

ACHARYA NAGARJUNA UNIVERSITY

A State Government University, Accredited with "A" Grade by NAAC
Nagarjuna Nagar - 522 510, Guntur, Andhra Pradesh, India.



M.Sc. GEOLOGY

SYLLABUS

2022 - 2023 onwards

UNIVERSITY COLLEGE OF SCIENCES

PROGRAM CODE:

ANUCS11





**ABOUT
UNIVERSITY**

ACHARYA NAGARJUNA UNIVERSITY (ANU)

- A Brief Profile

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakhruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded “A” grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more. It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil. and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on-Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann & Dr. S. John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

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**VISION,
MISSION &
OBJECTIVES
OF THE
UNIVERSITY**

ACHARYA NAGARJUNA UNIVERSITY

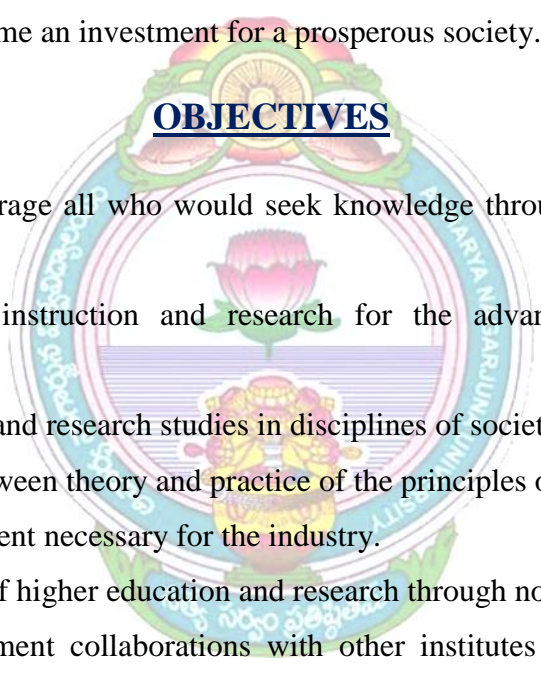
VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

OBJECTIVES

- 
- The logo of Acharya Nagarjuna University is a circular emblem. It features a central pink lotus flower above a blue and white striped banner. The emblem is surrounded by a green border with text in Telugu and English. The English text includes 'ACHARYA NAGARJUNA UNIVERSITY' and 'WISDOM BEGETS KNOWLEDGE'.
- To inspire and encourage all who would seek knowledge through higher education and research.
 - To provide quality instruction and research for the advancement of science and technology.
 - To promote teaching and research studies in disciplines of societal relevance.
 - To bridge the gap between theory and practice of the principles of higher education.
 - To develop human talent necessary for the industry.
 - To open up avenues of higher education and research through non-formal means.
 - To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
 - To motivate and orient each academic department/centre to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
 - To focus specially on the studies involving rural economy, justifying its existence in the rural setting.



**VISION
&
MISSION OF
THE COLLEGE**

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES

VISION OF THE COLLEGE:

University College of Sciences envisages to be a good team of people with scientific temperament, research bent and a flair for Teaching & Learning for the betterment of the Community, Society, State and the Country at large.

MISSION OF THE COLLEGE:

The College intends to incubate and nurture the Leaders, Mentors, Educators and researchers who can transform the country and contribute to advances in science while addressing the challenges faced by the society for the betterment of human life.



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**VISION
&
MISSION OF
THE
DEPARTMENT**

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF GEOLOGY
M.Sc. GEOLOGY

VISION OF THE DEPARTMENT:

To create and maintain the conditions that allows students to engage in transformative learning and develop into their ideal learners through instruction that meets international standards. This would be accomplished by upholding high academic standards, preserving the standard of scientific instruction and learning and giving students an encounter that would transform them intellectually, personally and socially.

MISSION OF THE DEPARTMENT:

- 
- M1** To create a scientifically sound and innovative learning environment for students
 - M2** To build world-class infrastructure and pioneering laboratories
 - M3** To promote research and industry-institute relationships through teamwork for development and innovation.
 - M4** To conduct conferences, seminars, workshops and programmes for societal development that will open up new channels for the exchange of research and the advancement of knowledge in priority areas.
 - M5** To provide high-quality education and other services in a competitive manner, it is possible to improve students' leadership abilities, moral and ethical principles, research cultures and innovative capabilities.

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF GEOLOGY
M.Sc. GEOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's):

- PEO1** To provide knowledge in geology and their applications
- PEO2** To develop students' analytical and logical skills so they can swiftly adjust to changing work contexts, take in more knowledge and have problem-solving abilities.
- PEO3** To introduce students to innovative technology and inspire them to take on new challenges
- PEO4** To develop their capacity for self-improvement, self-control, and leadership while introducing them to a comprehensive strategy for teamwork in accordance with the standards of professional conduct.
- PEO5** High technical skill in research that produces, disseminates, and applies new information for the benefit of society.

PROGRAMME OUTCOMES (PO's):

- PO1** Become professional in the subject of Geology and apply the principles of the same to the needs of the Employer / Institution /Enterprise/ Society.
- PO2** Gain Analytical skills in the field/area of Geology.
- PO3** Able to identify, analyse, interpret geological data in multiple perspectives.
- PO4** Able to use skills and modern technical tools in the field of Geology.
- PO5** Able to work as an individual and as teams with cross-culture perspective with a potentially become leader with practical communication skills.
- PO6** Identify, formulate, research literature, and analyse complex problems reaching substantiated conclusions.



STRUCTURE

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF GEOLOGY
M.Sc. GEOLOGY
COURSE STRUCTURE

SEMESTER-I

S. No.	Components of Study	Subject Code	Title of the paper	No. of Credits	Maximum Marks		No. Hours for week
					100		
					Internal	External	
1.	Mandatory Core	GEO 1.1 (22)	Mineralogy and Crystallography	4	30	70	6
2.		GEO 1.2 (22)	Structural Geology and Tectonics	4	30	70	6
3.	Compulsory Foundation	GEO 1.3 (22)	Indian Stratigraphy and Paleontology	4	30	70	6
4.	Elective Foundation	GEO 1.4 (a) (22)	Geomorphology and Engineering Geology	4	30	70	6
		GEO 1.4 (b) (22)	Gemology				
		GEO 1.4 (c) (22)	Climatology				
5.	Practical -I	GEO 1.5 (22)	GEO 1.1 (22) and GEO 1.2 (22)	4	30	70	6
6.	Practical -II	GEO 1.6 (22)	GEO 1.3 (22) and GEO 1.4 a/b/c (22)	4	30	70	6
TOTAL		600		24	180	420	36

★ **Elective Foundation: Choose One Paper.**

SEMESTER-II

S. No.	Components of Study	Subject Code	Title of the paper	No. of Credits	Maximum Marks 100		No. Hours for week
					Internal	External	
					30	70	
1	Mandatory Core	GEO 2.1 (22)	Igneous and Metamorphic Petrology	4	30	70	5
2		GEO 2.2 (22)	Indian Mineral Deposits and Mineral Economics	4	30	70	5
3	Compulsory Foundation	GEO 2.3 (22)	Environmental Geology	4	30	70	5
4	Elective Foundation	GEO 2.4 (a) (22)	Sedimentology and Marine Geology	4	30	70	5
		GEO 2.4 (b) (22)	Natural Hazards and Disaster Management				
		GEO 2.4 (c) (22)	Ore dressing and Mineral beneficiation				
5	Practical -I	GEO 2.5 (22)	GEO 2.1 (22) and GEO 2.2 (22)	4	30	70	5
6	Practical -II	GEO 2.6 (22)	GEO 2.3 (22) and GEO 2.4 a/b/c (22)	4	30	70	5
7.	Skill Development Course		Field work/ Field Tour	4	--	--	6
TOTAL			600	28	180	420	36

- ★ **Elective Foundation: Choose One Paper.**
- ★ **MOOCs online courses will be available in the ANU-MOOCs (www.moocs.anuonline.ac.in) web portal or SWAYAM Platform of MHRD or from IIT-Bombay website. Every student has to complete one MOOC course in their II semester.**

Note: Exit policy offered by the university to the students who are successfully completed two semesters will be eligible to awarded PG Diploma.

SEMESTER-III

S. No.	Components of Study	Subject Code	Title of the paper	No. of Credits	Maximum Marks		No. Hours for week	
					100			
					Internal	External		
						30	70	
1	Mandatory Core	GEO 3.1 (22)	Geochemistry	4		30	70	5
2		GEO 3.2 (22)	Fuel Geology	4		30	70	5
3	Elective - I	GEO 3.3 (a) (22)	Statistical and Computer Applications in Geology	4		30	70	5
		GEO 3.3 (b) (22)	Micropaleontology					
		GEO 3.3 (c) (22)	Environmental Impact Assessment and Management					
4	Elective - II	GEO 3.4 (a) (22)	Mining Geology	4		30	70	5
		GEO 3.4 (b) (22)	Medical Geology					
		GEO 3.4 (c) (22)	Dimensional Stones and construction Materials					
5	Practical -I	GEO 3.5 (22)	GEO 3.1 (22) and GEO 3.2 (22)	4		30	70	5
6	Practical -II	GEO 3.6 (22)	GEO 3.3 a/b/c (22) and GEO 3.4 a/b/c (22)	4		30	70	5
7.	Skill Enhanced Course		Surveying	4		--	--	6
TOTAL			600	28		180	420	36

- ★ Elective – I : Choose One Paper
- ★ Elective – II : Choose One Paper
- ★ MOOCs online courses will be available in the ANU-MOOCs (www.moocs.anuonline.ac.in) web portal or SWAYAM Platform of MHRD or from IIT-Bombay website. Every student has to complete one MOOC course in their III semester.

SEMESTER-IV

S. No.	Components of Study	Subject Code	Title of the paper	No. of Credits	Maximum Marks		No. Hours for week	
					100			
					Internal	External		
						30	70	
1	Mandatory Core	GEO 4.1 (22)	Mineral Exploration	4	30	70	6	
2		GEO 4.2 (22)	Petroleum Exploration	4	30	70	6	
3	Elective - I	GEO 4.3 (a) (22)	Hydrogeology	4	30	70	6	
		GEO 4.3 (b) (22)	Soil Geology					
		GEO 4.3 (c) (22)	Watershed Management					
4	Elective - II	GEO 4.4 (a) (22)	Remote Sensing And GIS	4	30	70	6	
		GEO 4.4 (b) (22)	Sedimentary Basins of India					
		GEO 4.4 (c) (22)	Research Methodology					
5	Practical -I	GEO 4.5 (22)	GEO 4.1 (22) and GEO 4.2 (22)	4	30	70	6	
6	Practical -II	GEO 4.6 (22)	GEO 4.3 a/b/c (22) and GEO 4.4 a/b/c (22)	4	30	70	6	
7.		Project Work		4	--	100	--	
TOTAL			700	28	180	520	36	

★ **Elective – I: Choose One Paper**★ **Elective – II: Choose One Paper**



**FIRST
SEMESTER**

ACHARYA NAGARJUNA UNIVERSITY
UNIVERSITY COLLEGE OF SCIENCES
DEPARTMENT OF GEOLOGY
M.Sc. GEOLOGY
SEMESTER-I

G.1.1. (22): MINERALOGY AND CRYSTALLOGRAPHY

COURSE OBJECTIVES:

- ▲ To acquire in depth knowledge about these rock forming minerals in terms of their groups, associations, physical properties, optical properties, chemical composition, mode of occurrence, distinguishing properties, environment of their formations and their economic significance.
- ▲ Assessing the Qualities of Gemstones by physical, chemical and optical nature. Study about their mode of occurrence and their industrial and Medicinal uses.
- ▲ To observe various crystallographic characters as well as physical and optical phenomena by making use of appropriate advanced instruments meant for the purpose.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Acquire knowledge to identify the Rock forming minerals by studying the minerals in hand specimens and under petrological microscopes.	Understand
CO2	Acquire knowledge to identify the silicate minerals by studying the minerals in hand specimens and under petrological microscopes.	Analyse
CO3	Understand the physical and chemical properties of non-silicate minerals in hand specimens, and also petrological as well as ore-microscopes.	Understand
CO4	Identification of colour causing elements by using different instruments. Students will be able to distinguish between natural and synthetic Gem minerals.	Evaluate
CO5	Understand the symmetry of elements in crystallography. Describe the functioning and application of modern analytical instruments used in mineral identification	Analyze

Units	Content	Hrs
I	1) Structures and classification of Silicates 2) Atomic structure, Mineral chemistry, Physical and Optical properties and mode of occurrence of silicates : a) Olivine group b) Pyroxene group c) Amphibole group d) Feldspar group e) Mica group f) Garnet group	15
II	Atomic structure, Mineral chemistry, physical and optical properties and mode of occurrence of a) Epidote group b) Silica group c) Zeolite group d) Andalusite e) Kyanite f) Sillimanite g) Staurolite h) Topaz i) Beryl j) Zircon k) Tourmaline l) Sphepe m) Chlorite n) Nepheline o) Vermiculite	15

III	Classification of Non-Silicates - Native Elements – Metals – Semi-Metals – Non-Metals, Sulphides, Oxides, Hydroxides, Carbonates, Sulphates, Halides, Molybdates, Phosphates, Arsenates, Venadates – Details on atomic structure, Chemistry, Physical and optical properties and paragenesis of the above classes.	15
IV	Introduction of Gem stones. Mineral Chemistry, structure and color of gems. Qualities of gem stones, Physical properties of gemstones – Identification of gems by X-ray diffractometry – Refractive Index – Critical angle. Causes of colors – Chromophores, color centers, luminescence – Alexandrite Effect – Color zoning. Gem Industry in India and the world. Uses of gem stones as Jewellery, property and Medicinal – Exploration for gems.	15
V	1) Symmetry of crystals –Thirty two crystal classes 2) Bravais Lattices in the Crystal systems 3) Law of zones and zone- relations 4) Twins; Twin-Laws 5) X-ray Diffraction – d-spacing and cell parameters 6) Crystal projections – Spherical, Stereographic and Gnomonic projections 7) Construction of Petrological Microscope- Nicol Prism –Thin-section and Polished-section making—Accessory plate	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED BOOKS:

- 1) Deer W. A., Howie R. A. and Zussman, J., 1996. The Rock Forming Minerals, Longman.
- 2) Berry L. G., and Mason B., Descriptive Mineralogy.
- 3) Paul Kerr. Optical Mineralogy.
- 4) Phillips. Wm.R and Griffen D.T. 1986. Optical Mineralogy. GBS edition.
- 5) Putnis Andrew 1992. Introduction to Mineral Sciences. Cambridge University Press.
- 6) Dana, W. E. A Text Book of Mineralogy.
- 7) SachinathMitra, Fundamentals of Optical, spectroscopic and x-ray Mineralogy.
- 8) Dana Text Book of Mineralogy Revised by Ford.
- 9) “Gems and Gem Industry in India” by R. V. Karanth (Memoir 45, Geological Society of India, Bangalore, 1st Ed. 2000).

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	1
CO2	3	3	2	1	2	1
CO3	3	3	2	1	2	1
CO4	3	3	3	3	3	2
CO5	3	3	2	1	2	1

G.1.2. (22): STRUCTURAL GEOLOGY AND TECTONICS**COURSE OBJECTIVES:**

- ▲ To understand the knowledge about the mechanical properties of rocks and their response to stresses by elastic, plastic and ductile brittle deformations, and fracturing.
- ▲ To analyze the deformation processes and mechanisms through an accurate geometric and genetic analysis of folds, faults and joints. Explain the deformation process of foliation and lineation.
- ▲ To analyze the geological, seismic and other relevant data on the concept of continental drift and plate tectonics, plate movements and seismicity.

