman, 2020, textbook of paleontology , alpha editions
11. David harper and michael benton, 1997,basic paleontology, prentice hall
12. Michael benton, 2019, dianosarus rediscover .the scientific revolution in paleontology, thames and Hudson.

COURSE OUTCOMES:

- Acquisition of concepts related to the Fossilization and its significance.
- Gaining knowledge about concept of evolution.
- Acquisition of Knowledge on stratigraphic importance of vertebrates
- Understood about types and importance of microfossils.

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First Year	**CORE PRACTICAL I PALAEONTOLOGY, STRUCTURAL GEOLOGY AND REMOTE SENSING**	**Semester I**
Code:	**(Practical)**	**Credit: 3**

COURSE OBJECTIVES:

- To study the evolutionary characteristics of different fossils in hand specimens.
- To study the preparation structural set up.
- To understand the techniques involved in Satellite date interpretation.

PALAEONTOLOGY:

Magascopic study of corals, Graptolites, Triobites, Brachiopous, Lamelle branches, Gasterpous, Ammonites and Echinoderms with special reference to their evolutionary characters. Study of plant fossils. Micro-scopic study of some forms 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 determinatio of attitude of tabular bodies(interpretation of lithological data from inclined boreholes, preparation of Latitudinal vertical sections measurement of bore hole devictions.)

REMOTE SENSING:

Elementary exercises relating to photogrammetry, use of pocket and mirror steroscopes, photo scale, overlap, side lap height measurements, annotation of aerial photographs; Interpretation lithology geological structures, landforms, drainage network, landuse/land cover features; generation of digitally enhanced products and feature extraction.

Current Contours (For Continuous Internal Assessment only):

New mapping tools and Hyperspectral remote Sensing.

COURSE OUTCOMES:

- Hands-on exercise to identify fossils
- Hands-on exercise to find out trends of rocks starata
- Hands-on exercise of toposheets and satellite images
- To understand the interpretation of Remote Sensing data,
- To get idea on different structures in the field and map
- Able to understand the scope and importance of microfossils
- To know how to identify fossils and which are the utilities of Palaeontology
- Role of remote sensing in natural resource mapping and management

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First Year **ELECTIVE COURSE I** **Semester I**

1. REMOTE SENSING

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To understand the energy interaction in the atmosphere
- To know about satellite Remote Sensing and its importance
- To understand the data interpretation using satellite images
- To know about the concept of Digital Image Processing
- To study the applications of Remote Sensing different fields

UNIT – I:

Fundamentals of Remote Sensing: Electromagnetic spectrum –Stefan Boltzman's law – Blackbody – Wien's displacement law - Energy interaction in the atmosphere, Energy interaction with the earth's surface features.

UNIT - II:

Satellite Remote Sensing: History of space imaging; Types of satellites - Scanning systems and Detectors: Across-track and along-track scanning systems, Plat forms, Sensors and their resolutions: spatial, spectral, radiometric and temporal.

UNIT - III:

Satellite Data Interpretation: Visual interpretation: Elements of photo and image interpretation, interpretation strategies and keys.

UNIT - IV:

Digital image processing: Image rectification and restoration; Geometric correction, radiometric correction, noise removal; Image enhancement; spatial filtering, edge enhancement. Image classification: Supervised classification - Unsupervised classification; Data merging and GIS integration.

UNIT - V:

Remote sensing application for lithological and structural mapping, geomorphological studies, mineral exploration, groundwater exploration, landslides, floods and soil erosion.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only)

LIDAR – Hyperspectral Remote Sensing

REFERENCES:

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
7. Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford

a. Barrett, E.C and C.F. Curtis (1982). Introduction to environmental remote sensing. Chapman & Hall publishers, New York.

8. Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
9. Bruno Marcolongo and Franco Mantovam (1997). Photogeology – Remote sensing applications in earth sciences, Oxford & IBH Publishers Co. Pvt. Ltd., New Delhi
10. Rampal, K.K (1999). Handbook of aerial photography and interpretation. Concept Publishers Company, New Delhi.
11. Jean Yves Scanvic (1997). Aerospatial remote sensing in geology. Oxford & IBH Publishers Co. Pvt. Ltd.
12. Agarwal, C.S and Garg, P.K (2000). Textbook on remote sensing in natural resources monitoring and management, Wheeler Publishing Company Ltd., New Delhi
13. Narayan, L.R.A (1999). Remote sensing and its application. Universities Press Ltd., Hyderabad.
14. Basudeb bhatta, 2011, Remote sensing and gis, OxfordPublications
15. George joseph and Jegannadhan,2018, Fundamentals of remote sensing, The orient black swan
16. Bhatia, 2021, Fundamentals of remote sensing, Atlantic publications
17. Patel and Surendra singh, 2013, Remote sensing principles and applications, Scientific publishers
18. Matt weilberg, 2016, Photogrammetry and Remote sensing, Syrawood publishing house
19. Simon jones, 2009,Innovations in remotesensing and Photogrammetry, Springer publications
20. Pushpam prakash,2021,Introduction to satellite Photogrammetry
21. Michael kasser, 2002, Digital photogrammetry, Taylor and francis
22. Kali charan sahu,2021,Textbook of remote sensing and geographical information systems, Atlantic publications

COURSE OUTCOMES:

- Understood the concept of Energy Interactions in the Atmosphere and with the Earth's surface features.
- Gaining knowledge on different satellites and its products
- Acquisition of knowledge on Data acquisition Procedures
- Data interpretation keys and elements
- Application of Remote Sensing in various Geological resources targeting.

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First Year **ELECTIVE COURSE I** **Semester I**

2. ENVIRONMENTAL GEOLOGY

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To understand the Sources and inducing factors of disasters.
- To understand the consequences of natural disasters
- To study the different management plans for natural hazards and disasters.

UNIT – I:

Introduction: An Overview of sources of disasters: internal sources of energy – external sources of energy – energy circulation and human risk – human fatalities through geological time.

UNIT – II:

Landslides: Causes of Landslides, landslides induced by human activity, factors influencing slope stability, hazards related to landslides, landslide disaster management planning and role of geology, case studies. Soil Erosion: Soil formation processes, soil profiles, soil horizon, soil properties, soil classification, causes of soil erosion, consequences of soil erosion, strategies for reducing soil erosion and role of geology, case studies

UNIT – III:

Earthquakes: Causative factors, Seismic waves, earthquake strength, distribution, seismicity in the Indian region, earthquake related hazards, earthquake disaster management planning and role of geology, case studies. Volcanic eruption: Magma sources and types, causative factors, distribution and types of volcanoes, hazards related to volcanic eruption – Disaster management planning and role of geology, case studies

UNIT – IV:

River Flooding: Causes and factors influencing flood severity, flood characteristics, stream hydrographs, flood frequency curves, flood hazards, flood disaster management planning and role of geology, case studies.

UNIT – V:

Coastal zone processes, hazards related to coastal zones – coastal erosion, coastal flooding, sea water intrusion, coastal pollution, strategies for reducing environmental problems associated with coastal zones and role of geology, case studies. Tsunamis – origin, significance and prediction.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Role of Geology in disaster management

REFERENCES:

1. Todd, D.K. 1959- Ground water Hydrology, Wiley
2. Tolman, C.F. – 1937, Ground water, McGraw Hill
3. Ragchunath, H.M. - 1983 - Groundwater, Wiley Eastern
4. Davis, S.N. and Dewiest, R.J.M, 1966-- Hydrology, Wiley
5. Keller, E.A (1976).Environmental Geology. Charles E. Merril Publishers, New York
6. Lundgren, L (1986). Environmental Geology. Prentice-Hall Publishers, New Jersey
7. Strahlfer, N, and Strahler, A.H. - 1973 - Environmental Geosciences Wiley Eastern
8. Davis *et.a1*. - 1976 - Environmental Geoscience, Wiley Eastern
9. Howard, A.D &Irwin Remson (1978). Geology in Environmental Planning. McGraw-Hill Publications, New York
10. Coates, D.R (1985). Geology and Society. Cahpman and Hall Publishers, New York
11. Miller, G.T.Jr. (1994). Living in the Environment – Principles, Connections and Solutions. Wadsworth Publishing Company, California.
12. Sinha and Pankaj Srivastava (2000). Earth Resources and Environmental
13. Issues, ABD Publishers, Jaipur
14. Meinzer.O.E - 1962 - Hydrology, Dover
15. Garg, S.P. - 1982 - Groundwater and Tube wells, Oxford and IBH
16. Fox, C.S. - 1949 - Geology of Water supply, Technical Press
17. Frederick Betz, J.R. - 1975 - Environmental Geology -Benchmark papers in Geology, V.25, Dowden.
18. Abbott, P.C (2002). Natural Disasters, McGraw-Hill Publications, New Delhi
19. Montgomery, C.W (2000). Environmental Geology, McGraw-Hill Publications, New Delhi
20. Valdiya, K.S (1987). Environmental Geology – Indian Context. Tata McGraw-Hill Publishing Company Ltd., New Delhi
21. erach bharuca , third edition ,textbook of environmental studies, orient blackswan
22. knodel , 2020,environmental Geology, springer
23. ved verma, kataria & sons , 2019,environmental studies and disaster management, s.k.kataria & sons
24. srivastava , 2019,text book of disaster management, scientific publishers
25. vaidhyanadhan, 2020,an introduction to disaster management natural disasters and man made hazards , cats publisher
26. sanjay sharma , 2011,environment engineering and disaster management , university science press

COURSE OUTCOMES:

- Give an exposure about different kinds of disasters
- Acquisition of knowledge about role of geology in disaster management
- Discuss about the different mitigation strategies

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First Year **VALUE ADDED COURSE I** **Semester I**

WATER RESOURCES MANAGEMENT

Code: **(Theory)** **Credit: 2***

COURSE OBJECTIVES:

- To know and understand the importance of water
- To gain knowledge about water conservation
- To learn different strategies for water resources management.

UNIT – I:

Introduction – Scope and advantages of Groundwater- Aquifer- Infiltration - Water table – forms of water.

UNIT – II:

Hydrologic cycle- sources of Groundwater- Origin and occurrence of groundwater. Water conservation Groundwater potential zones demarcation.

UNIT - III:

Drainage – types of drainage – quantitative drainage morphometry assessment.

Unit – IV:

Water harvesting - Rainwater harvesting - Groundwater harvestingmethods of harvesting-Rural and Urban.

UNIT – V:

Water Quality – standards of water for different uses- Drinking purposesIrrigation purposes- Industrial purposes. Water Pollution- Introduction- Types of pollution-controlling methods

REFERENCES:

Arul.P (2000) A text book of Ground water, Dhanam Agency, Virudhachalam 2nd
Raghunath H.M (2015) Hydrology 3 Ed. New Age International publisher.
Todd, D.K. (1980).Groundwater Hydrology, John Wiley and Sons

COURSE OUTCOMES:

Students will gain knowledge over the water resources
They know about different harvesting system.

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First Year **CORE COURSE III** **Semester II**

ADVANCED CRYSTALLOGRAPHY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To Study about crystal classes and projection types.
- To know about the irregularities in crystals.
- To understand about formation of different crystal systems.

UNIT – I:

Symmetry elements in Crystals - Space Lattice: Definition types and features – 14 Bravais lattices derivation- Schoenflies, Hermann and Maugin notation. Derivation of 32 Crystal classes and their symmetry projections – Spherical, Stereographic and Gnomonic projections.

UNIT – II:

Crystals belonging to normal classes. Calculation of crystal elements using inharmonic ratio- tangent relation, Napier's theorem and equation to normal.

UNIT – III:

Symmetry elements and classes of the following systems: Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinc and Triclinic.

UNIT – IV:

Symmetry elements and classes of the following systems: Orthorhombic, Monoclinc and Triclinic.

UNIT – V:

Crystal growth, Irregularities in crystals. Twins: Simple and contact twins, Interpenetration twins, polysynthetic twin. Twin laws.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

To discuss about instruments used for crystal growth and x-ray crystallography.

REFERENCES:

1. Dana, E.S. – 1955 – Text Book of mineralogy, wiley
2. Wade, F.a. and mattox, R.E – 1960 – Elements of crystallography and Mineralogy, Harmer and brods.
3. Philips, P.C. – 1956 – An introduction to Crystallography, Longmans Green & co.
4. Wahiatrom, E.E, - 1960 – Optical Crystallography, Wiley.
5. Burerger, M.J. – 1956 – Elementary Crystallography, Wiley

6. Naidu, P.R.J. – 1958 – 4-Axes universal stage, commercial printing and publishing house
7. Haribury, C.S. – 1971 - Dana's Manual of Mineralogy, Wiley.
8. Christopher hammond , 2001,basics of crystallography and diffraction , oxford university press
9. Frank hoffman , 2020,introduction of crystallography, springer international publishing
10. Klaus herman , 2017,crystallography and surface structure (second edition), wiley
11. Kelly ,groves ,kidd , 2000,crystallography and crystal defects, wiley
12. Donald sands , 1978,introduction of crystallography, benjamin cummings
13. Walter borchardt-ott , 2011,crystallography (third edition), springer berlin heidberg.

COURSE OUTCOMES:

- Acquisition of knowledge about different crystals systems
- Understood about the irregularities crystals
- Able to understand about recent developments in crystallography

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First Year **CORE COURSE IV** **Semester II**

MINERALOGY AND MINERAL OPTICS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know about the Mineral formation
- To know about the structural classification of silicate minerals
- To understand the optical properties of different minerals

UNIT – I:

Structural classification of silicate minerals – Isomorphism – Exsolution – Order, disorder relations – Polymorphism = Pseudomorphism- Fluorescence in minerals – Metamict state – Staining techniques and micro chemical tests. Description of chemistry, optical and physical properties, and paragenesis of the following: ortho and ring silicates; olivine group, Garnet Group,

UNIT – II:

Aluminosilicates, Epidote group, Zircon, Sphene, Topax, Staurolite, Beryl, Cordierite and Tourmaline. Chain silicates – Pyroxene group, Amphibole group and Wollastonite. Sheet silicates – Mica group, chlorite group and clay minerals. Tekto silicates – Quartz group, feldspar group, feldspathoids and zeolites. Description of chemistry, optical and physical properties and paragenesis of the following: Apatite, Fluorite, Corundum, Spinet and Calcite.

UNIT – III:

Polarisation – Optical properties of crystals – optical ellipsoids – polarizing Microscopes and accessories – Quartz wedge – Mica plate – Gypsum plate – Berek compensator – Micrometer ocular. Determination of Refractive indices of minerals by immersion method.

UNIT – IV:

Uniaxial minerals – double refraction in calcite – Nicol prism – optic axis – Primary and secondary optic axes; Ray velocity surface – Uniaxial indicatrix – optic sign; interference colour – interference figure – crystal orientation – extinction – Extinction angle - - Sign of elongation - Pleochroism – Birefringence.

UNIT – V:

Biaxial minerals – Biaxial indicatrix – optical directions – Primary and secondary optic axes – optic axial angle – Mallard's formula – optic sign – crystallographic orientation – interference figures – Sign of elongation – Extinction – Extinction angle – Pleochroic scheme- Birefringence optical anomalies – Dispersion. U stage techniques for determination of Anorthite content and twin laws in Plagioclase – optic orientation

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Newly excavated mineral deposits and its geological significance. .

REFERENCES:

1. Dana, E.S. – 1955 – Text Book of mineralogy, wiley
2. Wade, F.a. and mattox, R.E – 1960 – Elements of crystallography and Mineralogy, Harmer and brods.
3. Philips, P.C. – 1956 – An introduction to Crystallography, Longmans Green & co.
4. Winchell, A.N. – 1968 – Elements of optical Minerology, parts, I & II Eiley Eastern
5. Wahiatrom, E.E, - 1960 – Optical Crystallography, Wiley.
6. Berry, L.G. and Mason Brain, W.HY. – 1961-Mineralogy, Freern
7. Deer, W.A. Howie, R.A. and Zussman, J- 1966 – An introduction to the Rock forming minerals, Longmans.
8. Burerger, M.J. – 1956 – Elementary Crystallography, Wiley
9. Naidu, P.R.J. – 1958 – 4-Axes universal stage, commercial printing and publishing house
10. Heinrich, E.W. – 1965 – Microscopic identification of Minerals McGraw Hill
11. Naidu, P.R.J. C.S. – 1971 – Johansen's optical mineralogy, Allied
12. Haribury, C.S. – 1971 - Dana's Manual of Mineralogy, Wiley.
13. Deer, W.A. Howie, R.A. & Zussman, J-1962 – Rock forming MineralogyVols. 1 to 5, Longmans.
14. Grim,R.N. – 1953 – Glay Mineralogy , McGraw Hill
15. Goger, R.G and kerr, P.F. – 1942 – optical Mineralogy, McGraw Hill.