COURSE OURCOMES (CO's):

	Course Outcome	Level
CO1	Student will understand about rock mechanics: concept of stress and strain, Stress and Strain ellipse.	Understand
CO2	Rupture/fracture formation, Analysis of ductile structures –foliation and lineation.	Analysis
CO3	To Apply the skills for the geometric description of the various structures observed in natural deformed rocks.	Skill
CO4	Understand the Crustal evolution during the Precambrian era in Peninsular India.	Understand
CO5	Analyze how plate movements involved in separation of Peninsular India from Gondwanaland and their reconstruction based on fossils, lithology, paleo-climate, paleo- magnetism etc.	Knowledge and Analysis

Units	Content	Hours
I	Materials of the outer shell of the Earth: atoms, gases, liquids and solids - Mechanical principles: composition and resolution of forces, differential forces. Concept of stress and strain, stress-strain diagrams. Mechanics of plastic deformation. Principles of failure by rupture, relation of rupture to strain. Foliation; types of foliation and importance of foliation in determining major structures. Lineation; origin and types of lineation.	15
II	Different types of Classifications of Folds. Geometry of Folding. Mechanics and Cause of folding. Buckling, status of strain within and outside buckled layers and field evidences of buckling. Recognition of folds in the field.	15
III	Description of Joints. Classification of Joints and their significance. Description and Classification of Faults. Criteria for recognition of Faults in the field – Thrust and Reverse faults – Relation of Thrusts to Stress – Mechanics of Normal Faults and Strike Slip Faults. Classification, origin and significance of Shear Zones.	15
IV	Structure and composition of Earth interior. Crustal evolution of Earth. Tectonic evolution of Dharwars, Eastern Ghats Granulite Terrane, Sausar and Sakoli groups of Central India, Aravalis, Singhbhum Shear Zone, Cuddapahs and Himalayas.	15
V	Continental drift theory. Principles of Plate Tectonics; types of plate boundaries, ocean floor spreading, subduction zone, transform faults, causes for plate movement, rate of plate movement, benioff zone, island arcs, mantle plume and hot spot. Plate tectonics and seismicity.	15

TASKS AND ASSIGNMENTS:

Each Student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

REFERENCE BOOKS:

- 1) Structural Geology - M. P. Billings (1968, New Delhi)
- 2) An Outline of Structural Geology - Bruce E. Hobbs., Means W. D. and Willams P. F., 1976, John Wiley
- 3) Structural Geology and Tectonic Principles - P. C. Badgley, 1965, Harper and Row
- 4) Folding and Fracturing of Rocks - Ramsay J. G. 1967, Mc Graw Hill.
- 5) Holmes principles of Physical Geology - A. Holmes and D. L. Holmes
- 6) Continental Drift and Plate Tectonics – K.C. Conde.
- 7) Aspects of tectonics, focus on South Central Asia - K. S. Valdiya
- 8) Continents a Drift readings from Scientific American - J. Tuzo Wilson.
- 9) Precambrian Geology of India - S.M. Naqvi and J.J.W. Rogers
- 10) Archaean Geology- C.S. Pitchimuthu.

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOME:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3
CO2	3	3	2	3	1	3
CO3	3	3	3	3	3	3
CO4	3	2	3	2	1	3
CO5	3	3	2	2	1	3

G.1.3. (22): INDIAN STRATIGRAPHY AND PALEONTOLOGY

COURSE OBJECTIVES:

- ▲ From this paper, the student will be able to understand the Principles of Stratigraphy, basis for stratigraphic classification and the Indian Geological Systems.
- ▲ The students will also get knowledge about mega and micro fossils and their significance with reference to Stratigraphy.
- ▲ The course is intended to familiarize the student with functional morphology, classification and evolution of different animal and plant fossils. The content includes Micro fossils and their applications, divisions of the Marine Environment and their characteristic Fauna and Flora.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the principles of stratigraphy and role of Non-paleontological and Paleontological criteria in stratigraphic classification. The students can learn the history and formation of Geological Time Scale.	Understand
CO2	Learn the sub-divisions of Litho-Stratigraphic classification.	Analyze
CO3	Get knowledge about the distribution of Indian geological systems and their components.	Apply
CO4	Classification and evolution of some important fossil groups of both animal and plant fossils.	Analyse
CO5	Gain knowledge in Micro Paleontology, their distribution in Marine environments and their significance in Indian stratigraphy.	Apply

Units	Content	Hours
I	1) Elements of Stratigraphy - Criteria for stratigraphic Classification and Correlation, Non – Paleontological criteria; Order of Superposition, Petrographical characters. 2) Paleontological Criteria – Index fossils, Fossil assemblage, Phylogeny, Micropaleontology. 3) 3. Standard Stratigraphic Scale, Geological Time Scale.	15
II	1) Lithostratigraphic Classification – Super Group, Group, Formation, Member, Beds. 2) Bio stratigraphy, Magneto stratigraphy, Cyclostratigraphy and Event stratigraphy; Seismicstratigraphy and Sequence stratigraphy	15
III	1) Indian Stratigraphy – Sargur Super group, Dharwar Super group, Cuddapah Super Group, Kurnools, Delhi super group, Vindhyan Group, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Thiruchirapalli, Gondwana Sequences, Siwaliks and Deccan Traps.	15
IV	1) Functional morphology, Classification and Evolution of Trilobita, Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Echinodermata and Graptolites, Protozoa. Functional morphology, evolution and significance of Plant Fossils, Horse, Elephant and Man	15

V	1) Introduction of Microfossils, Applications of Microfossils. Kingdoms of life. Stratigraphic distribution of major microfossil groups of India. 2) Morphology, Ecology distribution and outline classification of Foraminifera. Role of Foraminifera in hydrocarbon exploration. 3) Pollen and spores and their stratigraphic and paleoecological significance.	15
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TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED BOOKS:

- 1) Stratigraphic Principles and Practice -Weller,M.,.
- 2) Principles of Stratigraphy - Dunbar,C.S. &Rodgers,J.
- 3) Geology of India - Wadia, D.N.
- 4) Geology of India and Burma – M.S Krishnan.
- 5) Fundamentals of Historical Geology and Stratigraphy of India – Ravindra Kumar
- 6) Outlines of Paleontology - Swinnerton, W.H.
- 7) Paleontology- Evolution and animal distribution - Jain, P.C. and Anantharaman,
- 8) Evolution of the vertebrates - Colbert, E.H.
- 9) Paleontology of Invertebrates - M. Henry Woods
- 10) An introduction to the study of fossil plants - Walton, J.
- 11) Invertebrate Paleontology and Evolution - Clarkson, E.N.K.
- 12) Elements of Micropaleontology - G. Bignot.
- 13) Micropaleontology – M.D. Brasier.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	2	1
CO2	3	1	2	1	3	2
CO3	3	3	2	1	2	2
CO4	3	3	3	3	2	2
CO5	3	2	3	3	3	3

G.1.4. (A) (22): GEOMORPHOLOGY AND ENGINEERING GEOLOGY

COURSE OBJECTIVES:

- ▲ The overarching objective of the Geomorphology understanding of natural processes which act on the earth's surface and landforms.
- ▲ The course also considers some of the practical aspects of reading a topographical, geomorphological map, aerial photos and satellite imageries, recognize the landforms understanding the natural processes.
- ▲ This course also focuses on the applied and exploration aspects so as to enable the student to apply this knowledge in the relevant fields of Geomorphology.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	1. Students will acquire the knowledge of the physical processes that form the landscape.	Knowledge
CO2	They are able to analyze variations of topographic maps, aerial photos and satellite photos to understanding and applications of various aspects like engineering.	Understanding
CO3	The course also considers geological knowledge for the practice of engineering aspects.	Knowledge
CO4	The geological knowledge will help to choose right site selection	Application
CO5	Students will understand causes and failures of engineering constructions.	Analysis

Units	Content	Hours
I	<p style="text-align: center;">GEOMORPHOLOGY</p> 1. Scope, outline and concepts of Geomorphic principles 2. Exogenesis process and topographic forms:- (i) Fluvial (ii) Aeolian (iii) Marine (iv) Glacial (v) Weathering and mass- wasting 3. Endogenesis process and topographic forms:- (i) Volcanic (ii) Fold and fault	15
II	1. Planation an and planar surface – Concepts of Peneplation and Pediplanation 2. Statisical study on drainage basin and terrain morphometry 4. Conventional and modern study:- (i) Topomap (ii) Aerial photo and satellite image 3. Applied and exploration study :- (i) Ground water (ii) Mineral exploration	15

III	ENGINEERING GEOLOGY Building stones and Road metals:- (i) Types (ii) physical and engineering properties 2. Landslides :- (i) Types (ii) Properties (iii) Restoration measures 3. Soils – (i) Types (ii) Textural classes (iii). Properties and mechanics 4. Coastal erosion:- (i). Topography and nature (ii). Tidal dynamics	15
IV	1. Geological investigations for site and route section:- (i) Dams and reservoirs and different designs 2. Historical study on problems of river valley projects – failures and results:- (i) River flooding (ii) Water supply (iii) Erosion and siltation	15
V	1. Geomorphological and engineering applications:- (i).Statistical study on drainage basin and terrain morphometry (ii) Geo-environment projects, 2. (i) Mega-engineering projects (ii) Tunnels and canals, (iii) Road ways and ghat ways.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS:

GEOMORPHOLOGY

- 1) Principles of Geomorphology – William D. Thornbury, 1984, Wiley Eastern Limited.
- 2) Fundamentals of Geomorphology – Richard John Huggett (Routledge Pub. London),2007
- 3) Key concepts in Geomorphology – Bierman and Montgomery (W.H.Freeman)
- 4) Introduction to Coastal processes and Geomorphology – Robin Davidson Arnott, 2010
- 5) Introduction to Physical Geology – A. N. Strahler (John wiley)
- 6) Fluvial Processes in Geomorphology (1964) L. B. Leopold Eurasia Publishing House, New Delhi.
- 7) A text book of, Geomorphology – P. G. Worcester.

ENGINEERING GEOLOGY:

- 1) Engineering Geology – Parbin Singh
- 2) Engineering Geology for Civil Engineers (1995). – D. Venkata Reddy Oxford & IBH, New Delhi.
- 3) Engineering Geology – Dimitri
- 4) Textbook of Engineering Geology-Chennakesavulu, B.S.Publications, New Delhi.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

Courses Outcomes G.1.4	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	1	2
CO2	3	3	3	2	1	1
CO3	2	2	3	2	1	2
CO4	3	1	2	1	1	2
CO5	3	2	2	3	1	1



G.1.4. (B) (22): GEMOLOGY

COURSE OBJECTIVES:

- ▲ To learn origin, classification of gemstone resources and their stratigraphic units in India.
- ▲ To learn and examine the nature, quality and rarity of the gemstones.
- ▲ To understand the physical and optical properties of gemstones.
- ▲ To give an idea about the gemstone testing instruments.
- ▲ To gain knowledge and to provide skills to become a successful Gemologist.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Learn about gemstone resources and their stratigraphic units in India.	Knowledge
CO2	Understands the formation, classification and properties to final the grading and evaluation.	Understand
CO3	Knowledge in order to identify original gemstones and stimulants.	Analytical and Skill
CO4	Gain knowledge on quality enhancement methods.	Skill
CO5	Acquire skills which will be useful to them in gem industry.	Skill

Units	Content	Hours
I	Gem Industry in India and the world – qualities of gem stones – Navaratnas – Geological Distribution – Associated rock types – Mode of occurrence – Distribution in India – Distribution in the world – Uses of gem stones as Jewelry, property and Medicinal – Exploration for gems. Measurement Units. Role of Geologist in Gem Industry.	15
II	Physical properties of gemstones – Identification of gems by X-ray diffractometry – Refractive Index – Critical angle – R.I. measurement – Immersion cell and relative Indices – Use of refractometer, reflectivity meter, spectrometer, polariscope, gemological microscope, Loupe and Petrological Microscope.	15
III	Mineral Chemistry, structure and color of gems – Internal arrangement of atoms, bonding – Isomorphism – Polymorphism – Pseudomorphism – Causes of colors – Chromophores, color centers, luminescence – Alexandrite Effect – Color zoning – Use of crossed filters and Chelsea filters – Flaws in gemstones. Identification of organic and miscellaneous gems.	15
IV	Colour distinction - Enhancement and treatments – enhancement methods: coloured and colourless impregnation, Dyeing, Bleaching and its identification – Methods of treatment – Laser drilling, Irradiation, Heat treatment, Surface modifications, Diffusion treatment and its identification – Composites; Types, Classification and Identification.	15

V	Gem cutting and Polishing – Styles of cutting – Cabochon cut – Faceted cut – Proportion of cutting – Planning – Diamond cutting – Colored stone cutting– polishing abrasives – Fabricated stones – bead making – carving and engraving –synthetic gemstones – Techniques of gem synthesis – Diamond synthesis – Lapidary.	15
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TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED READINGS:

- 1) “Gems and Gem Industry in India” by R. V. Karanth (Memoir 45, Geological Society of India, Bangalore, 1st Ed. 2000)
- 2) “Diamonds in India” by T. M. Babu (Geological Society of India, Bangalore, 1998)
- 3) “Precious Stones” by CurzioCipriani (Mecdonald& Co. (Publishers) Ltd., London.
- 4) “Manual of Mineralogy” by Cornelis Klein and Cornelius S. Hurlbut. Jr (John Wiley & Sons Publication)
- 5) “Mineralogy” by L. G. Berry and Brian Mason.
- 6) “An Introduction to the rock forming Minerals” by Deer, Howie and Zussman (ELBS Edition)
- 7) “Mineralogy” by Dexter Perkins (2nd Ed. Prentice Hall of India Private Limited).
- 8) Anderson, B.W (1990): Gem testing (10th edition), Butterworth Scientific, London.
- 9) Hall, C. (1994): Gemstone, Dorling Kindsley, London.
- 10) Kerr, P.F. (1997): Optical mineralogy, 4th Ed. McGraw Hill Book & Co, New York,
- 11) Peter Read (1991): Gemmology 2nd Ed., Butter worth - Heinemanu Ltd. Lundu.
- 12) Richard Laddicoat (1987), Handbook of gem identification - G.I.A.
- 13) Santa Monica., Edward Gubelin (1986): Photo Atlas of Including Gem Stones – ABC Edition, Zurich, Gem Testing10th Ed.
- 14) Anderson, B.W. (1990): Gemstone Enhancement 2nd Edition, Butterworth Scientific London.
- 15) Nassau, K. (1994): Gemstone Enhancement; Butterworths, London.
- 16) Webster, Robert, 1980: Gems, 5th Ed, Butterworths, London.
- 17) Dorling Kindersley, (1994): Read, P. Gemmology. Butterworth Heinemann,
- 18) O’ Donoghue, M. (1999): Identification of Gemstones.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	3	2	3	2	2
CO3	2	3	3	3	2	2
CO4	2	3	3	3	2	1
CO5	2	2	3	3	2	3



G 1.4. (C) (22): CLIMATOLOGY

COURSE OBJECTIVES:

- ▲ To produce post-graduates who possess quantitative, scientific reasoning skills that can be applied to atmospheric problems.
- ▲ To understand the skills for interpreting and applying atmospheric observations and knowledge of the atmosphere and its evolution.
- ▲ To understand the physical basis of the natural greenhouse effects and various human activities which are increasing emissions of the natural greenhouse gases.
- ▲ To understand and explain the causes of climate change.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Possess scientific reasoning skills that can be applied to atmospheric problems	Skill
CO2	Learn to explain short- and medium-term weather forecasts based on sound meteorological principles.	Analyze
CO3	Know about the Impact and interpret weather forecasting.	Analyze
CO4	Learn about precipitation and gain overall knowledge of storms	Analyze
CO5	Explore the Impacts of climate change	Apply

Units	Content	Hours
I	Latitudes & Longitudes. Standard Time. Motions of the earth: Rotation and Revolution, Atmosphere: Role, Structure & Composition, Temperature Distribution on Earth Insolation & Heat Budget. Geographical distribution of the climatic types – Koppen's and Thornthwaite's classification of climate.	15
II	Lapse rate – Atmospheric stability, Latent Heat of Condensation, Atmospheric Pressure Belts and Wind Systems. Factors Affecting Wind movement, Coriolis Force, Types of Winds: Permanent, Secondary & Local Winds. Types & Effects on Weather, Geostrophic Wind, Jet Streams & Rossby Waves, Major Jet Streams: Subtropical Jet Stream & Polar Jet Stream.	15
III	Air Mass - Air masses based on Source Regions, Fronts, Types of Fronts: Stationary Front, Warm Front, Cold Front & Occluded Front, Humidity: Relative Humidity & Dew point, Condensation, Forms of Condensation: Dew, Fog, Frost, Mist, Types of Clouds.	15
IV	Precipitation: Types of Precipitation, Types of Rainfall, Thunderstorm, Thunder & Lightning, Tornado. Tropical Cyclones: Favorable Conditions for Formation, Stages of Formation & Structure, Storm Surge, Naming of Cyclones.	15
V	Climate Change: Introduction, definition - Classification of climate; - Climatic changes through geological time, Assessing climate change, Human intervention on climate change - Greenhouse effect, greenhouse gases, Climatic change and global warming, Kyoto protocol. Causes of climate change: - Ocean circulation pattern, Changes in compositions of atmosphere, Changes in solar radiation - Impact of climate change: Rising of CO ₂ , impact on atmospheric circulation & weather pattern – biosphere – hydrosphere – Sea level changes, Adaptation provinces.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Bernard Haurwitz and James, M. Austin, Climatology, McGraw Hill publications, Newyork & London.
- 2) D.S. Lal., Climatology
- 3) Austin Miller. A., Climatology
- 4) B.S. Negi., Climatology and oceanography.
- 5) Climatology: Thomas A Blair
- 6) Grant R Bigg: The Oceans and Climate
- 7) Alan, H. Strahler and Arthur, N.Strahler1992: Modern Physical Geography, Fourth Edition, John Wiley & Sons. Inc
- 8) Alan Strahler and Arthur Strahler (2002): Physical Geography, 2ndedition, John Wiley & Sons Inc.
- 9) Byers (2005), Meteorology, The Encyclopedia of Britannia, 15th Ed.
- 10) Dorothy J. Meeritts and Andrew De(1997): Wet & Kirsten Menking, Environmental Geology – W.H. Freeman and Company, New York
- 11) Horace General, (1994): Meteorology, McGraw Hill., New York
- 12) John, M. Das (1995): The Monsoons, National Book House Trust, New Delhi (Third Edition)
- 13) Rev. Fr. S. Ignacimuthu (2010): Environmental Studies, MJP, Publishers,
- 14) Travis Hudson (2012): Living with Earth-An Introduction to Environmental Geology, PHIL earning Private Ltd.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	2	3	3	2	1
CO3	3	2	2	2	1	1
CO4	3	2	2	2	1	1
CO5	2	1	2	2	1	1

PRACTICALS:

G.1.1. (22): MINERALOGY AND CRYSTALLOGRAPHY

- 1) Megascopic and Microscopic study of silicate, non-silicate minerals and Gem stones
- 2) Calculation of mineral formulae from chemical analysis of silicate Minerals and their identification based on chemical data.
- 3) Crystal Models – Symmetry Elements and Forms; Habit of important minerals. Stereographic projections.
- 4) Exercises on Etching and staining of minerals.
- 5) Determination of R.I. and order of Interference colours in thin sections.

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G.1.2. (22): STRUCTURAL GEOLOGY

- 1) Calculation of true & apparent dip.
- 2) Estimation of thickness – Depth of ore body.
- 3) Determination of Throw/Heave/Stratigraphic separation etc., related to faults.
- 4) Preparation and interpretation of geological maps and sections.
- 5) Use of Stereo net in structural problems.

G.1.3. (22): INDIAN STRATIGRAPHY AND PALEONTOLOGY

- 1) Preparation of different stratigraphic distribution maps of India.
- 2) Recognition of Fossil Groups - Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Trilobita, Echinodermata, Graptolites and plant fossils.
- 3) Construction of Biostratigraphic range charts and paleoenvironmental analysis of well sections.
- 4) Study of paleogeographic Maps.
- 5) Study of morphological characters and taxonomy of selected Foraminifera and Ostracoda.

&

G.1.4. (A) (22): GEOMORPHOLOGY & ENGINEERING GEOLOGY

GEOMORPHOLOGY

- 1) Topomap interpretation:– (i). Physiography, (ii). Drainage (iii). Structural trends (iv). Lineaments (v). Geomorphic study (vi). Hydromorphical study
- 2) Preparation and interpretation of topographic profiles from topomaps
- 3) Delineation of catchment areas of drainage basin and morphometry analysis
- 4) Study of remote sensing data :- (i). Aerial photo (ii). Satellite multi spectral image

ENGINEERING GEOLOGY:

- 1) Topomap study on topographic environment for ideal site and route selection:-
- 2) (i) Dams (ii) Reservoirs (iii) Canal alignment (iv) Check dams (v) Flood water storage (vi) Ghat roads
- 3) Identification of building stones and rock metal and study for physical and engineering properties
- 4) Visit to barrages, power houses, tunnels etc.

(Or)

G.1.4. (B) (22): GEMOLOGY

- 1) Megascopic Identification of some important gem minerals based on physical properties.
- 2) Identification of polished or finished gem stones.
- 3) Microscopic studies of some important gem minerals using petrological microscope.
- 4) Measurement of R. I. of gem minerals.
- 5) Exercises to distinguish between synthetic gems and natural gems.
- 6) Gem cutting methods and drawing styles of cutting.

(Or)

G.1.4. (C) (22): CLIMATOLOGY

- 1) Geographical distribution of the climatic types.
- 2) Explain Structure & Composition of atmosphere with neat sketches.
- 3) Atmospheric Pressure Belts and Wind Systems.
- 4) Explain the monsoons of the India with neat sketches.



**SECOND
SEMESTER**

M.Sc. GEOLOGY

SEMESTER-II

G.2.1. (22): IGNEOUS AND METAMORPHIC PETROLOGY

COURSE OBJECTIVES:

- ▲ The Igneous petrology is to elucidate the physico-chemical characters of magma and its tectono magmatic settings will be understood by the study of these rocks.
- ▲ The structural, textural features and classification of igneous rocks will be described.
- ▲ To discuss metamorphic factors, structural and textural characters.
- ▲ Metamorphic processes and types of metamorphism will be described.
- ▲ This course aims to enable students to identify critical mineral assemblages, textural and mineral chemical data as well as provide theoretical basis for interpreting this data for past geodynamic processes, especially the orogenic events.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the structural and textural features of igneous rocks. And to study the different silicate systems	Understand
CO2	Understand the classification of igneous rocks and to identify geochemical variation diagrams to know petrological processes.	Analyse
CO3	Petrographical study of different igneous suits.	Analyse
CO4	Understand Metamorphic processes and application of basic concepts in metamorphic reactions and facies concepts	Understand and Apply
CO5	Describe the different metamorphic zones and grades	Analyse

Units	Content	Hours
I	1) Forms of Igneous Rocks 2) Mega and Micro -Structures 3) Textures of Igneous rocks 4) Reaction series in magmatic system 5) Phase equilibrium of single, binary, Ternary silicate systems	15
II	1) Classification of Igneous rocks, Norm (CIPW) and Niggli values 2) Petrographic Provinces-Variation Diagrams 3) Trace elements in Petrological processes 4) Magmatic differentiation and Assimilation.	15
III	1) Petrography of the following groups: a) Granite-Granodiorite-Diorite b) Syenite-Nephelinesyenite c) Gabbro-Peridotite-Dunite d) Dolerite e) Rhyolite-Trachyte-Dacite f) Andesite-Basalt g) Phonolite-Leucitophyre. 2) Petrography and origin of the following: Pegmatites, Maffic rocks, carbonatites, Lamprophyres, Monomineralic rocks.	15

IV	1) Nature of Metamorphism and factors controlling metamorphism. 2) Structures and textures of metamorphic rocks. 3) Metamorphic Minerals and processes. 4) Metamorphic Zones and Mineralogical grade. 5) Mineral paragenesis and metamorphic facies. 6) ACF, AKF and AFM diagrams.	15
V	1) Classification of metamorphic rocks. 2) Cataclastic, Regional and contact metamorphism of argillaceous, arenaceous, calcareous and basic igneous rocks. 3) Mylonite Zones. 4) Burial Metamorphic bodies. 5) Regional dynamothermal metamorphic bodies. 6) Schorl Rocks. 7) High pressure facies. 8) Low-pressure facies. G) serpentinites.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- ★ Assignments
- ★ Seminars
- ★ Class Tests

SUGGESTED BOOKS:

- 1) Igneous and Metamorphic Petrology by Myron G. Best.
- 2) Igneous Petrology by Anthony Hall.
- 3) Igneous and Metamorphic Petrology by Anthony R. Philpotts.
- 4) Metamorphic Petrology by Francis J. Turner.
- 5) Petrogenesis of Metamorphic Rocks by H. G. F. Winkler.
- 6) The Principles of Petrology by G. W. Tyrrell.
- 7) Igneous and Metamorphic Petrology by Turner and Verhoogen.
- 8) The study of rocks in thin sections by W. W. Moorhouse.
- 9) Petrographic Methods and calculation by Arthur Holmes.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	3	3	2	2	1
CO3	2	2	3	2	2	2
CO4	3	1	2	2	2	1
CO5	1	2	3	3	2	2

G. 2.2. (22): INDIAN MINERAL DEPOSITS AND MINERAL ECONOMICS

COURSE OBJECTIVES:

- ▲ To understand the various ore-forming processes and classification of minerals.
- ▲ Emphasizes the occurrence, distribution and industrial utility of various metallic and non-metallic minerals/ores in India.
- ▲ Estimation of ore reserves based on geometric and graphic methods. Gain the knowledge on the economic and policy issues related to minerals and their national importance.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Understand the origin of the common ore minerals in the earth crust.	Understand
CO2	To acquire the knowledge of the wide range of ore deposits, the geometry of ore bodies, alteration patterns and assemblage of ore and gangue minerals	Knowledge
CO3	To analyze the industrial suitability of the different metallic and non-metallic minerals and their distribution in India.	Analysis
CO4	Analyze the country mineral resources during deficiency and surplus times in view of war and peace times.	Analysis
CO5	To develop the new skills/technologies to use the low grade, scrap, synthetics for conservation of mineral resources.	Skills

Units	Content	Hours
I	Introduction: Classification of economic mineral deposits. Mode of occurrence and formation of ore deposits; magmatic concentration, hydrothermal processes (cavity filling and replacement), contact metasomatism, oxidation and supergene enrichment, residual and mechanical concentration, sublimation, evaporation, sedimentation and metamorphism.	15
II	Geological setting, characteristic features, genesis, distribution and uses of metallic Ore deposits of India - Iron, Manganese, Chromium, Aluminum, Nickel, Titanium, Molybdenum, Gold, Silver, Platinum, Copper – Lead – Zinc deposits of India.	15
III	Geological setting, Characteristic Features, Genesis and Uses of Non - Metallic Ore deposits of India – Magnesite, Asbestos, Phosphorates, Limestone, Marble, Barytes, Diamonds, Graphite, Apatite, Talc, Gypsum, Calcite and Mica.	15
IV	Concept of Mineral Economics. Significance of Minerals in Nations Economy. Use of various Minerals in Manufacturing Industries – Metals, Non-Metals, Fuels. National Mineral Policy. Classification of Minerals – Major, Minor, Fuels, Industrial Minerals. Strategic, Critical and Essential Minerals.	15
V	Reserves, production and distribution of various minerals in the world. Tenor grade & Specifications of important Minerals with examples. Conservation and Substitution of Minerals – Low grade, Ores use of scrap, New technologies, Synthetics & Synthesis. Changing Pattern of Mineral Consumption. Growth of Mineral Industry and Economy in India & Andhra Pradesh. Minerals and Mineral based Industries in Andhra Pradesh.	15

TASKS AND ASSIGNMENTS:

Each Student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS:

- 1) Introduction to India’s economic Minerals by N. L. Sharma and K. S. V. Ram.
- 2) Economic Mineral deposits by Jensen and Bateman.
- 3) Indian Bureau of Mines – year books.
- 4) Ore deposits of India by Gokhale and Rao, T. C.
- 5) Indian Mineral deposits by S. Krishna Swamy.
- 6) An Introduction to Mineral Economics by K. K. Chatterjee, Wiley Eastern Ltd.
- 7) Mineral Economics by R. K. Sinha and N. L. Sharma.
- 8) Economic Geology by Umeshwar Prasad.

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOME:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	1	3
CO2	3	3	3	3	1	3
CO3	3	3	3	3	1	3
CO4	3	3	3	2	1	2
CO5	3	3	3	2	1	2

G.2.3. (22): ENVIRONMENTAL GEOLOGY

COURSE OBJECTIVES:

- ▲ Objective of this course is to enable the students to know about the fundamental principles, basic concepts of environmental geology, Ocean water circulatory patterns and Earth processes.
- ▲ This course aims to equip students with causes of natural disasters and mitigation. It also helps to understand the interaction of humans with the geological environments and their impact on natural resources.
- ▲ Further, the paper gives knowledge about the influence of Geological factors on human health and Environmental legislation.

COURSE OUTCOME (CO's):

	Course Outcome	Level
CO1	Understand the basic concepts of environmental geology	Understand
CO2	Understand cause and effect of various major climatic shifts. Study of Ocean-Atmosphere link and their effects on climatic variation.	Understand
CO3	Apply the concepts of environment impact by various agents (Hazards)	Apply
CO4	Interaction of humans with the geological environments and their impact on natural resources.	Apply
CO5	Impact of different geological factors on human health and environmental legislation.	Analyze

Units	Content	Hours
I	1. Environmental Geology : (a) Introduction -fundamental principles, objectives, and scope (b) Basic concepts 2. Earth system and its components 3. Earth materials and processes: (a) Plate tectonics (b) Geological cycles-rocks, minerals, soils and water (c) Surface processes for landform development	15
II	1. Ocean : (a) Water circulatory patterns (b) Impact on climate and weather 2. Climate : (a) Structure and composition of atmosphere (b) Solar radiation and heat balance (c) Global wind circulation and rainfall distribution 3. Classification of climates – Koppen" s and Thornthwaite" s scheme of classification. 4. Climate change and global warming: (a) Natural and man-made reasons. (b) Effects on ecosystems, natural resources, surface and ground water, soil fertility, food production, energy consumption, coastal regions and sea level, diseases.	15

III	1. Natural events and hazards (Nature, cause, damage, and preventive methods) : (a) River flooding (b) Cyclones and storms (c) Earth quakes and volcanoes (d) Landslides and avalanches (e) Coastal process and tsunamis 2. Soil erosion and degradation: (a) Types of erosion and degradation (b) Conservation and management practices	15
IV	1) Human interaction and impacts - Surface and underground mining, Mineral development. 2) Industrialization and urbanization: (i) Air pollution- change in heat balance, effects of greenhouse gases, water vapour and other particulates; acid rains (ii) Depletion of natural vegetation. 3) Surface and ground water hydrology- water supply and use, water pollution and degradation, water management; waste disposal 4) Land evaluation and planning for land use practices	15
V	1. Geological factors and human health: Role of trace elements of fluorine, Iodine, zinc, selenium, lead, arsenic and mercury. 2. Geologic environment for certain chronic diseases – heart, lung and cancer 3. Environmental legislation.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

REFERENCE BOOKS:

- 1) Environmental Geology –Edward A. Keller (CBS Publishers and Distributors)
- 2) Environmental Geoscience -Strahler A.N. and Strahler A.H. 1973 (Hamilton Pub)
- 3) Environmental Geology in Indian context – Valdiya K.S (McGraw Hill)
- 4) Fundamentals of Physical geography – Text book for XI, NCERT
- 5) The Earth's changing surface – Bradshaw M.J and Abbott A.J and Gelsthorpe 1978 (ELBS Pub)
- 6) Earth the living Planet – Bradshaw M.J 1979 (ELBS)
- 7) Geological hazards resources and Environmental Planning – Gary B. Griggs and John A gilchrist (Wadsworth pub. Calif)
- 8) Geology in Environmental planning – Arthur D Howard and Irwin Remson (McGraw Hill)
- 9) Oil Erosion and Conservation – Tripathy R.P and Sing H.P (Wiley Eastern Ltd)
- 10) The Dynamic Earth System _ Patwardhan A.M (Prentice Hall)
- 11) India's Environmental problems and perspective – RadhaKrishna B.P and Ramachandran K.K (Geological Society of India)