COURSE OUTCOMES:

- Got detailed idea about the process of formation of different group of minerals and crystals
- Understood the geological distribution of mineral deposits
- Describe about both megascopic and microscopic characteristics of minerals
- Understood about the structural classification of silicate minerals and non silicate minerals
- Gain knowledge on chemistry, optical and physical properties and paragenesis of different minerals.

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First Year **CORE CHOICE COURSE II** **Semester II**

1. GEOPHYSICAL EXPLORATION TECHNIQUES

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To Understand geophysical principles and concepts
- To get exposure with instruments used in the mineral exploration.
- To gain knowledge on the field conditions and interpretation of geophysical data.
- To know the different techniques in identifying the resources and the interpretation of geophysical data.

UNIT – I:

Scope and historical development of Geophysics- geophysical exploration methods- limitations- problem of ambiguity in geophysical interpretation Gravitational field of Earth. Measurement of gravity- types of gravimeter- Field Procedure. Reduction of gravity data-Interpretation of gravity anomalies and interpretation. Applications of gravity method in mineral exploration.

UNIT – II:

Electrical methods: Self potential method, Instruments, Field procedure. Resistivity method- Instruments, Field procedure, Interpretation. Electrical Resistivity Tomography concepts. Electromagnetic methods-Magneto-Telluric method -Induced Polarization Methods-Applications of electrical methods.

UNIT – III:

Earth's Magnetism and their concepts- Types of Magnetism, Magnetic measurements: Instruments-Field procedure- Corrections and reduction of data-Magnetic anomaly maps-Interpretation. Applications of magnetic methods in mineral exploration.

UNIT – IV:

Elements of earthquake seismology; seismic waves, seismic sources, faulting source, Principles of reflection and refraction methods-Instruments and equipments-Operational methods-weathering and elevation corrections. Interpretation of a refraction seismic data by graphical and analytical techniques. Seismic reflection data processing.

UNIT – V:

Well logging principles and concepts. Open hole, cased hole and production logging; Electrical logs; lateral, latero, induction, S.P porosity logs. Principles of Radioactivity- sonic, density, neutron, natural gamma logging while drilling.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

LIDAR, GPR and other contemporary techniques related to Geophysical exploration.

REFERENCES:

1. Dobrin, M.B. (1960), Introduction to Geophysical prospecting, , Mc Graw Hill Book Co., New Delhi.
2. Mathew N.O, Sadiku, 2007.Elements of Electromagnetics,., Fourth edition, Oxford University Press.
3. Parasnis, D.S. (1975). Principles of Applied Geophysics, Chapman and Hall. Pacal, 2nd Ed. 1977.
4. Stanislane, M. (1984), Introduction to Applied Geophysics, Reidel Publishers. New York.
5. Ramachandran Rao, M.B. (1975), Outlines of Geophysical prospecting (A Manual for Geologists) Prasa Ranga, University of Mysore,
6. Sharma, P.V. (1986), Geophysical methods in Geology, Elsevier
7. Stanislane, M. (1984), Introduction to Applied Geophysics, Reidel Publishers.
8. Telford.W.M, Sheriff, R.E., Gelot, L.P, (2001), Applied Geophysics (Second Edition) Cambridge University press. London.

COURSE OUTCOMES:

- Students will gain knowledge about various instruments used in geophysical exploration for resource targeting.
- Students will understand logging principles and concepts.
- Exposed to analysis and interpretation of different geophysical data.

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First Year **CORE CHOICE COURSE II** **Semester II**

2. GEOCHEMICAL EXPLORATION TECHNIQUES

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know understand the principles and concepts of geological and geochemical explorations.
- To understand sampling and sample preparation methods.
- To gain knowledge on the field conditions and interpretation of geochemical data.

UNIT – I:

Geological Exploration Techniques: Reconnaissance Vs detailed mapping, surface mapping. Degree of precision, choice of scales, isolation of outcrops. Sampling: general principles. Methods of sampling: channel, chip, grab, pitting, trenching, digging. Sampling errors and precautions.

UNIT – II:

Mineralogical guides. Rock alteration: nature of alteration, target rings of mineral distribution. Stratigraphic and lithological guides, reasons for favourability, competent Vs incompetent formations. Fracture pattern as guides: (Structural guides) vein patterns. Contacts and folds as guides: folds younger than the ore; folds older than ore; dislocated ore bodies. Physiography in relation to oxidation and enrichment. Residual ores, supergene sulphide zones

Unit – III:

Geochemistry, Introduction, definition, aim and scope. Origin and abundance of elements. Distribution of elements in lithosphere. Geochemical cycle-Geochemical classification of elements. Geochemical differentiation of elements in exogenic and endogenic cycle. Redox reactions and Eh-pH diagrams and their applications.

UNIT – IV:

Geochemical Exploration: Introduction, Principles of geochemical exploration, geochemical environment. Study of geochemical dispersion, mobility, geochemical association. Methods of surveying and sampling: Anomalies, background value, threshold value, path finder elements.

UNIT – V:

Methods of geochemical exploration: (a) Lithogeochemical prospecting (b) Hydrogeochemical prospecting (c) Biogeochemical prospecting (d) Geobotanical prospecting. Anomalies in Residual overburden. Leached ore outcrops, Gossans and Residual soils transported overburden. Geochemical anomaly map and interpretation of data. Geochemical trace element indicators and their significance.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

The importance of XRF-ICPMS-AAS.

REFERENCES:

1. Fyfe, W.S.1964, Geochemistry of solids. Mc Graw Hill Book Co.,
2. Goldschmidt, V.M.1954, Geochemistry, Oxford University press. 26
3. Krauskopf..K.B , 1986, Introduction to geochemistry, , Mc Graw Hill.
4. Mason, B.1971, Principles of Geochemistry, John Wiley & Sons.
5. Mason,B. and Moore.C.B. 1991, Introduction to Geochemistry, Wiley Eastern
6. Rankama and Sahama, (1950), Geochemistry, University of Chickago Press,
7. Misra K.C. (2005) Introduction To Geochemistry: Principles And Applications. Wiley India.
8. William M. White(2013)Geochemistry. Wiley-Blackwell.
9. H.E. Hawkes, J.S. Webb. 1979. Geochemistry in Mineral Exploration,: Academic Press, London
10. Jenners, 1987. Geochemical exploration, Universal Books Distributors Co.,
11. Kovalevskii, A.L. 1979, Biogeochemical exploration for mineral deposits, Oxonian press.
12. Arthur Brownlow 1982, Geochemistry, Prentice Hall

COURSE OUTCOMES:

- Students will gain knowledge over sampling principles and geochemical survey techniques.
- Students will understand various guides for geochemical explorations.
- Understand the various geochemical element distributions.
- Exposed to analysis and interpretation of different geochemical data.

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First Year	**CORE PRACTICAL II**	**Semester II**
	CRYSTALLOGRAPHY AND MINERALOGY	
Code:	**(Practical)**	**Credit: 3**

CRYSTALLOGRAPHY:

Sterographic and Gnomonic projections of natural crystals of normal classess-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 cantact 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 blaxial minerals, sign of elonation optic axial angle by Mallard's method and anorthite content of oriented sections of plagioclase. Identification of pinacoidal sections of pyroxenes and Amphiboles, Determination of Anorthite content and twin laws in plagioclase by stage method.