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	2
CO2	2	3	2	2	1	1
CO3	2	3	3	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	1	1	2	2



G.2.4. (A) (22): SEDIMENTOLOGY AND MARINE GEOLOGY**COURSE OBJECTIVES:**

- ▲ The Course paper objective is the interpretation of ancient environmental conditions in sediment source areas and depositional sites.
- ▲ Sedimentological constituents, textures, structures, and fossil content of the deposits laid down in different geographic environments.
- ▲ It provides difference between continental, littoral, and marine deposits of the geologic record.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Students will get the knowledge about the process of sedimentation according to rock Cycle.	Knowledge
CO2	This course is designed to know complete study of structures and textures of sedimentary rocks	Knowledge
CO3	This course will help to apply geophysical techniques for observing the seabed and sub-seabed.	Application
CO4	The course will provide complete knowledge about of sea level changes, geological timescale and causes of formation of corals	Understanding
CO5	Students will be able to know about the new concepts i.e., fluid mechanics	Knowledge

Units	Content	Hours
I	1. Sedimentary Processes – Physical processes: Shearing, Classifying and Naming of Sedimentary rocks- Descriptive and Genetic classifications: Limestones, Authigenic rocks, Carbonaceous rocks, Terrigenous rocks (Shales, Sandstones, Conglomerates, Breccias, Pyroclastic rocks).	15
II	1 Sedimentary Rocks – Brief study of texture, structure, chemical composition and mineralogical composition of Conglomerates, Breccias, Sandstones, Shales and Limestones. 2 Provenance Studies – Lithology, position, distance and climate of source area, relief and tectonism. 3 Lithification and Diagenesis – Lithification, diagenesis, compaction pressure solution, carbonate cementation, source of calcium carbonate cement. Lithification by sea water and fresh water.	15
III	1. Morphology of the Oceans – Hypsometry, Continental Shelf, Continental Slope, Continental Rise, Ocean Basin floor, Ocean ridges. 2. Oceanic Crust-Structure: Seismic refraction Seismic reflection, Deep sea Drilling Dredging of Fracture Zones, Ophiolitic complexes. Petrology and sources of oceanic crust.	15
IV	1. Ocean circulation – Surface circulation: Surface water temperatures salinities, Density and wind,	15

	2. Elements of surface circulation – The Coriolis Effect, Geostrophic currents, 3. The Ekman spiral, Upwelling, Equatorial currents, Western Boundary currents, Deep circulation. 4. Sea-Level History and Seismic stratigraphy – Importance of Sea – Level changes and its causes, Quaternary - Mesozoic – Tertiary sea level Changes. 5. Coral Reefs – Classification and origin – Coral Reefs – Favorable conditions , classification, origin, uses, threats.	
V	1. Classification of sediments and origin. Fluid mechanics and Transport Mechanics. 2. Methods of exploring the Ocean floor and Sediment sampling Methods- Echo-Soundings, Grab/Snapper sampler, 3. Coring devices, Bottom Photography, Diving.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

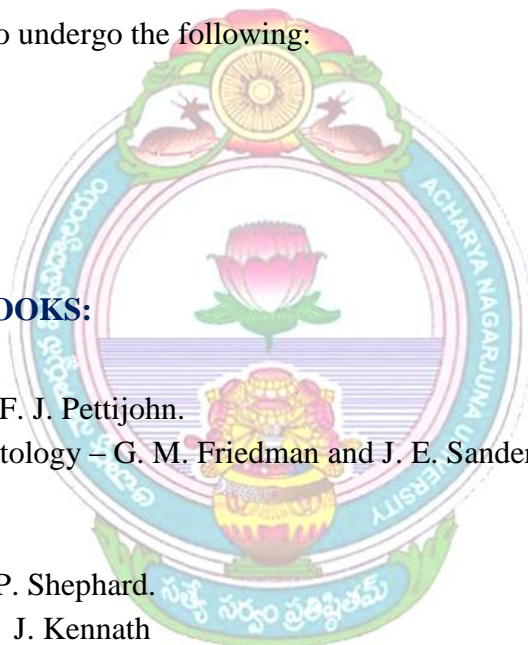
SUGGESTED TEXT BOOKS:

SEDIMENTOLOGY:

- 1) Sedimentary Rocks – F. J. Pettijohn.
- 2) Principles of Sedimentology – G. M. Friedman and J. E. Sanders.

MARINE GEOLOGY

- 1) Marine Geology – F. P. Shephard.
- 2) Submarine Geology – J. Kennath
- 3) The Mineral Resources – John L. Mero.



COURSE OUTCOMES VS PO's MAPPING:

Courses Outcomes G.2.4	Program Outcomes Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	2	1	1	1	2
C02	3	2	1	2	1	3
C03	2	1	2	3	1	1
C04	2	1	2	2	1	2
C05	2	3	2	3	1	3

G2.4. (B) (22): NATURAL HAZARDS AND DISASTER MANAGEMENT**COURSE OBJECTIVES:**

- ▲ To understand the origin and types of disasters
- ▲ To Compare hazards, disasters and associated natural phenomena and their interrelationships, causes and their effects
- ▲ To build skill to respond to disasters

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the origin of different disasters	Understand
CO2	Learn about the different types of natural disasters	Knowledge
CO3	Identify the different types of manmade disasters	Analyze
CO4	Adopt the laws and regulations towards hazard management	Apply
CO5	Prepare controls of mitigating toward natural disasters.	Skill

Units	Content	Hours
I	Introduction- Hazard and Disaster: Definition and Terminologies, Classification. Understanding Disaster Management: Comprehensive Disaster Management Plan and its Elements Disaster Management Act-2005 and its Institutional Framework- Policy and Administrative frame work for Disaster Management	15
II	Understanding Natural Disasters: Earth Quake, Landslides, Avalanches, Volcanic eruptions. Heat and Cold waves, Coastal Disasters, Cyclone, Flood, Drought, Tsunami	15
III	Understanding Man-made Disasters: Nuclear Disasters, Chemical Disasters. Biological Disasters, Building fire, Coal fire, Forest fire and Oil fire, Rail accident, Road accidents, Air accidents, Sea accidents, Dams and Dam bursts, Air pollution. Water pollution, Industrial pollution, Climate change: Global warming, sea level rise, Ozone Depletion	15
IV	Hazard, Risk and Vulnerability: Concept and Elements, Risk Reduction Disaster Management Prevention, Preparedness and Mitigation. Disaster Preparedness Plan, Role of Information, Education, Communication and Training. Role of various Agencies in Disaster Response, NGO's, Armed Forces, Police and other Forces	15
V	Potential hazards in Andhra Pradesh with special reference to Floods and coastal erosion during the monsoons.Man-made drought during summer, saline water intrusion along the coastal aquifers – mitigation measures. Cyclone, drought and flood in various parts of India – frequency of occurrence, vulnerable areas- reasons	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) K. S. Valdiya, 2013: Environmental Geology, McGraw Hill Education (India)
- 2) D. Collins Larry, R. and Schneid Thomas, D., 2000: Disaster Management and Preparedness, Taylor and Francis.
- 3) Goel, S.L. and Kumar Ram, 2000: Disaster Management, Deep and Deep Publications.
- 4) Living with Risk: A global review of disaster reduction initiatives, 2004 Vision, United Nations.
- 5) Parasuraman, S., 2004: India Disasters Report: Towards a Policy Initiatives, Oxford University Press.
- 6) Abbot. P.C (2002): Natural Disaster, McGraw Hill Publications New Delhi
- 7) Coates.D.R (1985) Geology & Society – Chapman & Hall Publishers New Delhi
- 8) Davis et.al (1976) Environmental Geosciences – Wiley Eastern
- 9) Howard A.D & Irwin Remson (1978) – Geology in Environmental Planning –McGraw Hill Publishers
- 10) Keller E.A (1976) – Environmental Geology – Charles E Merrill publishers – New Jersey
- 11) Lundgren.L(1986) Environmental Geology – Prentice Hall Publication- New Jersey
- 12) Strahler N & Strahler A.H (1973) – Environmental Geosciences Wiley eastern publishers.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	2	3	2	1	1
CO3	2	3	3	3	1	1
CO4	2	2	2	3	3	1
CO5	2	3	3	3	1	1

G.2.4. (C) (22): ORE DRESSING AND MINERAL BENEFICIATION

COURSE OBJECTIVES:

- ▲ Identification of ores and their constituents.
- ▲ Identification of various aspects of liberation and separation methods.
- ▲ To know the methods of laboratory sizing practice and industrial aspects of sizing equipment.
- ▲ To know Classification principles and application operation of mineral processing equipment.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the ore dressing processes and techniques	Understand
CO2	Knowledge on basic ore dressing operations	Skill
CO3	Methods of ore Separation and its applications	Analyze and Skill
CO4	Knowledge on mineral processing and its economics	Evaluation
CO5	Acquire knowledge on mineral processing tools and machines	Applications and Skill

Units	Content	Hours
I	Ore Dressing - Ore dressing and its importance, low grade ores and their beneficiation. Ore-microscopy and its contribution to ore-dressing techniques. Aggregate properties of minerals and rocks and their consideration in ore dressing techniques.	15
II	Basic ore dressing operations viz. crushing (Primary crushing and Secondary/Tertiary Crushing), grinding, sizing, screening and classification.	15
III	Concentration processes: Magnetic and electrostatic separation, gravity concentration; Froth Floatation, Amalgamation and Agglomeration.	15
IV	Introduction fundamentals of mineral processing. Classification in mineral processing. Importance of mineral processing, economics of mineral processing, occurrence of ores in nature, justification for mineral processing, Role of geologist in mineral processing.	15
V	Crushing, type of crushers, cone crushers, Hammer mill, stamp mill, recent advances in crushing, principles of grinding, dry and wet grinding, trembling mills – Ball mill, types of ball mills, rod mill, types of rod mills.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Gaudin, A.M. Principles of Mineral Dressing. McGraw Hill Pub. Co. Ltd. Bombay.
- 2) Elements of ore dressing – A.F. Taggart.
- 3) Course in mining geology – R.N.P. Araogyaswamy.
- 4) Mineral processing – E.J. Pryor.
- 5) Ore Processing – S.K. Jain.
- 6) Ore deposits of India – Their distribution and processing – K.V.G.K. Gokhale and T.C. Rao.
- 7) Wills, BA. 1988. Mineral Processing Technology. Pergamon Press. Oxford.
- 8) Vijayendra, MG. 1995. Hand book of Mineral Dressing. Vikas Publishing House Pvt Ltd.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	1	2
CO2	3	2	2	2	1	1
CO3	2	3	3	3	1	1
CO4	2	3	3	3	2	2
CO5	2	3	3	3	2	2

SKILL DEVELOPMENT COURSE: FIELD WORK / FIELD TOUR

The course is intended to familiarize students with exposure of rocks, basic techniques of field work, introduction to concepts of geological mapping, hand-on training of mapping in any geological province of interest



PRACTICALS:

G.2.1. (22): IGNEOUS AND METAMORPHIC PETROLOGY

IGNEOUS PETROLOGY:

- 1) Identification of important rock types in hand specimens and thin section study of rocks from India.
- 2) Construction of variation diagrams.
- 3) Calculation of C.I.P.W. Norm (Based on Mineralogical Magazine, 34; 276-282, C. H. Keelsy, 1965)
- 4) Model analysis of rocks by point counting.
- 5) Application of GCB Toolkit – Geochemical, Geotectonic classification plots and Spider diagrams

METAMORPHIC PETROLOGY:

- 1) Identification of following rock types in hand specimens and in thin sections: Slate, Marble, Green-schist facies of rocks (Phyllites-Mica-Schist). Amphibolite facies of rocks (Hornblend schist); Pyroxene facies of rocks (Charnockite); Granulite facies of rocks (Garnetiferous gneisses) Eclogitefacies of rocks (Eclogites); Quartzites; schorl rocks.
- 2) Plotting of metamorphic minerals on ACF, AKF diagrams.
- 3) Determination of finite strain in metamorphic rocks by drawing strain ellipse.

&

G.2.2. (22): INDIAN MINERAL DEPOSITS AND MINERAL ECONOMICS

Physical properties, identification, and industrial uses of Hand specimens of ore minerals of Iron, Manganese, Chromium, Nickel, Tatanium, Molybdenum, Copper, Lead, Zinc, Gold, Silver, Platinum, Bauxite, Phosphorates, limestone, Barytes, diamonds Graphite, Calcite, Micas. Practical assignments on ore deposits. Microscopic identification of ore minerals. Estimation of reserves by geometric and graphic methods.

PRACTICALS:

G.2.3. (22): ENVIRONMENTAL GEOLOGY

- 1) Study the nature of river flooding and construction of Hydrographs
- 2) Procedure to estimate the earth quake magnitude by graphical method
- 3) Study of plate boundaries, seismic and volcanic zones from maps
- 4) Map drawing and interpretation of seismic zones in India
- 5) Study of flood prone areas in river basins from maps
- 6) Study of forest types of India from maps
- 7) Study of soil types and soil erosion in India from maps
- 8) Analysis procedures for a few elements and compounds of water.
- 9) Study of coastal regions of India from satellite images
- 10) Aerial photo study for different terrain environment

&

G.2.4. (A) (22): SEDIMENTOLOGY AND MARINE GEOLOGY

- 1) Study of Primary and Secondary sedimentary structures. Microscopic and Megascopeic study of some important sedimentary rocks-Conglomerate, Breccia, Sandstone, Limestone, Shale, Laterite.
- 2) Separation of Heavy Minerals.
- 3) Microscopic study of Detrital Minerals.
- 4) Estimation of calcium carbonate and organic matter from sediments.
- 5) Preparation of sedimentary maps from analytical data.
- 6) Beach profile measurements.
- 7) Mechanical analysis of sediments and calculation of statistical parameters.
- 8) Demonstration of sampling devices.
- 9) Analysis of Bathymetric charts

(Or)

G.2.4. (B) (22): NATURAL HAZARDS AND DISASTER MANAGEMENT

Evaluation of environmental impact of air pollution groundwater, landslides, deforestation, cultivation and building construction in specified areas.

(Or)

G.2.4. (C) (22): ORE DRESSING AND MINERAL BENEFICIATION

- 1) Horse power (HP) calculation.
- 2) Mass balance of a flow sheet.
- 3) Flow sheet design.
- 4) Performance of a jaw crusher.
- 5) Performance of a hand jig.
- 6) Assignment on a topic of mineral processing design and presentation.
- 7) Visit to a mineral processing industry.



**THIRD
SEMESTER**

M.Sc. GEOLOGY

SEMESTER-III

G.3.1. (22): GEOCHEMISTRY

COURSE OBJECTIVES:

- ▲ The course gives an introduction about the origin of elements and its migration and distribution of various parts of the Earth.
- ▲ The study describes the principles governing the elements and to know about the instruments will give information on analytical techniques and to apply the Radio metric dating method.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the origin of elements and its migration and distribution of various parts of the Earth.	Understand
CO2	Evaluate the Geochemical behavior of elements	Evaluation
CO3	Acquire knowledge on analytical techniques and instruments	Analyses
CO4	Understand the Various geological processes associated with lithosphere and hydrosphere	Understand
CO5	Applications of isotope geochemistry in the field of geochronology	Apply

Units	Content	Horrs
I	1 Origin and Cosmic abundance of elements and nuclides in the Sun and the Earth 2) Geochemistry of the Earth's Crust, Mantle and Core. 3) Geochemical classification of elements. 4) Meteorites and its classification.	15
II	1) Geochemical behaviour of Major elements in the magmatic cycle, Principles governing the Minor elements.2) Laws of Thermodynamics 3) Gibbs free energy, Principles of Ionic substitution in minerals 4) Isomorphism and Polymorphism	15
III	1) Geochemistry of Sedimentary rocks – Physico-chemical factors, products of Sedimentation. 2) Metamorphism as Geochemical Phenomenon – Internal Metamorphism, Metasomatism. 3) Geochemical cycle. 4) Analytical Techniques – Colorimetry, Flame photometry, Atomic Absorption Spectrophotometer.	15
IV	Geochemical mobility under low and high P-T conditions; Geochemical Dispersion, Primary and Secondary dispersion patterns and their classification; Geochemistry of Lithosphere, Atmosphere, Biosphere; Geochemical cycle. Geochemistry of Water, Water – rock interaction, Eh-pH – diagram and natural water environment.	15
V	Radiogenic isotopes, Radioactive decay and growth; Basic ways of dating, Isochrons, Radiometric dating of single mineral and whole rock; Radioactive Decay schemes of U-Th-Pb, Rb-Sr, K-Ar; Geochemistry of Uranium ;and Thorium – Nuclear Reactors, Neutron activation analysis. Application of stable isotopes in Geology.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED READINGS:

- 1) Principles of Geochemistry – Brian Mason & C.B. Moore
- 2) Geochemistry – Gold Schmidt.
- 3) Geochemistry – Rankama and Sahama.
- 4) Introduction to Geochemistry – Krawskopt, K.B., M.C. Graw Hill Applied Geochemistry – F.R. Siegel.
- 5) Stable Isotope Geochemistry – Springer verlag Principles of Isotope Geology – John wily Publication Faure, G; 1986.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	1
CO2	3	2	2	2	1	1
CO3	2	3	3	2	1	1
CO4	2	2	1	1	1	1
CO5	1	2	3	3	2	2

G.3.2. (22): FUEL GEOLOGY (COAL, PETROLEUM AND ATOMIC MINERALS)

COURSE OBJECTIVES:

- ▲ Students will be able to understand fundamentals of coal, coal forming environments, origin, petrography and classification.
- ▲ Application of coal petrography to assess the suitability particular coal for different industries (coke, industrial gas, crude oil and CBM).
- ▲ Students analyze the different hypothesis for origin, accumulation and migration of hydrocarbon.

COURSE OUTCOME (CO's):

	Course Outcome	Level
CO1	To identify the coal forming sedimentary environments. Analyze the different factors for effecting coal formation and its quality.	Analyse
CO2	Apply the concept of macerals to evaluate coal quality and suitability different industrial purposes.	Apply
CO3	Students will understand about the mechanism of petroleum generation from organic materials.	Understand
CO4	Analyze the different factors for the mechanism of oil migration.	Analyse
CO5	To acquire the knowledge on mode of occurrence of atomic minerals in nature and its environmental impact.	Knowledge

Units	Contents	Hrs
I	Geological basis of coal formation – Origin of Peat swamps, paleogeographic and tectonic requirements, development of coal facies. Types of deposition, peat forming plants, nutrient supply, bacterial activity, temperature and redox, potential, diagenesis. Definition and origin of kerogen and coal. Rank, grade and type of coal. Indian and international classifications. Proximate and, ultimate analyses. Macro-lithotypes. Concept of macerals and classification of macerals.	15
II	Preparation of coal for industrial purposes; coal carbonization (coke manufacture), coal gasification and coal hydrogenation. Coal bed methane exploration and production. Coal forming epochs in the geological past. Geological and geographical distribution of coal deposits in India.	15
III	Occurrence of Petroleum: Surface occurrence see pages – Mud volcanoes – disseminated deposits – Vein deposits – Kerogene shale. Subsurface occurrences: Showings – Pools – fields – provinces. Reservoir rock – Classification – nomenclature – fragmental Chemical – miscellaneous. The reservoir pore space. Porosity and permeability. Reservoir traps – general and structural. Classification of traps – Structural traps – caused by folding, faulting and fracturing. Reservoir traps; Stratigraphic traps: Primary stratigraphic traps in clastic rocks and chemical rocks, Secondary stratigraphic traps. Reservoir traps; combination and Salt domes.	15

IV	Origin of Petroleum: Organic origin; nature of organic source material – modern organic matter. Transformation of organic matter into petroleum, bacterial action – heat and pressure – alteration of petroleum. Migration and accumulation of petroleum; primary migration, water squeezed out of clays – normal water circulation – sedimentary oil – recycled oil. Secondary migration; entrained particles – capillary pressure – displacement phenomena – buoyancy – dissolved gas effects – accumulation – tilted oil – water contacts – stratigraphic barriers – vertical migration – time of accumulation.	15
V	Primary and Accessory Atomic Minerals occurrence in Earth Crust. Atomic Minerals as Source of Energy. Types of Uranium Deposits in India; Hydrothermal type – Sandstone type – unconformity type – Strata-bound type -Albitite and other types. Thorium bearing Mineral Resources in India. Nuclear power stations of the country and future prospects. Atomic fuels and environment.	15

TASKS AND ASSIGNMENTS:

Each Student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS:

- 1) Stach's text book of Coal Petrology - Gerbruder Borntralger, Berlin Stuttgart, 1975/1982.
- 2) Text book of Coal (Indian context) - Chandra, D, Sing, R. M and Singh, M. P 2000. Tara Book Agency.
- 3) Geology of Petroleum - A. I. Levorsen.
- 4) Petroleum Geology by K. K. Landes.
- 5) Petroleum Geology – Richard C Shelly
- 6) Petroleum Geology F. K. North.
- 7) Radioactivity in Geology. Principles and Application by Durance E. M. 1986. Ellis Hoor wool.
- 8) Nuclear Geology – U. Aswadhnarayana.
- 9) Tissot, B.P. and Welte, D.H. (1984): Petroleum formation and occurrence, Springer–Verlag

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOME:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	3	3	2	3

G.3.3 (A). (22): STATISTICAL AND COMPUTER APPLICATIONS IN GEOLOGY

COURSE OBJECTIVES:

- ▲ In the current scenario knowledge on Statistics and Computer applications is essential for the students of Geology course.
- ▲ The content of the paper is aimed to impart the knowledge about various applications of statistics to analyze the Geological data.
- ▲ It is also intended to give knowledge on calculation, preparation presentation and management of geological data.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Learn about the various central tendency measures and significance of frequency curves.	Evaluate
CO2	Understand dispersion, symmetry and peakedness of the data, and learn about the difference between the different frequency distributions	Understand
CO3	Gain knowledge on various distributions methods and also various sampling methods	Apply
CO4	Importance of computer applications in geological sciences.	Apply
CO5	Learn to tabulate the geological data, calculation various statistical parameters and Graphical representation by using Excel.	Apply

Units	Content	Hrs
I	1. Introduction, Application of statistics for Geo-Science systems. 2. Collection of Data-Classification and Tabulation-Frequency Distribution – Discrete Frequency distribution – continuous frequency distribution – cumulative frequency distribution. 3. Frequency Distribution, frequency curve and its characteristics – Mean, Median and Mode, Relationship between mean, median and mode.	15
II	1. Cumulative frequency – Characteristics of cumulative frequency curve, Applications of cumulative Frequency curves. 2. Measures of Dispersion – Range, Variance, Standard Deviation, Covariance, Coefficient of variation. 3. Measures of Skewness and Measures of kurtosis.	15

III	1. Normal distribution – Characteristics of Normal curve, Standard scores, Finding the Areas under Normal curve. 2. Binomial distribution – Characteristics, Approximating, uses. 3. Sampling - Theoretical basis, Simple Random sampling, Restricted Random sampling – Grid sampling, Stratified sampling, Cluster sampling.	15
IV	1. Introduction Computer applications in Geology - in Remote sensing, GIS, mining, hydrogeology, structural geology and mapping. 2. M.S Office - Introduction, M S Word, M S Excel, M S Power point, MS Access. 3. M S Word- M S Word – File, Edit, View, Insert, Format, Tools, Table.	15
V	1. M S Excel – File, Edit, View, Insert, Format, Tools, Data. 2. M S Power point- File, Edit, View, Insert, Format, Tools, Slide show, Animation.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS:

- 1) Geostatistics with applications in Earth Sciences. D. D. Sharma, 2002, Capital Publishing Company, New Delhi, 170
- 2) Statistics for Geoscientists – Techniques and applications. Saroj K. Pal, 1998, Concept Publishing Company, 601
- 3) Statistics and Data Analysis in Geology- Davis, J.C., 3rd Edition, John Wiley & Sons, Inc.
- 4) Working in M S Office – Ron Mansfield. Tata McGraw Hill.
- 5) Introduction to Computers – V. Raja Raman.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	2	2
CO2	2	3	1	1	2	2
CO3	1	3	2	2	2	2
CO4	2	2	2	3	3	3
CO5	1	2	2	2	2	2

G.3.3. (B) (22): MICROPALAEONTOLOGY**COURSE OBJECTIVES:**

- ▲ Study of morphological characters and taxonomy of fossils
- ▲ Systematic study of microfossils and exercises related biostratigraphy and environmental applications

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Know about the significance and classification of microfossils	Understand
CO2	Learn about the separation of microfossils from matrix and identification of microfossils.	Evaluate
CO3	Understand the significance of Polynomorphs	Analyze
CO4	Know the significance of mineralized microfossils	Analyze
CO5	Learn about the various applications of micropalaeontology	Apply

Units	Content	Hrs
I	Definition and significance as geological record – Classification of Micro paleontology – Plant microfossils – Animal microfossils - Index fossils.	15
II	Detailed study and distribution Calcareous microfossils – Phosphatic microfossils – Siliceous microfossils – Organic microfossils.	15
III	Detailed study and significance of Polynomorphs – Pollengrain – Plant Spores – Fungal spores – Chiinozoa – Acritarchs – Archean cells.	15
IV	Detailed study and significance of mineralized microfossils – Ostracods – Conodonts – Sebecodonts – Cloudinids – Dinoflagellate cysts – Sponge spicules	15
V	Applications of micropaleontology in the fields of biostratigraphy, palaeoenvironments, petroleum geology and palaeoceanography.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED READINGS:

- 1) “Applied Micropalaeontology” by J M Jenkins
- 2) “Micropaleontology: Principles and Applications” by M S Srinivasan and Pratul Kumar Saraswati
- 3) “Micropaleontology: Application of Stratigraphy and Paleoceanography” by Devesh K Sinha
- 4) “Micropaleontology” by Gandhi M Suresh 5. “Elements of Micropalaeontology” by Gérard Bignot
- 5) Haq, B.U. and Boersma, A. – An introduction to Marine Micropaleontology
- 6) Haynes, J.R. – Foraminifera
- 7) Brasier, M.D. – Microfossils
- 8) Bignot, G. – Elements of Micropaleontology
- 9) Jones, D.J. – Introduction to Microfossils
- 10) Kathal, P.K. – Microfossils and their Applications
- 11) Glaessner, M.F. – Principles of Micropaleontology
- 12) Moore, R.C – Treatise on Invertebrate Paleontology (Two Volumes)
- 13) Van Morkhoven, F.P.C.M. – Post Palaeozoic Ostracoda. (Two Volumes)
- 14) Ramsay, A.T.S. (Ed) – Oceanic Micropaleontology (Two Volumes)
- 15) Hedley, R.H. and Adams, C.G. (Ed) – Foraminifera (Three Volumes)
- 16) John Imbrie and Newell Norman (Ed) – Approaches to Paleoecology
- 17) John W. Neale (Ed) – Principles of Zoological Microplaeontology
- 18) Jain, P.C. and Anantharaman, M.S. – Paleontology-Evolution and animal distribution
- 19) John W. Murray – Atlas of Invertebrate Macrofossils
- 20) Paul Tasch – Paleobiology of the Invertebrates
- 21) Yassini, I. and Jones, B.G. – Foraminifera and Ostracoda from estuarine and shelf environments of the southeastern coast of Australia

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	1
CO2	2	3	3	3	2	2
CO3	3	2	2	2	1	1
CO4	2	2	2	2	1	1
CO5	2	2	3	3	2	2

G.3.3. (C) (22): ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

COURSE OBJECTIVES:

- ▲ To impart knowledge on concept of environmental impact assessment
- ▲ To prepare the database for planning and management of EIA
- ▲ To develop the skills to prepare mitigation measures
- ▲ To understand the Various Acts related to Environment audit

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand the concept and Scope of EIA	Understand
CO2	Get detailed knowledge on soil quality, erosion and prediction	Analyze
CO3	Knowledge on Air quality, pollution and its impacts	Analyze
CO4	Assessment of ground water quality, pollution activities and its impacts	Analyze
CO5	Awareness on environmental legislation	Apply

Units	Content	Hrs
I	Concept and Scope of EIA – Elements and methodologies of EIA – Classification of environmental parameters – Public participation in environmental decision making process – Planning and management of EIA – Criteria for the selection of EIA methodology	15
II	Procurement of relevant soil quality data, Soil erosion types, impacts of soil erosion, prediction, assessment of impacts significance, Identification and incorporation of mitigation measures	15
III	Procurement of relevant Air quality data, Air pollution and its impacts, Wild life and other Ecosystem quality data, impact prediction, assessment of impacts significance, Identification and incorporation of mitigation measures	15
IV	Introduction and methodology for the assessment of ground water, delineation of study area, identification of water pollution activities. Impact of water pollution, assessment of impacts significance, prediction, Identification and incorporation of mitigation measures.	15
V	Need of Environmental audit – Importance of environmental legislation – Classification of environmental audit – Audit data and report - The Air Act – The Environmental Protection Act – The water Act – Wild life Act - Case studies.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) H.S. Bhatia, 2003: A Text Book of Environmental Pollution and Control – Galgotia Publications (P) Ltd, New Delhi.
- 2) Larry, W. Canter, 1977: Environmental Impact Assessment - McGraw-Hill publications.
- 3) Anjaneyulu, Y. and Manickam, V, 2017: Environmental Impact Assessment Methodologies – B.S. Publication.
- 4) BalakrishnaMoorthy, 2008: Environmental Management, 2nd Edn – PHI Publications.
- 5) B.B. Hosetti, and A. Kumar, 1998: Environmental Impact Assessment and Management - Daya Publishing house.
- 6) CANTER L.W., “Environmental Impact Assessment”, International 1996, McGraw Hill Pub. Co. Ltd., New York
- 7) Jain, R.K. Urban L.V.Stracy, G.S. “Environmental Impact Analysis”, 2nd edition, VauNostr and Reinhold Co, New York.
- 8) Anjaneyulu, ValliManickam,” Environmental Impact Assessment Methodologies”, 2nd Edition, B.S.Publications, Sultanbazar, Hyderabad.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	1
CO2	3	2	2	2	1	1
CO3	3	2	2	2	1	2
CO4	2	3	3	3	2	2
CO5	2	2	1	1	1	1

G.3.4. (A) (22): MINING GEOLOGY

COURSE OBJECTIVES:

- ▲ The main objectives are Systematic exploration of mineral deposits for preparing mineral Inventory.
- ▲ The another objective is development and conservation of minerals,
- ▲ To encourage value addition of minerals through promotion of mineral based industries, enforcement of mineral laws and rules.
- ▲ Collection of royalty/cess to generate revenue, ensure scientific mining, safety & welfare measures.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Students will be able to know mineral regulation policies and mining acts	Knowledge
CO2	Students will understand various types of open cast mining methods and drilling techniques	Understanding
CO3	Students will acquire the basics of various types of underground mining methods	Understanding
CO4	Students will understand productivity analysis for the selected mining system;	Analysis
CO5	This course will provide the knowledge of different crushers ,power shovels, dredgers excavators and their uses in mining sector	Applications

Units	Content	Hrs
I	Mines and Minerals (Regulations and development) - Act ,1957 – Mining Lease – Minor Minerals – Prospecting license – Renewal – Royalty and dead rent – Mineral concession rules (1960) – Certification of approval – Mining license for scheduled minerals - Tenor and Grade - Mine Management - Mine Safety, Types of mining methods – Alluvial mining – Pan and Batea – Long tom – Sluicing (Ground Sluicing) – Derrick and cable way – Hydraulic mining – Drift mining – Fore poling and Dredging.	15
II	Open cast mining or quarrying – Bench mining , Glory Hole mining, Kaolin mining ; Strip mining – Rippling , Drilling and blasting , Operations and mining of the minerals from ocean (On the beach – placer deposits, From the Shelf – Sand and Gravel, From the deep – Ferromanganese Nodules)	15

III	Underground Coal Mining – Classification of underground Coal mining methods – Panel system , Board and pillar method, Long wall advancing, Long wall retreating , Horizon mining , Strip mining , mine supports , Lighting, Ventilation. Underground metal mining – Shaft Sinking methods , Gophering , Breast stopping, Open over hand Stopping , Open underhand Stopping , Underground Glory hole mining , Pillar and Chamber method, Sublevel Stopping method, Drifting , Rising and winzing , Lighting, haulage and ventilation.	15
IV	Ore dressing and beneficiation : , Manual crushing : Grinding – Sizing by Screening , Flotation , magnetic separation , Electrostatic Separation ; Concentration of Ore by Washing and Scrubbing, Jigging , Tabling and miscellaneous methods.	15
V	Mining equipments : Power shovels, Dumpers, Scrapers , land dredges bucket wheel excavators, conveyor belt , Spreaders and Drag liners, Jaw crushers, Gyratory crushers ,cone crushers, Sledging rolls, Hammer mill or Pulverator , Stamping, Spring rolls	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED BOOKS:

- 1) Courses in Mining Geology – Arogyaswamy.
- 2) Mining Geology – Hugh Exton Mckinstry
- 3) Principles of Mineral Dressing – Gaudin
- 4) Mining Policy Initiatives – Dhar, Gautam
- 5) Mineral Processing Technology – Wills
- 6) Mining of Mineral Deposits – L. Shevyakov
- 7) Mining the Ocean – T.K.S.Murthy
- 8) P.SeshagiriRao's Law of Mines and Minerals – N. Hunaimy, Asia Law House, Hyderabad.
- 9) Indian Bureau of Mines, Nagapur Guidelines for mining plan preparation 1994.
- 10) Indian Minerals year Books, Published by Indian Bureau of Mines, Nagapur.