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First Year	ELECTIVE COURSE II 1. MINING GEOLOGY	Semester II
Code:	(Theory)	Credit: 4

COURSE OBJECTIVES:

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- To study the different sampling techniques
- To find out the factors controlling the choice of various mining methods

UNIT – I:

Mining terms and their descriptions. Sampling - Principles – Types of sampling – Collection & preparation of samples. Assaying and evaluation of ore-bodies and their extensions-ore reserve estimation.

UNIT – II:

Drilling: Types of drills – methods of drilling – geological logging. Explosives-Blasting – Rock excavations. Methods of stoping. Ventilation. Haulage. Shafts and shaft sinking.

UNIT – III:

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 – IV:

Subsurface mining (or) Under ground mining;-Stoping : Open stopes – supported stopes, shrinkage stopes. Caving;-Top slicing-sub level caving –block caving. Ground water control – Mine ventilation

UNIT – V:

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 - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Contemporary methods for excavation of ores.

REFERENCES:

1. Arogyaswamy, R.N.P. 1973 Courses in Mining Geeology,Oxford &IBH, New Delhi.
2. Higham, S 1951 An introduction to Metalliferous mining, Lord

3. Gokhale, K.V.G.K and Rao, T.C. 1978 Ore deposites of India distribution and processing, Thomson.
4. Mc Kinstry, H.E 1960 Mining Geology, New york.
5. Gauding, A.M. 1939 Principles of Mineral Dressing, McGraw Hill.
6. Thamus, P.J. 19790 An introduction to mining, Methun.
7. Taggart, A.E. Elements of ore dressing.
8. Stanton, R.L. 1972 Ore Petrology, Mcraw Hill.
9. AureleParriaux, 2009, Geology Basics for Engineers, CRC Press
10. Howardl.Hartman, 2002, Introductory Mining Engineering, John wiley& sons
11. James Park, 2013, A Textbook of Mining Geology for the use of Mining Students and Miners, General books
12. Marot Abzalov, 2016, Applied Mining Geology, Springer
13. Samuel John Truscott, 2018, A Text book of Ore Dressing, FB&C Limited
14. Robert Hallowell Richards, 2014, A Textbook of Ore Dressing –Primary source Edition, Bibliolife

COURSE OUTCOMES:

- Able to Demonstrate familiarity with a wide range of mineral deposits
- Gained knowledge about different mining methods.
- Understood about assaying and evaluation of ore bodies their extensions
- Able to discuss about factors controlling the choice of various mining methods.

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First Year **ELECTIVE COURSE II** **Semester II**

2. ENGINEERING GEOLOGY AND ORE DRESSING

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To know about the geological investigation pertaining to different fields of civil engineering
- To study the different techniques of ore beneficiation
- To find out instruments used for ore dressing

UNIT – I:

Engineering Geology: The role of Geology in Civil Engineering . engineering properties of rocks – Strength and elastic properties. Properties of building stones, concrete aggregates and rail road ballast. Types of earth movements – Land slides, their causes, Classification and preventive measures.

UNIT – II:

Types of Dams – Geological investigations of Dam sites. Dam construction - problems – remedial measures. Spill ways, reservoir problems. Tunnels: problems relating to tunneling in hard and soft grounds.

UNIT – III:

Geological investigations proceeding tunneling. Geological investigations pertaining to bridges, buildings highways and airfields and coastal erosion.

UNIT - IV:

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.

UNIT – V:

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.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Discuss about recent technological developments in Engineering geology

REFERENCES:

1. Krynine, D.P. and Judd, W.R. 1957 principles of Engineering Geology and Geotochniques, Mcgraw Hill.
2. Legget, R.F. 1962 Geology and Engineering , McGraw Hill
3. Gokhale K.V.G.K and Rao, D.M .1981 Experiments in Engineering Geology, Mcgraw Hill.
4. Arogyaswamy, R.N.P. 1973 Courses in Mining Geeology, 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 deposites of India distribution and processing, Thomson.
7. Mc Kinstry, H.E 1960 Mining Geology, New york.
8. Fox, C.S 1949 Engineering Geology, New York
9. Blyth, F.C. 1979 A Geology for Engineers, ELBS
10. Gauding, A.M. 1939 Principles of Mineral Dressing, McGraw Hill.
11. Thamus, P.J. 19790 An introduction to mining, Methun.
12. Taggart, A.E. Elements of ore dressing.
13. Stanton, R.L. 1972 Ore Petrology, Mcraw Hill.
14. ChennaKesavulu, 2016, Textbook of Engineering Geology, Trinity press
15. AureleParriaux, 2009, Geology Basics for Engineers, CRC Press
16. David George Price, 2009, Engineering Geology (principles and practise), Springer
17. K.V.G.K.Gokhale, 2016, Principles of Engineering Geology, BSP Books Private Limited.
18. Howardl. Hartman, 2002, Introductory Mining Engineering, John wiley & sons
19. James Park, 2013, A Textbook of Mining Geology for the use of Mining Students and Miners, General books
20. Marot Abzalov, 2016, Applied Mining Geology, Springer
21. Suping Peng and Jincai Zhang, 2007, Engineering Geology for Underground Rocks, Springer
22. Beth Thorpe, 2016, Mining Geology Exploration and Management, Syrawood Publishing House
23. Samuel John Truscott, 2018, A Text book of Ore Dressing, FB&C Limited
24. Robert Hallowell Richards, 2014, A Textbook of Ore Dressing –Primary source Edition, Bibliolife
25. Tony Waltham Fred Bell and Marthin Cuishaw, 2007, Sinkholes And Subsidence Karst and Caverous Rocks in Engineering And Construction, Springer

COURSE OUTCOMES:

- Got knowledge about the role of geology in the Civil Engineering and type of earth movements
- Understood about the geological investigation in different field of civil engineering constructions
- Gained exposure about the principles of assaying and evaluation of ore bodies their extensions

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First Year	NON-MAJOR ELECTIVE COURSE I GEOLOGY FOR COMPETITIVE EXAMINATION I	Semester II
Code:	(Theory)	Credit: 2

COURSE OBJECTIVE:

- To learn about the basics of Geology, branches of Geology, Solar system, earthquake, volcanoes, continents and Ocean, tectonic process, mountains, major types of rocks and minerals.

UNIT – I:

Definition of Geology – Branches of Geology – The Solar system:– Origin of Earth - Nebular hypothesis – Planetesimal hypothesis – Tidal hypothesis – Von Weiszacker's hypothesis - Dust Cloud hypothesis - Big bang theory. Detailed study of the structure and composition of Earth's interior.

UNIT – II:

Earthquakes and Volcanoes: Definition — Focus and Epicenter – Magnitude and Intensity –seismic waves – Seismograph and Seismogram – Distribution of Earthquakes in India–Prediction of Earthquakes – Tsunami.

UNIT – III:

Volcanoes: Definition – Types, –Distribution of volcanoes, Causes of volcanism – Effects of Volcanic activity - Prediction of volcanoes.

UNIT – IV:

Distribution of continents and Oceans –Continental drift: Wegner's and Taylor's hypothesis-Merits and demerits of drift theories; Seafloor spreading- Concept of plate tectonics – Different kinds of plate margins.

UNIT – V:

Quartz and Feldspar group of Minerals, Origin of Igneous, Metamorphic and Sedimentary rocks and its distribution in Tamil Nadu.

UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment only):

Asteroids, meteorites, recent earthquake occurrences, volcanic eruptions-sealevel rise - Mineral wealth of Tamil Nadu.

REFERENCES:

1. Arthur Holmes (1992) Principles of Physical Geology: Thomas Nelson & sons London.
2. Philip G. Worcester (1939) A textbook of geomorphology: D. Van Nostrand co., London.

3. Radhakrishanan. V (1966).General Geology - V.V.P. Press.
4. Mahapatra, G.B.(2015) A text book of Geology(- CBS, Delhi
5. Patwardhan, A.M. (2012) The Dynamic Earth System - PHI Learning PVT. Ltd, NewDelhi
6. William J. Miller (1949) -Principles of physical Geology - Thomas Nelson & sons , London.
7. W. D. Thornbury (1969) A text book of geomorphology - D. Van Nostrand co., London.
8. A.L. Bloom (1978) General Geology - V.V.P.Press.
9. L.D. Leet & Judson (1960) Physical Geology - Prentice Hall, India.
10. Edger W. SpencerEarth Science (2002) -Mc Graw Hill, New Delhi.
11. Richard John Huggett, 2016, Fundamentals of Geomorphology,Taylor and francis, Fourth edition
12. Vishwas .s.kale and Avijit Gupta, 2018, Introduction to Geomorphology, The orient black swan Publications
13. Michael A.Summerfield, 2011Geomorphology and global tectonics, John Willey Publications
14. Siva Nand Jha, 2021, A Handbook of Geomorphology, Shree Navman Publications
15. Ajit kumar sil, 2021, Global tectonics and Geomorphology, Himalayan books.