COURSE OUTCOMES VS PO_s MAPPING:

Courses Out Comes G.3.4(a)	Program Outcomes Pos					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	3	2	1	1	1
CO3	2	3	2	3	1	1
CO4	3	3	2	3	1	1
CO5	3	3	2	3	1	1



G.3.4. (B) (22): MEDICAL GEOLOGY

COURSE OBJECTIVES:

- ▲ To provide knowledge and skills on the interpretation of the geological impact on geographical distribution of diseases in the environment and on human and animal health.
- ▲ To understand the basics of minerals and their influence on human health, flora and fauna.
- ▲ To assess the occurrence of various elements and its cyclic movement through the abiotic-biotic environment

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Understand about relationship of human Health and Geological Processes	Understand
CO2	Importance of the Water quality standards and its effects on human health	Analyze
CO3	Impact of Micronutrient Deficiencies in Agricultural Soils and Crops on the Nutritional Health of Humans.	Analyze
CO4	Analyze the interaction of abundance of elements and geological effects	Analyze
CO5	Various emissions of volcanic activity and mining activity, and its impact on human health	Analyze

Units	Content	Hrs
I	General characteristics of tropical, subtropical environments - Rock weathering and soil formation - Weathering and formation of secondary minerals - Chemistry of weathering of ultra-basic rocks - Fundamental Relationship of Public Health and Geological Processes - Environmental Biology - Natural Distribution and Abundance of Elements – Anthropogenic Sources - Uptake of Elements on Chemical and Biological Perspective and its functions - Geological Impacts on Nutrition.	15
II	Radon in Air and Water, Arsenic in Groundwater and the Environment - WHO and BIS Standards for drinking water - Fluoride in Natural Waters, soils, sediments, plants - Bioavailability of fluoride, Dental fluorosis, Skeletal fluorosis, Water Hardness and Health Effects, Geochemical basis for tropical endomyocardial fibrosis (EMF) - Effect of water hardness on urinary stone formation (urolithiasis) - Types of stones: Calcium oxalate, Calcium phosphate, Uric acid, Magnesium ammonium phosphate stones, Cysteine.	15

III	The iodine cycle in the environment - Iodine in drinking water, Iodine in food, Iodine Deficiency Disorders (IDD), Endemic cretinism, Goitrogens - The nitrogen cycle, Nitrate as fertilizers and environment, Nitrogen loading in rice fields, Nitrates from human and animal wastes, Nitrates and Methemoglobinemia, Nitrates and cancer - Bioavailability of Elements in Soil - The Impact of Micronutrient Deficiencies in Agricultural Soils and Crops on the Nutritional Health of Humans.	15
IV	Environmental Toxicology; Environmental Epidemiology, Environmental Medicine, Environmental Pathology, Speciation of Trace Elements - Techniques and Tools of GIS in Human Health Studies, Investigating Vector - Borne and Zoonotic Diseases with Remote Sensing and GIS - Mineralogy of Bones, Inorganic and Organic Geochemistry Techniques - Histochemical and Microprobe Analysis in Medical Geology.	15
V	Volcanic emissions and health, U in water and environment, - Selenium Deficiency and Toxicity in the Environment. Geophagy; Soil borne pathogens, Natural aerosolic mineral dusts and human health – dust storms, pneumoconiosis, lung diseases, silicosis, asbestosis tuberculosis.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) C.B., Dissanayake and R. Chandrajith (2009): Introduction to Medical Geology, Springer, London
- 2) H. Catherine, W. Skinner, Antony R. Berger (2003). Geology and Health: Closing gap, Oxford Univ. press, New York.
- 3) Iosif, F. Volfson, (2010): Medical Geology: Current Status and Perspectives, 2010, Russian Geological Society (ROSGEO) Publisher. Moscow.
- 4) K.S. Valdiya, (2004): Geology, environment, Society, University press (India), Hyderabad.
- 5) Lawrence K. Wang, Jiaping Paul Chen, Yung-Tse Hung, Nazih K. Shammass., (2009): Heavy Metals in the Environment, CRS Press, Taylor & Francis Group, Boca Raton, FL
- 6) M.M. Komatica., (2004): Medical Geology, Vol.2, Effects of geological environment on Human health, Elsevier, U.K.

- 7) OlleSelinus, B., Elsevier (2003): Essentials of Medical Geology (2005), Academic Press., U.K.
- 8) OlleSelinus, B., Finkleman, R.B., Jose, A. Centeno (2010): Medical Geology – Regional synthesis (2010), Springer, London.
- 9) Scott S. Olson., (1999) International Environmental Standards Handbook, CRC Press, London.CKE
- 10) William N. Rom., (2012). Environmental Policy and Public Health - Air Pollution, Global Climate Change, and Wilderness, by John Wiley & Sons, Inc. Published by Jossey Bass A Wiley Imprint.
- 11) Selinus, Olle (Ed.), 2013, Essential of Medical Geology, Revised Edition. Springer.
- 12) Syed E. Hasan, 2020, Medical Geology, PMCID publications.
- 13) Carlos-Alberto Ríos-Reyes, María-Paula Ríos-Gutiérrez and Santiago Joya-Neira, Archivos de Medicina Volumen, 2021, The importance of minerals in medical geology: impacts of the environment on health. Enero-Junio de.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	2	3	3	3	2	1
CO3	1	2	3	3	2	2
CO4	1	2	2	2	1	1
CO5	1	2	3	3	2	2

G.3.4. (C) (22): DIMENSIONAL STONES AND CONSTRUCTION MATERIALS

COURSE OBJECTIVES:

- ▲ To introduce the knowledge on dimensional stones and construction materials.
- ▲ To classify dimensional stones and construction materials.
- ▲ To inquire suitability of the dimensional stones of construction materials.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Know about Classification construction materials.	Evolution
CO2	Understand about the dimensional stones	Understand
CO3	Characteristics of dimension stones and its distribution	Analyze
CO4	Conservation of commercial rock deposits/ monumental/ building stone	Apply
CO5	Knowledge on engineering properties of rocks	Apply

Units	Content	Hrs
I	Classification of Rocks: (General Review). Geological classification: Igneous, sedimentary and metamorphic rocks. Chemical classification; Calcareous, argillaceous and siliceous rocks. Physical classification: Unstratified, stratified and foliated rocks. General characteristics of stones – Marble, Granite, Sand stone, Basalt, Lime stone and Slate. Requirements of good building stones. Identification of common building stones. Various uses of stones in construction.	15
II	Dimensional Stones: Criteria for selection of Dimensional Stones, Importance of Dimensional Stones in Archaeological Monuments – Dimensional Stone: Indian Scenario – Granite Industry in India – Dimensional Stones through Geological Time Scale – Granite Trade in South India.	15
III	Dimensional Stone Varieties – Characteristics of Dimensional stone – Distribution of Dimensional Stones in India –Distribution of Dimensional Stones in Andhra Pradesh – Export and Import Qualities.	15
IV	Construction Materials: Varieties of Construction Materials – Ornamental and Construction Materials in Indian History – Distribution of Building Materials in Andhra Pradesh – Conservation of Commercial Rock Deposits/Monumental/Building Stones. Quarrying of stones by blasting and its effect on environment.	15

V	Engineering properties of rocks, Behaviour of rock on application of stresses: Stress and its type; Strain and its type Application of Strain and stress curve; Mohr's Circle and Stress Transformation.	15
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TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Blyth, F.G.H. and Defreites, M.A., 1984: A Geology for Engineers
- 2) Krynine, D.P. and Judd, W.R., 1957: Principles of Engineering Geology.
- 3) Bell, F.G., 1999: Geological Hazards, Routledge, London.
- 4) Vikram, K., 1986: Directory of Dimensional Stones.
- 5) Raman, P.K., Mineral Resources of Andhra Pradesh.
- 6) Information Dossier on Regional Evaluation of Dimension Stone Granite in Andhra Pradesh, 1999: Geological Survey of India, OPAP.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	1	1
CO2	3	2	2	2	1	1
CO3	2	2	3	3	1	1
CO4	1	1	2	2	2	1
CO5	3	1	2	2	1	1

SKILL ENHANCED COURSE:
SURVEYING

1. Introduction – Traverse Surveying, (Using clinometers / Brunton compass)
 - a) Open Traverse
 - b) Closed Traverse
 - c) Cross Staff survey
 - d) Prismatic compass survey.

2. Plane table survey –
 - a) Radial method
 - b) Intersection method
 - c) Traversing
 - d) Two point problem
 - e) Three point problem

3. Leveling (Using Abney Level/Brunton Compass)
 - a) Profiling
 - b) Calculating heights
 - c) Dumpy level Profiling

4. Contouring –
 - a) Dumpy level
 - b) Telescopic Alidade

5. Introduction to Theodolite and operation method (Demonstration).



PRACTICALS:

G.3.1. (22): GEOCHEMISTRY

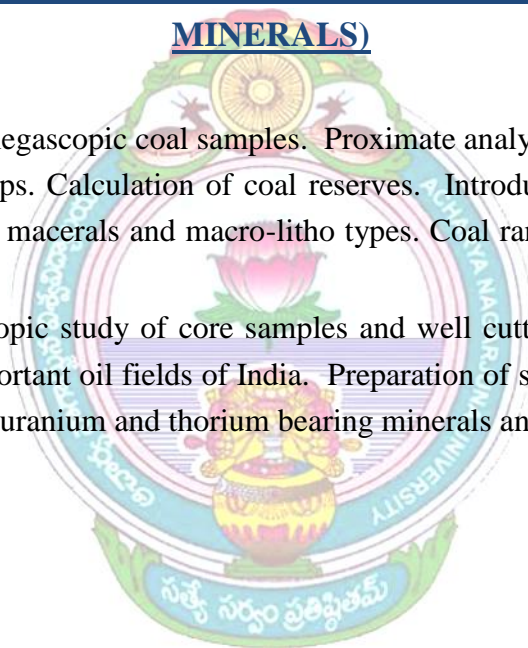
- 1) Sample preparation and preparation of A and B Solutions.
- 2) Major element analysis and Trace element analysis by using flame photometry colorimetry and UV-spectrophotometer.
- 3) Sampling problems. Problems in ore reserve estimation. Determination of vein and fault patterns of ore bodies.
- 4) Preparation and interpretation of various geochemical maps.

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G.3.2. (22) : FUEL GEOLOGY (COAL, PETROLEUM AND ATOMIC MINERALS)

Coal – Identification of megascopic coal samples. Proximate analysis of coal. Completion of outcrops in the given maps. Calculation of coal reserves. Introduction to coal microscopy. Identification of different macerals and macro-litho types. Coal rank measurements based on reflectance.

Megascopic and microscopic study of core samples and well cuttings. Study of geological maps and sections of important oil fields of India. Preparation of stratigraphic cross sections. Megascopic study of few uranium and thorium bearing minerals and rocks.



PRACTICALS:

G.3.3. (A) (22): STATISTICAL AND COMPUTER APPLICATIONS IN GEOLOGY

STATISTICAL APPLICATIONS

- 1) Problems related to theory syllabus.
- 2) Graph preparation related to theory syllabus.

COMPUTER APPLICATIONS

- 1) M.S Word – Word Processing, Slide preparation and Animation
- 2) Tabulation of data using Excel
- 3) Graphs preparation in Excel
- 4) Tabulate the geological data, calculation various statistical parameters and Graphical representation using Excel

(Or)

G.3.3. (B) (22): MICROPALAEONTOLOGY

Study of morphological characters and taxonomy of microfossils.

(Or)

G.3.3. (C) (22): ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

- 1) Study of soil types and prepare soil erosion map of India.
- 2) Analytical procedures for a few elements and components of Air, Water and Soil.

&

G.3.4. (A) (22): MINING GEOLOGY

- 1) Calculation of percentage of Metal and calculation of Grade in the following Ores– Iron, Chromium, Manganese, Copper, Aluminum, Magnesium, Zink, Titanium, Silver
- 2) Analysis of Lime stone
- 3) Proximate and ultimate analysis of Coal
- 4) Performance of Hand –Jig
- 5) Flow Sheet design
- 6) Use of the following for upgrading the Ore
Jaw Crusher, Roller Crusher, Ball mill, Rod mill, Seaving , Panning, Jigging, Froth Flotation, Tabling

(Or)

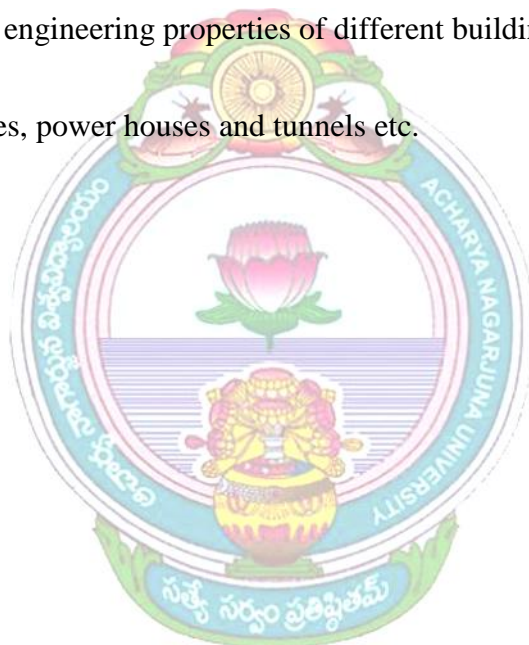
G.3.4. (B) (22): MEDICAL GEOLOGY

- 1) Analysis of Fluoride concentrations in different terrains.
- 2) Identify impact of micro nutrients in Agricultural soils.
- 3) Impact of different major ions and trace elements on human health

(Or)

G.3.4. (C) (22): DIMENSIONAL STONES AND CONSTRUCTION MATERIALS

- 1) Identification of building stones and construction materials
- 2) Study of physical and engineering properties of different building stones and construction materials.
- 3) Visit to Dams, barrages, power houses and tunnels etc.





**FOURTH
SEMESTER**

M.Sc. GEOLOGY

SEMESTER-IV

G.4.1. (22): MINERAL EXPLORATION

COURSE OBJECTIVES:

- ▲ The course is designed to understand the various mineral exploration methods based on Geological, Geophysical and Geochemical methods.
- ▲ The study meets the geological mapping geophysical exploration techniques to identify the various natural resources and the geochemical anomalies gives the information about pathfinder elements.
- ▲ Geochemical and Geobotanical indicators to find the new elemental concentrations.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Know about the different geological mapping methods, Guides to ores and sampling techniques	Apply
CO2	Acquire Knowledge on Geological prospecting for metallic and non-metallic mineral deposits	Understand
CO3	Know the different methodologies of geophysical data acquisition	Analyse
CO4	Understand the Geobotanical indicators to find the new elemental concentrations	Understand
CO5	Describe the geochemical association, path finder's geochemical guides to identify the new mineral prospects.	Apply

Units	Content	Hrs
I	1) Geological mapping - surface and sub-surface mapping. 2) Guides to ores: Physiographic guides, mineralogical guides, lithological guides, Stratigraphic guides, structural guides. 3) Reserve estimation, evaluation and sampling techniques	15
II	1) Geological prospecting for metallic and non-metallic mineral deposits – Bauxite chromite, coal, copper, Lead and Zinc, Manganese, phosphorites	15
III	1) Geophysical exploration Principles, simple type of measuring instruments, field procedures and interpretation of data 2) Gravitational methods of prospecting 3) Magnetic methods of prospecting 4)Electrical methods - Self potential, Resistivity and equipotential method 5) Seismic Refraction and reflection methods 6)Radioactive methods of prospecting.	15

IV	1) Geochemistry in mineral exploration, geochemical prospecting of minerals and elements as geochemical tracers 2) Geochemical associations and pathfinders and their applications.3) Groundwater as guide, methods of sampling – analysis for geochemical prospecting.	15
V	1) Plants as Geochemical indicators-Biogeochemical Anomalies Geobotanical Indicators-Surveying Techniques and Interpretation 2) Primary environments – Primary Aureoles and primary dispersion. 3) Secondary environments – Chemical weathering, application of P ^H and Eh, Adsorption, Mobility in the secondary environment.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED TEXT BOOKS:

- 1) Geochemistry in Mineral Exploration – Hawkes and Webb (1979). 2nd Edition, Academic Press, London.
- 2) Mining geology – McKinstry.
- 3) Courses in Mining Geology by R.N.P. Arogyaswamy (1974).
- 4) Introduction to Geophysical prospecting: M.B. Dobrin (1976).
- 5) Geophysical prospecting by M. B. Rama ChandraRao
- 6) Introduction to exploration geochemistry by Ervinson, A.A. (1974), Second Edition. Applied Publishing Ltd., U.S.A.
- 7) Rock Geochemistry in Mineral Exploration by Govett, G.J.S. (1983).
- 8) Geophysical Methods in Geology by Sharma P. V. 1986, Elsevier.
- 9) Principles of Applied Geophysics by Parasnis, D.S. (1975).

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	2	2	2
CO2	3	3	3	3	2	2
CO3	2	3	3	3	2	2
CO4	2	2	3	3	2	1
CO5	2	3	3	3	1	2

G.4.2. (22): PETROLEUM EXPLORATION

COURSE OBJECTIVES:

- ▲ To enable the students get knowledge on reservoir dynamics, reservoir mechanics and reservoir energy for movement of oil and gas in the pool.
- ▲ To understand source rock, oil and source rock identification and maturation of organic matter during process of formation.
- ▲ To apply the geophysical methods, subsurface geological maps, drilling and logging techniques for locating the petroleum prospects.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	To understand Movement of oil and gas in the oil pool based on reservoir dynamics, reservoir mechanics and reservoir energy.	Understand
CO2	To identify the different sources rocks and oil and source rock correlation on the basis of various criteria.	Analyze
CO3	Gain the knowledge on different types of petroliferous sedimentary basin conditions of India and their potentiality on hydrocarbons.	Knowledge
CO4	Delineate the structures of reservoir and cap rocks by geophysical methods exploration.	Analyze and Skill
CO5	Apply the logging techniques in petrophysical analysis and facies analysis	Apply

Units	Content	Hours
I	Reservoir dynamics: Reservoir conditions and temperature. Reservoir Mechanics; Phase relationships - Interface phenomena - capillary pressure. Reservoir energy; Movement of oil and gas in pool. Production phenomena of oil and gas.	15
II	Identification and characterization of Petroleum source rocks; Amount, type and maturation of organic matter. Oil and source rock correlation. Locating petroleum prospects based on principles of petroleum generation and migration (Geological modeling	15
III	Petroliferous Basins of India; Geology and Hydrocarbon Prospects of Krishna, Godavari, Cauvery, Cambay, Bombay High Basins and Assam Shelf. Position of Oil and Natural Gas in India - Future Prospects and the Economic Scenario. Gas Hydrates; Origin, Distribution and Economic Potential in India.	15

IV	Elements of geophysical methods of exploration; Magnetic, gravity and seismic methods. Interpretation of seismic data in basin modelling and preparation of subsurface geological maps. Application of remote sensing techniques in hydrocarbons and basin analysis	15
V	The petroleum geologist's maps and cross sections. Elements of well drilling; Cable-tool drilling, rotary drilling. Various types of drilling units. Elements of logging; Electric, radioactivity and the sonic logs etc. Nuclear magnetic resonance and dielectric logging. Application of logs in petrophysical analysis and facies analysis.	15

TASKS AND ASSIGNMENTS:

Each Student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS:

- 1) Petroleum Geology by North, F. K. (1985) Allen and Unwin Ltd.
- 2) Petroleum Formation and Occurrence by Tissot, B. P. and Welte, D. H. (1984) Springer Verlag.
- 3) Elements of Petroleum Geology by Selley R. C. 1998. Academic Press.
- 4) Geology of Petroleum by A. I. Levorsen (1972)
- 5) Introduction to Petroleum Geology by G. D. Hobson and E. N. Tiritsoo
- 6) Graphic problems in Petroleum Geology by L. W. Leroy and Julian W. Low

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOME:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	2	3	3
CO3	3	3	2	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	3	3	2	3

G.4.3. (A) (22): HYDROGEOLOGY

COURSE OBJECTIVES:

- ▲ The Hydrosphere is a basic life supporting system. The increasing population and mismanagement of the water resources raised the curtain for the conservation of water resources.
- ▲ The content, here mainly focused on the balance of hydrological cycle, the Hydrological properties of the sediments and rocks and vertical variation in groundwater occurrence.
- ▲ It also emphasizes aquifer types and exploration. The paper is also intended to impart knowledge on quality of water, importance of coastal aquifers and development and management of water resources.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Learn the role of various components of Hydrological cycle, Hydrological properties of rocks, Vertical Distribution of Ground Water and Types of Aquifers.	Understand
CO2	Know about the different Law's and Their applications in groundwater.	Apply
CO3	Know the various exploration methods of groundwater and gain the knowledge about the wells.	Apply
CO4	Quality of Ground Water and Sources of pollution, effects on human health	Analyze
CO5	Gain knowledge on coastal aquifers, development and management of groundwater, groundwater provinces in India, and Ground Water Legislation	Evaluate

Units	Content	Hrs
I	1) Origin of Water on Earth; Hydrologic cycle and its Components– Precipitation, Runoff, Infiltration and Evapotranspiration; 2) Hydrological properties of rocks – Porosity, Permeability, Specific yield, Specific Retention, Storativity, Transmissivity, Barometric and Tidal efficiencies; 3) Origin and Occurrence of groundwater; Vertical Distribution of Ground Water- Zone of Aeration: Soil moisture zone, Vadose zone, Capillary rise zone. Zone of Saturation, Water Table;	15

	4) Types of Aquifers- Unconfined, Confined, Semi - Confined & Perched; Springs;	
II	1. Darcy's law in isotropic and anisotropic media and its Application; Reynold's number and Hydraulic Conductivity, 2. Steady State, Unsteady State and Radial Flow equations; 3. Pumping Tests- Methods, Estimation of T & S by Theis, Jacob and Theis Recovery Methods, Specific Capacity Method by Slither's Method.	15
III	1. Surface investigation of groundwater - geologic, remote sensing, electrical resistivity, seismic, gravity and magnetic methods; 2. sub-surface investigation of groundwater- test drilling, resistivity logging, spontaneous potential logging, radiation logging; 3. Types of wells, Construction, Design and Maintenance of Shallow Wells, Deep Wells in Hard rocks, Soft rocks and in Unconsolidated Sediments; Well Development; Well Rehabilitation; Pumping equipment.	15
IV	1. Quality of Ground Water, Physical and Chemical properties; Quality criteria for domestic, irrigation and industrial uses; Graphical presentation of Water quality data; 2. Sources of pollution; Sea water intrusion- Ghyben-Herzberg relation, Upconing, and Control of saline water intrusion. 3. Problems of Arsenic, Fluoride and Nitrate; Radioisotopes to Ground Water Studies.	15
V	1. Water Table fluctuations and causative factors; Water Table Contour maps; Overexploitation and Ground Water Mining; 2. Ground Water Development in Urban areas and Rain water Harvesting; Renewable and Non-renewable Ground Water resources; 3. Concept of Basin Management, Watershed Basin Management; 4. Ground Water Provinces of India; Ground Water Legislation.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

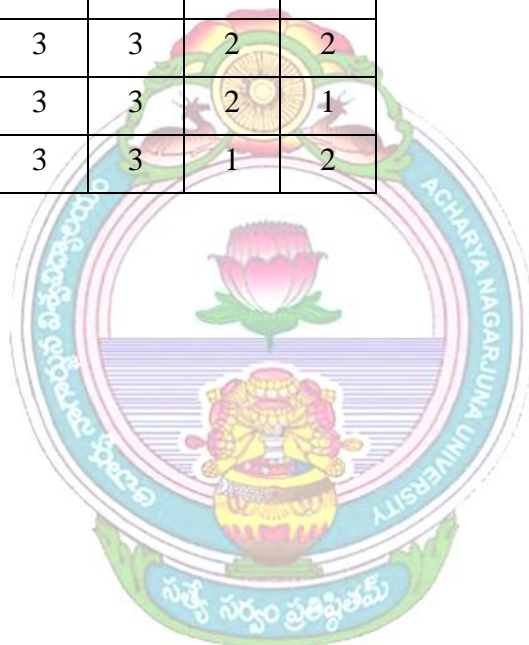
SUGGESTED BOOKS:

- 1) Groundwater Hydrology (1980) – D. K. Todd – John Wiley & Sons.
- 2) Groundwater (1987) – H. M. Raghunath – Wiley Eastern Limited.

- 3) Groundwater Assessment, Development and Management (1987) – K. R. Karanth-Tata-McGraw Hill Company.
- 4) Applied Hydrogeology (1988) – C. W. Fetter – Morrill Publishing Company.
- 5) Hydro Geology - Davis S.N. and Dewiest, R.J.M. John wiley & Son New York.
- 6) Ground water Resources evaluation - Walton. W.C. McGraw Hill Publ. Co. New Delhi.
- 7) Ground water Hydrology -Bouwer H. McGraw Hill Book Co. New Delhi.
- 8) Groundwater (1995) – Ed. P. Sankara Pitchaiah – Scientific Publishers.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	1
CO2	2	2	3	3	2	2
CO3	2	3	3	3	2	2
CO4	2	3	3	3	2	1
CO5	1	2	3	3	1	2



G.4.3. (B) (22): SOIL GEOLOGY

LEARNING OBJECTIVES:

The course aims to make student:

- ▲ Understand the soil forming processes, its classification and various geochemical parameters.
- ▲ Understand about the soil of the past and the present.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Understanding different aspects of Soil Formation.	Understand
CO2	Knowledge on soil Fabric analysis	Analyze
CO3	Learn about the Peds and Voids	Knowledge
CO4	Significance of Paleosols study	Apply
CO5	Evaluation of Calcretes	Evaluation

Units	Content	Hrs
I	Concept of soil, components of soil, soil profile. Process of soil formation, pedogenic processes. Classification of soil, mineral and chemical composition of soils, mineral stability during weathering; Soil organic matter form and function. A brief introduction to methods of soil conservation.	15
II	Fabric analysis - size and shape, concepts of size and shape, grade scale, methods of analysis, presentation of data, analysis and field grading. Concepts of structure fabric: Soil fabric, soil structure, soil texture and field grading units;	15
III	Peds and pedality, size and shape of peds, pedality, primary, secondary and tertiary structures and their interpretation; Voids - concepts, size, shape, arrangement and morphological classification.	15
IV	Paleosols - Field recognition, description, origin and causes. Paleosol in stratigraphic records; Significance of paleosol study; Paleosols and human evolution.	15
V	Calcrete - definition, classification, calcrete formation, pedogenic calcrete soil profile, macro features in calcretes, micromorphology (petrography), calcretes from Quaternary and ancient sedimentary sequences; significance of calcretes. Laterite - characteristics, genesis, Indian occurrences.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Braddy, N.C: Nature and properties of soils.
- 2) Gerrard, A.J.J. : Soil and Land forms
- 3) GovindaRajan, S.V. &GopalaRao, kH.G.: Studies of Soils of India.
- 4) Gurrison, S. (1989): The Chemistry of Soils, Oxford University Press.
- 5) Hunt,C.B: Geology of Soils
- 6) Jeffe, J.S.: The A.B.C. of soils
- 7) Terzaghi, K. &Pock,R.G.: Soil Mechanics in Engineering
- 8) Tayler, D.W.: Fundamentals of Soil Mechanics
- 9) Wright; V. Paul (Ejditer) j: Paleosols: their recognition and interpretation, Blackwell Scientific Publication.
- 10) Wright; V. Paul and Tucker, M.E. (1991) Calcretes. Blackwell Scientific Publication.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	1	2	2	1	1
CO3	3	2	2	2	1	1
CO4	2	2	1	1	1	1
CO5	1	1	2	2	1	1

G.4.3. (C) (22): WATERSHED MANAGEMENT

COURSE OBJECTIVES:

- ▲ To provide basics of watershed management
- ▲ To apply the mitigation techniques of land erosion
- ▲ To develop water harvesting techniques based on the terrain conditions
- ▲ To implement the approach of people's participation in watershed management
- ▲ To provide the technical know-how of analyzing the degradation of soil and water resources and implementation to the measures for soil and water conservation.
- ▲ To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management.

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Importance of watershed management	Understand
CO2	Know about Erosion, Degradation and Land Management	Analyze
CO3	Classification of different water harvesting techniques	Apply
CO4	Learn about sustainable development and management of watersheds.	Analyze
CO5	Learn about various Watershed Development Programs	Apply

Units	Content	Hrs
I	INTRODUCTION OF WATERSHED: Objectives of watershed development - Characteristics of watershed – Principles of watershed – Effects of watershed on community – Delineating the watershed – Basic data on watersheds –Need for watershed development – Watershed development programmes in India.	15
II	EROSION, DEGRADATION AND LAND MANAGEMENT: Types and Factors affecting erosion - Effects and control methods of erosion - Estimation of soil loss due to erosion - Universal soil loss equation – Degradation agents – Impact of the degradation of watersheds– Land use and land capability studies - Management of Agricultural, Forest, Grassland and wild land – Reclamation of saline and alkaline soils.	15
III	WATER HARVESTING: Concept of Rainwater harvesting - water harvesting structures - Guidelines for construction of harvesting structures – Success stories of water harvesting structures –Role of people's participation in construction and management of harvesting structures– Rain water harvesting from roof top.	15

IV	PLANNING AND MANAGEMNT: Elements of watershed management – Planning and Implementation of watershed Management activities – Multidisciplinary approach for watershed management – Impact of watershed Management.	15
V	WATERSHED DEVELOPMENT PROGRAMME: River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDpra) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Rajora, R., (1998), Integrated Watershed Management, Rewat Publications, New Delhi.
- 2) Tideman, E.M., (1996): Watershed Management: Guidelines for Indian Conditions, Omega Scientific Publishers, New Delhi.
- 3) Lal. S., (2004), Watershed Development, Management and Technology, Mangal Deep Publications.
- 4) Paranjape, S. et. al., (1998), Watershed Based Development: A Source Book, Bharat GyanVigyanSamathi, New Delhi.
- 5) Suresh, R., (2002), Soil and Water Conservation Engineering, Standard Publishers and Distributors, Delhi.
- 6) Kakade, B.K., (2002), Soil and Water Conservation Structures in Watershed Development Programs, BAIF Development Research Foundation, Pune.
- 7) Gurmel Singh et al. 2004. Manual of soil and water conservation practices. Oxford & IBH publishing Co. New Delhi.
- 8) Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.
- 9) Tripathi R.P. and H.P.Singh 2002, Soil erosion and conservation, Willey Eastern Ltd., New Delhi.
- 10) Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.
- 11) Tideman, E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	1	1
CO2	3	2	2	2	1	1
CO3	2	3	3	3	2	2
CO4	3	2	2	2	1	1
CO5	3	2	2	2	1	1



G.4.4 (A) (22): REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS (GIS)

COURSE OBJECTIVES:

- ▲ The main objectives of this specialization are to provide exposure to students in gaining knowledge on concepts and applications.
- ▲ The advent of leading to modeling of earth resources management using Remote Sensing, to acquire skills in storing, managing digital data for planning and development and skills in advance techniques such as hyper spectral.
- ▲ The course also considers the new technology like GPS thermal and LiDAR scanning for mapping, modeling and monitoring.