COURSE OUTCOME:

- To know about the major geological process that happens in and around the earth.

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Second Year	**CORE COURSE V**	**Semester III**
	IGNEOUS PETROLOGY	
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

- To understand evolution of rocks and its petrogenetic significance
- To study the crystallization different magma
- To understand the petrographic provinces of magmatic rocks

UNIT - I:

Igneous activity at the present day – Magma types and their evolution at: The Ocean Floor, Island Arcs, Orogenic Continental Margins, Intracontinental Orogenic Belts, and other Continental provinces. Nature and Physical properties of Magmas. Forms and structures of intrusive and extrusive igneous rocks. Textures of Igneous Rocks - their evolution and petrogenetic significance.

UNIT - II:

Classification of Igneous Rocks: CIPW Norm, Niggli Values and Basis, IUGS – Streckeisen's Plutonic and Volcanic rocks classifications. Peacock's Alkali Lime Index and Classification based on Irvine and Baragar. Petrography and Petrogenesis of: Granite – Rhyolite Clan, Syenite – Trachyte Clan, Gabbro – Basalt Clan, Alkaline rocks, Anorthosites, Lamprophyres, Kimberlites, Komatiites, Carbonatites and Charnockite.

UNIT - III:

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 Unicomponent magma. Simple Eutectic (Albite-Silica), Solid Solution (Forsterite-Fayalite) and incongruent melting (Forsterite-Silica) behavior of Bicomponent melts. Ternary melt-systems of Diopside – Forsterite – Silica, Diopside- Albite – Anorthite and Anorthite – Forsterite – Silica. Effects of pressure, fluids and vapors (H_2O and CO_2) on melting and cooling behavior of silicate systems. Crystallisation of Basaltic magma.

UNIT - IV:

Magmatic Differentiation - Liquid immiscibility, Soret effect, Role of volatile components, Fractional Crystallization, Assimilation and Magma mixing - and their roles in magmatic differentiation. Field and laboratory evidences in favor and against the 'Reaction Principles' of Bowen and Osborn. Petrographic provinces of magmatic rocks. The diversity of magmatic rocks, their abundance and distribution on the earth's Crust.

UNIT - V:

Chemical petrology: Brief outline of Analytical methods of igneous rocks using Flame photometers, AAS, 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 and Trace elemental distribution in rocks and their application to igneous systems. Isotopes, and their geochemical criteria for discriminating between tectonic environments magmatic systems.

REFERENCES:

1. Tyrrell. G.W.(1963)- Principles of Petrology – Asia Publishing House.
2. Turner.F.J and Verhoogen.J –1960.- Igneous and Metamorphic petrology – McGraw Hill.
3. MacKenzie.W.S. et.al.,-(1982); Atlas of Igneous rocks and their textures – Longman.
4. Bowen.N.L.(1928)- The evolution of the Igneous Rocks. Dover Publications.
5. Middlemost. A.K.(1985) – Magmas and Magmatic Rocks.- LONGMAN.
6. McBirney.A.R.(1994) – Igneous Petrology – CBS Publishers and Distributors.
7. Raymond.L.A.-2002- Petrology – McGraw Hill.
8. Hall- A (1992) – Igneous Petrology – ELBS.
9. Barth, F.W. – 1962 – Theoretical Petrology, Wiley.
10. Shand –S.H.(1949)- Eruptive Rocks.
11. Morse.S.A – (1980)- Basalts and Phase diagrams –Springer – Verlag.
12. Winter. J.D.- (2001) – Igneous and Metamorphic Petrology –Prentice
13. fans carmicheal francis turner,1974,igneous petrology, mcgraw-hill
14. anthony hall , 1987,igneous petrology, longman scientic and technique
15. alexander of mc birnay , 2007,igneous petrology, jones and bartlet bearing
16. hugnes , 2013,igneous petrology ,elseiver
17. gupta , 2007,petrology and genesiss of igneous rock
18. francis turner john verhogen , 2004,igneous and metamorphic petrology, cbs publication and distribution
19. ronald frost , 2019,essengtials of igneous and metgamorphic petrology, cambridge university press
20. anthony philtopps jagagve , 2009,Principles of igneous and metamorphic petrology, cambridge university press
21. myronbest eric hchristansen , 2000,igneous petrology, wiley
22. lizhaonqi zianzhon gqi zhaonhin g zhing, 1997,igneous petrology, vsp
23. jyothishankar roy gautam sen biswajitb ghosh, 2010,topics in igneous petrology, springer
24. verlag berlin neddellorg , 1985,principles of igneous petrology, springer

COURSE OUTCOMES:

- Discuss about classification of Igneous rocks and petrography and petrogenesis
- To understand about principles and laws of thermodynamics
- Explain about crystallization of basaltic magma
- Discuss about petrographic provinces of magmatic rocks
- Discuss about diversity of magmatic rocks, their abundance and distribution on the earth's crust
- Demonstrate different analytical methods of igneous rocks using Flame photometers, AAS, XRF, ICP.

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Second Year **CORE COURSE VI** **Semester III**

SEDIMENTARY AND METAMORPHIC PETROLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the significant of sedimentary deposits
- To study the applications of trace elements and rare earth elements in sedimetological problems
- To understand the classifications of metamorphic rocks

UNIT – I:

Sedimentation - Textures and structures of sedimentary rocks - Classification and composition of sedimentary rocks — Study of residual deposits – Terra rosa, Clay with flints, 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. Heavy minerals and their significance-provenance of sediments –sedimentary differentiation, Lithification and Diagenesis.

UNIT – II:

Sedimentary environments – Marine environments – Non – marine environments – Mixed environments. Modern sedimentary environments. Tectonics & sedimentation - Sedimentary basins – Downwarp basins – Rift basins – Interior basins- Foreland basins – Subduction basins – Pullapart basins – Delta type basins – Composite basins – Geosynclines - Types – Characteristics of sediments. Plate tectonics – Basin formation – Basins in compressional zones – Basins in Stike slip zones – Basins in transform fault zones.

UNIT – III:

Stratigraphy and Sedimentation – Seismic Stratigraphy - Sequence stratigraphy. Basin analysis – Paleocurrents 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 – Cathodoluminesence – X – ray diffraction – Scanning electron microscope - Application of trace element, rare earth element and stable isotope geochemistry to sedimentological problems.

UNIT – IV:

METAMORPHIC PETROLOGY: Agents of metamorphism – Types of metamorphism – Metamorphic textures and structures – Study of Cataclastic metamorphism - Grades, Zones and facies of metmorphism – A critical review of facies concept – Facies of Contact Metamorphism – Facies of Regional metamorphism – Facies of Burial metamorphism - Graphical representation of

facies, ACF, AKF, AMF diagrams. Classification of metamorphic rocks based on texture and mineralogy; chemical composition.

UNIT – V:

Goldschmidth's mineralogical phase rule and its application – stress and antistress minerals – Retrograde metamorphism – Metamorphic diffusion and differentiation – Metasomatism – Granitisation and Migmatites – Metamorphism in relation to magma and orogeny – Paired metamorphic belts. Application of trace element, rare earth element and stable isotope geochemistry in metamorphism.