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Students will be able to recognize and explain at a basic level fundamental physical principles of remote sensing, including the electromagnetic spectrum; the emission, scattering, reflection, and absorption of electromagnetic (EM) radiation;	Knowledge
CO2	Students will understand the concepts, methodologies and applications of Remote Sensing Technology	Understand
CO3	The sub-paper GIS objectives are to Maximize the efficiency of decision making and planning by using software like ArcGIS, ARC info,	Understanding
CO4	Students will acquire the basics of GIS and will use GIS to create maps, images and apps to communicate spatial data in a meaningful way to others	Application
CO5	The course will give details about advanced applications in remote sensing	Application

Units	Content	Hrs
I	1. Physics of Remote Sensing: <ul style="list-style-type: none"> (a) Introduction and definition (b) Energy sources and Electromagnetic spectrum properties (c) Wave theory (Maxwell) and Quantum theory (Plank) (d) Interaction effects with atmosphere and earth materials (e) Blackbody radiation and atmospheric windows (f) Remote sensing spectral regions and properties 	15

	<p>2. Remote Sensing platforms and sensors:</p> <p>(a) Platform system parameters;</p> <p>(i) Terrestrial, Airborne and Satellite platforms</p> <p>(ii) Sun synchronous Geostationary and Multi orbital platforms</p> <p>(b) Sensor system parameters:</p> <p>(i) Photo, digital and scanner image sensors</p> <p>(ii) Multi spectral photo and image systems</p> <p>(iii) Microwave and Radar sensor system</p> <p>(c) Satellite nature and mission details:</p> <p>(i) Remote sensing (natural resources) satellites</p> <p>(ii) Meteorological (atmosphere and communication) satellites</p> <p>(iii) Microwave Satellites</p>	
II	<p>1. Aerial photo:</p> <p>(a) Introduction and objectives</p> <p>(i) Cameras, lenses, films and filters,</p> <p>(b) Flight mission for planning, flying height and scale.</p> <p>(c) Types of photographs</p> <p>(i) Vertical, Oblique (low and high) and Terrestrial.</p> <p>(e) Photo elements for interpretation.</p> <p>2. Applications and interpretation criteria of remote sensing data:</p> <p>(a) Lithology and rock types</p> <p>(b) Geological structures</p> <p>(c) Geomorphology and hydrology</p> <p>(d) Engineering projects</p>	15
III	<p>1. Introduction, definition and terminology of GIS</p> <p>2. Computer environment of hardware and software</p> <p>3. GIS architecture and contributing disciplines,</p> <p>4. Functions and products</p> <p>5. Spatial data and nature</p> <p>5. Theoretical models and framework in GIS</p> <p>6. Model categories and measurement scales</p>	15
IV	<p>1. Spatial Data Modeling:</p> <p>(a) Stages in data Modeling</p> <p>(b) Graphic representation</p> <p>(i) Vector data (ii) Raster data (iii) Spectral data</p> <p>(c) Vector models:</p> <p>(i) Spagetti model (ii) Topological model (iii) Shape file (iv) Compact models.</p> <p>(d) Raster model:</p> <p>(i) Simple Raster arrays (ii) Compact structures (iii) Hierarchical structure</p>	15

V	<ol style="list-style-type: none"> 1. Introduction and basics of Global Positioning System (GPS), GPS satellites 2. Stereoscope: Stereogram and Stereo pair 3. Application and data analysis for urban and municipal aspects: <ol style="list-style-type: none"> (a) Rapid land use assessment (b) Rapid land information system development (i) Dynamic urban land use (ii) Semi-dynamic land use (iii) Passive land use 4. Land use and land cover systems in India. 	15
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TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

SUGGESTED TEXT BOOKS:

- 1) Remote sensing and Image Interpretation-T.M. Lillesand, and R.W.Keifer (John wiley and sons), 2000
- 2) Image Interpretation in Geology – S.A.Drury (Allen and Unwin, London), 1987
- 3) Aerial-photographic interpretation – Principles and applications – D. R. Leuder.
- 4) Remote sensing – Principle and Interpretation- F.F.Sabins (Freeman and Co) 1987
- 5) Principles and Applications of Photogeology – Shiv. N. Pandey.
- 6) Elements of Photogrammetry – P. Wolf. (McGraw Hill) 1983
- 7) Remote sensing in Geomorphology –H.Th. Verstappen
- 8) Remote Sensing and Photogrammetry – Principles and Applications – M. L. Jhanwar and J. S.Chowhan.
- 9) Remote Sensing and Geographic Information Systems – M. Anji Reddy.
- 10) Fundamentals of Geographic Information Systems – M.N. Demers (john Wiley and Sons), 1999
- 11) Principles of Geographic Information Systems – P. A. Burrough and R. A. McDowells
- 12) An Introduction to Geographic Information Technology – Sujit Choudhury, Deepankar Chakrabarti and Suchandra Choudhury (I.K.International Pub.House) 2010

COURSE OUTCOMES VS PO_s MAPPING:

Courses Out Comes G.4.4(a) (22)	Program Outcomes POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	1	2
CO2	3	3	1	1	1	1
CO3	3	2	2	3	1	1
CO4	3	3	1	2	1	3
CO5	3	2	3	1	1	3



G.4.4. (B) (22): SEDIMENTARY BASINS OF INDIA

COURSE OBJECTIVES:

- ▲ In this course the students will study the Evolution of sedimentary basins of India.
- ▲ To train the students how to map sedimentary basins

COURSE OUTCOMES (CO's):

	Course Outcome	Level
CO1	Knowledge on classification of basins and its evaluation	Understand
CO2	Learn about the different depositional systems	Analyze
CO3	Knowledge on East-Coast basins	Analyze
CO4	Knowledge on west coast basins	Analyze
CO5	Knowledge on different sedimentary basins of India	Analyze

Units	Content	Hrs
I	Basins Classification and Depositional Environments: Tectonic Basin Classification, Tectonics and Basin Filling, Basin Morphology and Depositional Environments. Basin Evolution and Sediments: Rift basins, Continental Margin and Slope Basins, Intracontinental Sag Basins, Deep-Sea Trenches, Foreland, Back arc and Retro arc Basins, Remnant and Foreland Basins, Collision – Related Basins, Pull-Apart Basins, Basin- Type Transitions (Polyphase Basins)	15
II	Basin mapping methods: Structure and isopach contouring, Lithofacies maps, Geophysical techniques, Clastic petrographic data, Computer mapping methods, Stratigraphic cross sections, Paleocurrent analysis, Remote sensing. Depositional systems and sequence stratigraphy: Stratigraphic architecture, Nonmarine depositional systems, Coastal depositional system. Clastic shelves and associated depositional systems, Carbonate and evaporate depositional systems, Clastic depositional systems of the continental slope, rise and basin plain, Sequence stratigraphy.	15
III	Stratigraphy, Structure and Tectonics of Onshore and Offshore Sedimentary basins of East Coast of India with special reference to – Bengal Basin – Mahanadi - Krishna - Godavari and Cauvery Basins.	15
IV	Stratigraphy, Structure and Tectonics of Onshore and Offshore Sedimentary basins of West Coast of India with special reference to Kutch – Saurashtra – Narmada – Cambay Bombay high, Kerala – Konkan Offshore Basins.	15

V	Stratigraphy, Structure and Tectonics of other Sedimentary basins of India with special reference to Cuddapah - Vindhyan – Rajasthan - Assam shelf – and Himalayan foot hill Basins.	15
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TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Einsele G 1992 Sedimentary Basins. Springer Verlag.
- 2) Miall A 2000 Principles of Sedimentary Basin analysis.
- 3) 3.Sengupta S 1997. Introduction to Sedimentology oxford – IBH.
- 4) Petrol ferrous Basins of India, ONGC, Petroleum Asia Journal

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	1
CO2	3	2	1	1	1	2
CO3	3	2	2	1	1	1
CO4	3	2	2	2	1	1
CO5	3	2	2	2	1	1

G.4.4. (C) (22): RESEARCH METHODOLOGY

COURSE OBJECTIVES:

- ▲ To know the concepts and fundamentals of research
- ▲ To identify the problem for research
- ▲ To identify the skills how to write research articles and proposals
- ▲ To know the methodology of thesis writing and project preparation

COURSE OUTCOMES:

	Course Outcome	Level
CO1	Knowledge on Concept and definition of Research	Understand
CO2	Gain knowledge on procedures of literature survey and Review	Knowledge
CO3	Preparation of Scientific reports and research articles, Thesis and Project writing	Apply
CO4	Methods of sample collection and preparation	Analyze
CO5	Learn about publication Ethics	Evaluation

Units	Content	Hrs
I	Concept and definition of Research: academic research, basic and fundamental research, applied research, theoretical, conventional and experimental research. Concepts and need of research hypothesis. Research proposal and concepts; developing research proposal in the field of geosciences; research approach and identifying gap areas from literature review; problem formulation and statement of research objective	15
II	Literature survey and review, use of digital library, online resource; necessity of review of literatures. Developing of bibliography. Concepts on plagiarism. ISSN, ISBN numbers and DOI number. Impact factors and citation index of research articles and assessing the quality of research articles.	15
III	Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance. Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE. Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification – References. Documentation and scientific writing Results and Conclusions. Preparation of manuscript for Publication of Research paper. Presenting a paper in scientific seminar.	15

IV	Types of sample collection (Water, Rocks & minerals, Fossils etc.), Preparation of samples for analytical techniques, Introduction on the techniques of data representation, Graphical representation of data, preparation of project reports; Integrative approach in geology.	15
V	Ethical Issues – Ethical Committees – Commercialization – copy right – royalty – Intellectual Property rights and patent law – Track Related aspects of intellectual property Rights – Reproduction of published material.	15

TASKS AND ASSIGNMENTS:

Each student is required to undergo the following:

- Assignments
- Seminars
- Class Tests

TEXT BOOKS / REFERENCE BOOKS:

- 1) Qualitative Research Methods for Social Sciences by Bruce, L. B. 2001, Allyn and Bacon, Boston.
- 2) Research Design: Qualitative, Quantitative and Mixed Methods Approaches by John, W. C., 2011, Sage Publications, Thousand Oaks.
- 3) Principles of Writing Research Papers by Lester, James, D. and Lester Jr. J. D., 2007, Longman, New York.
- 4) Silicate rock analysis by P. J. Potts, 1997.
- 5) Handbook of Instrumental Techniques for Analytical Chemistry by Frank A. Settle, 1997, Prentice Hall, Upper Saddle River, NJ.
- 6) An introduction to Research Methodology, Garg.B.L.,Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. RBSA Publishers.
- 7) Research Methodology: Methods and Techniques. Second Edition. Kothari, C. R. (2008). New Age International Publishers, New Delhi.
- 8) Research Methodology, Sinha, S.C. and Dhiman, A.K., 2002. EssEss Publications.2 volumes.
- 9) Statistical Methods. 37 th ed. Gupta S.P. (2008)., (Rev)Sultan Chand and Sons. New Delhi. 1470 p.
- 10) Internet for everyone, Leon & Leon (2202). Vikas Publishing House.
- 11) Law relating to patents, trademarks, copyright designs and geographical indications. Wadehra, B.L.2000, Universal Law Publishing.
- 12) Research Methodology Dr P M Bulakh, Dr P. S. Patki and Dr A S Choudhary 2010 Published by Expert Trading Corporation Dahisar West, Mumbai 400068

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	3	2	2	2	1
CO3	1	3	3	3	2	2
CO4	1	3	3	3	1	1
CO5	3	2	2	2	2	2



PROJECT WORK

TRAINING:

An independent project work by a student is the strength of this course. This course allows the student to visualize and implement studies related to any geological problem. It is desired that a student will implement his geological understanding through this work and become a competent professional geologist.

REPORT PRESENTATION:

An independent project work by a student is the strength of this course. This course allows the student to visualize and implement studies related to any geological problem. It is desired that a student will implement his geological understanding through this work and become a competent professional geologist.



PRACTICALS:

G.4.1. (22): MINERAL EXPLORATION

- 1) Sampling problems. Problems on ore reserve estimation. Determination of vein and fault patterns of ore bodies.
- 2) Resistivity methods of prospecting: a) Wenner method b) Schlumberger method. Seismic methods of prospecting problems.
- 3) Problems on average assay values, Grade maps and lithofacies maps and their interpretation. Plotting of the assay values. Anomaly maps and their interpretation. Use and interpretation of geophysical data.
- 4) Computation of gravity and magnetic effects produced by a sphere, cylinder and fault buried under the ground by drawing gravity and magnetic anomaly profiles.

G.4.2. (22): PETROLEUM EXPLORATION

- 1) Interpretation of logging data.
- 2) Study of important maps of petroliferous basins and sections in India.
- 3) Isopach and isolith maps.
- 4) Development of stratigraphic panel diagram.
- 5) Intertonguing deposits.
- 6) Correlation of intertonguing deposits within a Time-Rock Unit.
- 7) Study of Worlds important petroliferous basins and producing oil fields - using internet.
- 8) Calculation of oil reserves.

PRACTICALS:

G.4.3. (A) (22): HYDROGEOLOGY

- 1) Delineation of Drainage from the toposheets and basic aspects of Morphometric analysis.
- 2) Problems related to Hydrological Parameters.
- 3) Problems related to Water Quality.
- 4) Representation of Chemical Data.
- 5) Problems related to Pumping Tests.
- 6) Water Wells.
- 7) Water harvesting Structures

(Or)

G.4.3. (B) (22): SOIL GEOLOGY

- 1) Procedure of soil sample Collection
- 2) Preparation of soil samples for analysis.
- 3) Identify the soil nutrients for best agricultural practices
- 4) Soil profile and Soil map of India

(Or)

G.4.3. (C) (22): WATERSHED MANAGEMENT

- 1) Drainage basin analysis.
- 2) Construction of harvesting structures
- 3) Engineering practices of watershed management

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G.4.4. (A) (22): REMOTE SENSING AND GEOGRAPIC INFORMATION SYSTEMS (GIS)

- 1) Stereo test and study of different types of aerial photos
- 2) Study of properties of instruments and photo/ image products
- 3) Stereoscopic photo interpretation from stereograms for topography, drainage, geomorphic and geological details
- 4) Stereoscopic photo interpretation from stereopairs for topography, drainage, geomorphic and geological details
- 5) Photogrammetry and measurements
- 6) Map reading

(Or)

G.4.4. (B) (22): SEDIMENTARY BASINS OF INDIA

- 1) Preparation of Isopach contouring maps.
- 2) Graphical representation of geophysical data.
- 3) Preparation of Stratigraphic cross sections.
- 4) Preparation of sedimentary basin maps of India.

(Or)

G.4.4. (C) (22): RESEARCH METHODOLOGY

- 1) Preparation of manuscript.
- 2) Preparation of Research article for presentation and Publication.
- 3) Chapterization of thesis
- 4) Preparation of Project proposal.