REFERENCES:

1. Tyrrell, G.W. 1963 – Principles of Petrology, Asia Publishing House
2. Turner, F.J. & Verhoogen, J – 1960 – Igneous and Metamorphic Petrology, McGraw Hill.
3. Huang, W.T. – 1962 – Petrology, McGraw Hill.
4. Williams, H. Turner, F.J. & Billbert, C.M. – 1954 – Petrography, Freeman.
5. Pettijohn, F.J.- 1967 – Sedimentary Rocks, Harpers and Bros
6. Bayly, B. – 1968 – Introduction to Petrology, Prentice Hall.
7. Barth, F.W. – 1962 – Theoretical Petrology, Wiley.
8. Wahistrom, e.e. – 1962 – Theoretical Igneous Petrology, Wiley.
9. Hatch, F.H. Wells, A.K. & Wells, M.K. – 1949 – Petrology of Igneous Rocks, Thomas Murby.
10. Johannsen, A. – 1962 – Descriptive Petrography of Igneous Rocks, Vots. I to IV Allied Pacific.
11. Shand, S.H. – 1949 – Eruptive Rocks.
12. Krumbein, W.C. & Pettijohn, F.J. – 1938 – Manual of Sedimentary Petrography, Appleton century co.
13. Krumbein, W.C. & Sloss, L.L. – 1951 – Stratigraphy and Sedimentation, Freeman.
14. Harker, A – 1950 – Metamorphism, Methuen.
15. Winkler, H.G.F. – 1967 – Petrogenesis of Metamorphic Rocks, Springer and Werlog.
16. Hyndman, D.W. – 1972 – Petrology of Igneous and Metamorphic Rocks, McGraw Hill.
17. Miyashire, A – 1973 – Metamorphism and Metamorphic Rocks, George Allen & Unwin.
18. Sam Boggs, Jr Sam Boggs, 2009, Petrology of Sedimentary Rocks, Cambridge university press
19. Haldar , 2013,Introduction to Mineralogy and Petrology, Elsevier Science
20. Lore Raymond, 2002,PetrologyThe Study of Igneous, Sedimentary, and Metamorphic RocksMcGraw-Hill Education
21. GautamSen, 2013,Petrology Principles and Practice, Springer Berlin Heidelberg
22. Cornelis Klein, Anthony Philpotts, 2013,Earth Materials Introduction to Mineralogy and Petrology, Cambridge University Press
23. Anthony Philpotts, Jay Ague, 2009,Principles of Igneous and Metamorphic Petrology, Cambridge University Press
24. Ronald Frost, Carol Frost, 2019, Essentials of Igneous and Metamorphic Petrology, Cambridge University Press
25. Myron Best , 2013,Igneous and Metamorphic Petrology, Wiley

26. Bruce Yardley , 1991,An Introduction to Metamorphic Petrology ,Longman Scientific & Technical
27. John Winter, 2014,Principles of Igneous and Metamorphic Petrology, Pearson Education
28. Kurt Bucher, Martin Frey, 2013, Petrogenesis of Metamorphic Rocks, Springer Berlin Heidelberg

COURSE OUTCOMES:

- Discuss about various sedimentary deposites, differentiation, lithification and diagenesis
- To understand about different marine and Non-Marine environments
- To understand about Tectonics in relation with Sedimentology
- Discuss about application of trace element, REE and stable isotope geochemistry to sedimentological problems
- Give an idea about the relationship between stratigraphy and sedimentation
- Discuss about the classification of metamorphic rocks based on texture and mineralogy

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Second Year **CORE CHOICE COURSE III** **Semester III**

1. HYDROGEOLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the groundwater exploration methods
- To know about the different water bearing formations
- To understand well design and its development
- To understand the need of pump test
- To study the quality of water in various rock types

UNIT – I:

Hydrogeology : - Introduction - **Origin**: Meteoric, Juvenile and Connate waters – Hydrogeological Cycle: **Occurrence:** Groundwater occurrence in igneous, sedimentary and metamorphic rocks – Vertical distribution of groundwater in hard rock regions – Water bearing properties of rocks: Porosity, Permeability, Specific yield, specific retention, Transmissibility and storage coefficient. 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 – II:

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 – III:

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 Re-change and discharge areas; Re-charge methods and practices.

UNIT – IV:

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, Sea water intrusion in Coastal areas and its prevention Groundwater province of India –

UNIT – V:

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 problem in mining, a case study from Neyveli. Rain water harvesting and management.

REFERENCES:

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. Regunath, 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.
6. Tolman., G.F. 1937 Ground water McGraw Hill. New York.
7. Walton, W.C. 1970 ground water Resources evaluation McGraw Hill.
8. Karanath, K.R. 1987 ground water Assessment Development & management Tata McGraw Hill

COURSE OUTCOMES:

- Origin of water and hydrogeological cycle and explain about geochemical method of ground water exploration Occurrence
- To understand about ground water detection (both surface and subsurface) methods of Ground Water in igneous, metamorphic and sedimentary terrain
- Discuss about application of remote sensing methods in ground water exploration
- Introduce different types of wells and its design and discuss about ground water provinance of India
- To understand pump test and estimation of water flow in horizontal and vertical pipes.

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Second Year **CORE CHOICE COURSE III** **Semester III**

2. GEOLOGICAL OCEANOGRAPHY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn about the ocean morphology, processes, classification and marine resources.
- To understand the various dimensions of oceans, its structure and all aspects related to it.
- To understand the chemistry and its composition of marine water, various marine pollutants and its ecological impacts

UNIT – I:

History of development of oceanography; Origin of seas and oceans. Ocean morphology, deep ocean floor and various topographic features, ridges, seamounts, coral reefs, continental shelf, slope, benches and canyons. Hydrothermal vents and seawater - basalt interaction.

UNIT – II

Oceanic circulation, waves, currents and tides- T-S diagrams; mixing processes in the oceans; characteristics of important water masses. Wind generated waves in the oceans; their characteristics; shallow and deep water waves. Propagation, refraction, and reflection of waves. Wave spectrum, principles of wave forecasting. – Nearshore geological processes, sea level changes with special emphasis on Quaternary-Oceanic sediments and distribution of marine microfossils – Stratigraphy and geochemistry of deep-sea deposits.

UNIT – III:

Tectonic history of the oceans – Tectonics of Continental margins, continental shelves, divergent margins, active margins and marginal basins. Global tectonics and seafloor spreading-Chemical properties of sea water- Chemistry of oceanic rocks - marine instrumentation on navigation with special mention on geological studies such as dredges, grabs, water samplers, underwater cameras, etc.

UNIT – IV:

Mineral resources of the oceans – Diagenetic changes in oxic and anoxic environments – Mobility of redox metals – Isotope geochemistry and paleoceanographySedimentary markers (biological and chemical) of palaeoenivronmental conditions. Paleoceanography – Approaches to paleoceanographic reconstructions; various proxy indicators for paleoceanographic interpretation. Reconstruction of monsoon variability by using marine proxy records Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

UNIT – V:

Hydrocarbons beneath the sea floor; Marine gas hydrates and their economic potential. Ocean laws and management- Marine pollution-Deep-sea drilling projects and modern research in marine geology – Marine geology of Antarctic sea and other cold seas/oceans.

REFERENCES:

1. Kennet, J.P., 1982: Marine Geology, Prentice Hall.
2. Seibold, E. and Berger, W.H., 1982: The sea floor, Springer-Verlag.
3. Pipkin, B.W., Gorsline, D.S., Casey, R.E. and Hammond, D.E., 1972: Laboratory exercises in Oceanography, Freeman.
4. Gerlach, S.A. Marine Pollution. D.A. Ross, 1982 : Introduction to Oceanography, 3rd Edition, Prentice Hall H.U.
5. Sverdrup, M.W Johnson and R.H.Fleming 1941 The Oceans , Prentice Hall.
6. Grant Gross, M. (1977): Oceanography: A view of the Earth, Prentice Hall.

COURSE OUTCOMES:

- Students learn the description, physical properties and process of the ocean, ocean basin morphology and formation.
- Understand the marine instrumentations and how to extract the mineral resources of marine environment.
- Analyse the chemical properties, nutrients cycles and biogeochemical interactions of the ocean

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Second Year	**CORE PRACTICAL III PETROLOGY**	**Semester III**
Code:	**(Practical)**	**Credit: 3**

- Megascopic and Microscopic study of igneous, sedimentary and metamorphic rocks.
- Modal analysis of rocks.
- Mechanical analysis of sediments and statistical studies of data.
- Petrochemical calculations – C.I.P.W. Norm.
- Niggi values.
- Von wolff plots and variation diagrams,
- Harker's diagram and Niggli variation diagram, ACF diagram.

REFERENCES:

1. Gautam Sen, 2013,Petrology Principles and Practice, Springer Berlin Heidelberg
2. Ron Vernon, Vernon, 2004,A Practical Guide to Rock Microstructure, Cambridge University Press
3. Robin Gill, 2011,Igneous Rocks and Processes A Practical Guide, Wiley
4. halder , 2013,Introduction to Mineralogy and Petrology, Elsevier Science
5. Anthony Philpotts, 2009,Jay Ague,Principles of Igneous and Metamorphic Petrology, Cambridge University Press
6. Ronald Frost, Carol Frost , 2019,Essentials of Igneous and Metamorphic Petrology, Cambridge University Press
7. Ronald Frost, Carol Frost , 2019,Essentials of Igneous and Metamorphic Petrology, Cambridge University Press
8. Bruce Yardley, 1991,An Introduction to Metamorphic Petrology, Longman Scientific & Technical
9. Tyrrell , 2012,The Principles of PETROLOGY An Introduction to the Science of Rocks, Springer Netherlands
10. Cornelis Klein, Anthony Philpotts , 2013,Earth Materials Introduction to Mineralogy and Petrology, Cambridge University Press
11. Peter Scholle, Noel James, Read , 1989,Carbonate Sedimentology and Petrology, American Geophysical Union
12. Kurt Hollocher, 2014,.A Pictorial Guide to Metamorphic Rocks in the Field, CRC Press
13. Myron Best, 2013Igneous and Metamorphic Petrology, Wiley

COURSE OUTCOMES:

- Hands-on-exercise helps the student to identify and understand about different rock types.

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Second Year **ELECTIVE COURSE III** **Semester III**

1. COMPUTER APPLICATION AND GIS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To get an idea on fundamentals of computer
- To know about programming language
- To get an idea on MS-office
- To understand the GIS
- To learn various applications of GIS

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.

UNIT - II:

Programming language: Basic– Structure of programme – character set, constant, variables and operators – arithmetic expressions – library functions – classification of programme statements - input and output statements, control statements – writing programme in basic statistical operation. C – Structure of programme – character set, constant, variables and operators – arithmetic expressions – library functions classification of programme statements - input and output statements, control statements – writing basic and C programmes in basic statistical operation.

UNIT - III:

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 - 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.

UNIT - V: Surface modeling – TIN and DTM; Out put from GIS; Global Positioning System – concepts – segments – its application; Application of GIS in Geological studies and natural resource management.

REFERENCES:

1. Burrough, P.A.-1986- Principles of Geographical information system for land resource assessment.
2. John C.Davis - 1973 - Statistics and Data Analysis in Geology, John Wiley & Sons.
3. Krumbein and Graybill 1965 - An introduction to Statistical methods in Geology, Mc Graw Hill.
4. Rober L. Miller and James Stevenkahn -1962, Statistical analysis in the Geological Sciences, John Wiley & sons, Inc.

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Second Year **ELECTIVE COURSE III** **Semester III**

2. GEOSTATISTICS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To introduce the basic concepts of statistics to the students.
- To understand the purpose, meaning, and use of statistics.
- To apply statistical techniques to solve the given problems.

UNIT – I:

Concepts – Definition - Merits and limitation – Tabular and diagrammatic Illustration: Bar diagram and pie diagram – histogram and frequency polyson – ogives; Measures of central tendency.

UNIT – II:

Mean, Median, Mode, Dispersion – standard deviation – skewness, kurtosis – Karl Peason's coefficient of Skewness; Correlation and Regression-Concepts, Karl peason's coefficient of correlation – Rank correlation

UNIT – III:

Regression, lines of regression; Probability – Meaning and Uses Addition and Multiplication theorems – Baysian rule - A brief note on statistical software.

UNIT – IV:

Distribution of sample variance and chi square distribution; probability; testing normal distribution; students 't' test, 'f' test; confidence interval, analysis.

UNIT – V:

Calculation of variance- covariance, simple linear models; cluster analysis. Applications of Statistics in Geosciences.

REFERENCES:

1. Ajai, S. G. and Sanjaya, S.G. (2009) Statistical Methods for Practice and Research, Sage Publications, New Delhi.
2. Andy Field (2013) Discovering Statistics Using IBM SPSS Statistics, 4th Edition, Sage Publications, London.
3. Dennis D. Boos (2013). Essential Statistical Inference: Theory and Methods, Springer Science & Business Media.
4. Ding-Geng (Din) Chen, Karl E. Peace (2021) Applied Meta-Analysis with R and Stata.
5. George A. Morgan (2011). IBM SPSS for Introductory Statistics, Taylor & Francis.
6. Lyman Ott (2015). An Introduction to Statistical Methods and Data Analysis, Cengage Learning.
7. Course Outcome:
8. Familiarizes the properties of parametric, semi-parametric and nonparametric testing procedures.
9. Interpret and communicate the results from statistical analysis.

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Second Year **NON-MAJOR ELECTIVE COURSE - II** **Semester IV**

INTRODUCTION TO MINERALS, ROCKS AND FOSSILS

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To create awareness and importance of Mineral, Crystals, Gemstone, Ore and Gangue minerals.
- To study the Commercial significance of igneous, metamorphic and sedimentary rocks.
- To Study about fossils and its application.

UNIT – I:

Definitions of Mineral and Crystals, Ore and Gangue. Brief study of Physical Properties of Minerals; Nature, Streak, Cleavage, Hardness, Luster and fracture. Description of physical properties and chemical composition of the following mineral groups-Quartz group - Feldspars group-Pyroxenes group - Amphiboles group.

UNIT – II:

Study of Physical properties, Chemical composition and origin of the mineral used in the following industries: Cement industry, Glass and Ceramic industry, Paint industry, Paper industry, Fertilizer industry, Atomic industry, physical chemical properties of gemstone. Classification of gemstone, occurrence of gemstone in Tamilnadu – Ruby, Sapphire, Emerald, Moonstone and Iolite. Rocks:

UNIT – III:

Brief study of common characters of igneous, metamorphic and sedimentary rocks. Structures and texture of igneous, metamorphic and sedimentary rocks. Engineering properties of building stone. Important ornamental and architecture properties of rocks.

UNIT – IV:

Descriptive study of structure, texture, mineralogy and origin of the following igneous rocks: Granite, Syenite, Gabbro, Dunite, Basalt, Pegmatite, Anorthosite and Dolerite. Description of texture, mineralogy and origin of the following sedimentary rocks: sandstone, conglomerate, Breccia, Shell-Limestone and Shale. Brief study of the following metamorphic rocks: Slate, Schist, Gneiss, Marble and Charnockites. Fossils:

UNIT – V:

Introduction of Palaeontology. Definition of fossils – mode of preservation of fossils. Types of fossils -Uses of fossils. Morphological identification and description of the following fossils: Corals: Calceola, zaphrentis; Brachiopoda: Spriifer, Productus, Terebratula; Pelecypoda: Arca, Cardium. Meretrix, Cardita,

Pecten; Gastropoda: Natica, Turbo, Trochus, Turritella, Physa; Cephalopoda: Nautilus, Goniatites, Ceratites. Plant fossils: Glossopteris , Gangmopteris , Calamites , Lepidodendron, Sigillaria and Ptilophyllum.

REFERENCES:

1. Dana, F.S. (1955): A text book of mineralogy – Asia publishing House, Wiley.
2. Tyrrel, G.W. (1978) :The principles of petrology – Chapman and Hall Ltd., London.
3. Mahapatra, G.B(2008): A text book of Geology, CBS, Delhi
4. Lindgren W.(1993):Mineral Deposits, MCGraw Hill.
5. Henry Woods (1967) : Invertebrate Palaeontology – Cambridge University Press, London

COURSE OUTCOME:

- Understand distribution, geological setting and genesis of minerals, rocks and fossils.
- Factors controlling the formation of these deposits, reserves & preservation of fossils and the linkages with many other geologic processes.

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Second Year **CORE COURSE VII** **Semester IV**

ECONOMIC GEOLOGY AND ORE MICROSCOPY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the mechanical concentration of magma
- To find the areas of ore localizations
- To understand about ore microscopy
- To know about the significance of minerals in national economic

UNIT – I:

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 – II:

Classification of Mineral deposits, controls of Ore localisation – structural stratigraphic, physical and chemical; Metallogenetic 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 – III:

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 – IV:

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

UNIT – V:

Ore Microscopy: Construction of ore Microscope. Polishing and mounting of ores, Physical properties of Ore minerals, Determination of micro hardness; Factors affecting microhardness. Study of optical properties – Colour, reflectivity, bi-reflectance, Isotropism, natstotropism, Polarisation Colours, Rotation properties, Internal reflections and relation sense. Instrumentation and methods of determination of reflectivity, Polarisation figures of Isotropic and anisotropic Ore minerasl, Micro – chemical techniques, ore textures and paragenesis, application of Ore Microscopy.

COURSE OUTCOMES:

- Understand distribution, geological setting and genesis of metalliferous mineral deposits. Factors controlling the formation of these deposits and the linkages with many other geologic processes covered in other courses are explored.
- Recognize common ore minerals in hand samples and under the microscope
- Demonstrate familiarity with a wide range of mineral deposits, including recognizing the overall geometry, zonation and alteration patterns associated with specific classes of metallic mineral deposits
- Relate overall geometry, zonation and alteration patterns of rock associations to specific classes of metallic mineral deposits
- Evaluate different processes of element enrichment by fluids and melts to from ore bodies
- To understand about the occurrences and uses of ores and industrial minerals

REFERENCES:

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.
6. Coggin, B & Dey, A.K. – 1995 – India's Mineral Wealth, OUP.
7. Park, C.F. & Macdiarmid, R.A. 1970 – Ore deposits, Freeman.
8. Deb, S, 1980 – Industrial Minerals and rocks of India, Allied.
9. Gokhale; K.V.G.K. & Rao, T.C. – 1978 – Ore deposits of India, their distribution and Processing, Thomson Press.
10. Stanton, R.L. 1972 – Ore Petrology, McGraw Hill
11. Henry benedice medlicott, william thomas blanford , 2012,economic Geology, nabll press
12. Shackleton, 1986, economic and applied Geology, american society fer microbiology
13. Prasad , 2010,economic Geology and economicmineral deposits (2 nd edition), cbs press
14. Walter pohl, 2016, economic Geology principles and practice, wiley india exclusive
15. Sinha , 2019,mineral economic, cbs publishers
16. Asoke ghosh , 2016,mine and mineral economic, phl learing private limited
17. Prot chatterjee, 2015, introduction to mineral economics, international lid
18. Jaya prakash shivastava nishi rani, 2012, introduction to ore microscopy, phl learing
19. Eugene nathern cameron, 2007,ore microscopy , wiley james craig,
20. David vaughan , 2010,ore microscopy and ore petrography, wiley

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Second Year **CORE COURSE VIII** **Semester IV**

FUEL AND INDUSTRIAL GEOLOGY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know about the coal and petroleum bearing formations
- To understand the geological and geographical distributions of coal and petroleum
- To identify natural and synthetic gemstones

UNIT – I:

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 microlithotypes. 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). 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. Geological and geographical distribution of coal and lignite deposits in India. Coal exploration and estimation of coal reserves. Indian coal reserves and production of coal in India.

UNIT – II:

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. 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 policies of India.

UNIT – III:

Coalbed methane – a new energy resource. Elementary idea about generation of methane in coal beds, coal as a reservoir and coalbed methane exploration.
Atomic fuel- Mode of occurrence and association of atomic minerals in nature; atomic minerals as source of energy; methods of prospecting and productive geological horizines in India; nuclear power stations of the country and future prospects; atomic fuels and environment.

UNIT – IV:

Physical and chemical properties, mode of occurrence and distribution in India of the minerals required for the following industries, Refractory, Abrasive, Fertilizer, Cement, Paints, Glass and Pigments. Mineral wealth of TamilNadu.

UNIT - V:

Classification of gemstones, systematic description of crystallography, physical properties, optical properties, absorption spectra, chemical properties, special gemmological features, diagostic features and occurrences of common and less common gemstones. New instruments and techniques used to identify and testing the gemstones. Synthetic gemstones, history of synthesis, methods of manufacture, methods of differentiation between natural and synthetic stones.

REFERENCES:

1. Chandra, D., Singh, R.M. Singh, M.P., 2000: Textbook of Coal (Indian context). Tara Book Agency, Varanasi.
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3. Scott, A.C., 1987: Coal and Coal-bearing strata: Recent Advances. The geological Society of London, Publication no. 32, Blackwell scientific Publications.
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COURSE OUTCOMES:

- To understand about the origin of fuels and industrially valuable deposits
- To introduce the different methods for finding these deposits for different purposes
- To assess the quality of fossil fuels
- Globalization, production, transportation and uses of fossil fuels
- To understand the life cycle of fossil fuels.
- To understand the different oil fields and its mode of occurrence.

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Second Year	**ENTREPRENEURSHIP / INDUSTRY BASED COURSE SURVEYING TECHNIQUES**	**Semester IV**
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

- To impart knowledge in handling various tools of conventional and contemporary surveying instuments.
- To understand various measuring and ranging methods for mapping linear, angular and elevation units
- To know the recent advancements in surveying and data handling methods

UNIT – I:

Chain Surveying and Triangulation - Measurement of Bearings and Angles using Prismatic Compass.

UNIT – II:

Plane Table Surveying - Dumpy Level Survey.

UNIT – 3:

Measurement of Slope using Abney Level - Determination of Height using Indian Pattern Clinometer.

UNIT – IV:

Laser Distance Measurements - Handheld GNSS Surveying.

UNIT – V:

DGPS Surveying and Post processing - Total Station Surveying.

COURSE OUTCOMES:

- Learn the importance of different surveying techniques.
- Get confidence to become entrepreneur/surveyor .

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Second Year **PROJECT** **Semester-IV**

Code: **Credit: 5**

Each candidate shall be required to take up a Project Work and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT /EVALUATION /VIVA-VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External):

I. Plan of the Project - 20 marks

II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. - 45 marks

III. Individual initiative - 15 marks

2. VIVA-VOCE / INTERNAL& EXTERNAL - 20 marks

TOTAL **- 100 marks**

PASSING MINIMUM:

	Vivo-Voce 20 Marks	**Dissertation 80 Marks**
Project	40% out of 20 Marks (i.e. 8 Marks)	40% out of 80 marks (i.e. 32 marks)

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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Second Year	VALUE ADDED COURSE II	Semester IV
Code:	WATER QUALITY ANALYSIS	Credit: 2

COURSE OBJECTIVES:

- To build fundamental knowledge and skill to sampling and analysis water.
- To improve working ability to handle various instruments in water quality analytical laboratory.

UNIT – I:

Sample Collection: Groundwater - Surface water

UNIT – II:

Physical Parameter: – Colour – Odor – Turbidity

UNIT – III:

Chemical Parameter: Major Cation (potassium, calcium, sodium and magnesium) - Major Anions (Bicarbonate, chloride, sulfate) pH - Electrical Conductivity - Total Dissolved Solids etc.,

UNIT – IV:

Analytical Instruments: pH & TDS – EC meter - Spectro photometer - Flame photometer - Turbidity meter - Probs.

UNIT – V:

Plotting of graphs: Piper Trilinear – Wilcox - Gibb's diagram - Bivariate plot

UNIT – VI: Current Contours (For continuous internal assessment only):

ICPMS - Atomic Absorption Spectrophotometer (AAS)– WHO and BIS Standards.

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4. Sensors in Water Pollutants Monitoring: Role of Material. (2019). Germany: Springer Singapore. 5. Todd, D.K. (2011). Ground water Hydrology, Wiley India Edition, New Delhi (3rd Edition).

COURSE OUTCOMES:

- Gain insight into key concepts of water quality, water quality and health, impairment of natural water bodies.
- Comprehend components of water treatment and schemes based on source of water, select suitable unit process and unit operation at conceptual, theoretical, methodical level.
- Comprehend components of wastewater treatment and schemes based on input water quality and desired water quality.

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