CHOICE BASED CREDIT SYSTEM IN P.G.COURSES

M.Sc. GEOLOGY

Scheme of Instructions and Examination
Effective from the Academic Year 2019-2020

University Vision

Creation of an enabling environment where in universities would act as agents of social change and transformation through innovativeness and outreaching and make it a “People’s University”.

University Mission

Mitigating the economic and social sufferings of the region by invoking the strengths of faculty through community oriented actions by optimal usage of human resources.

Vision of the Department

The Department of Geosciences (Geology and Geophysics streams) is engaged in cutting-edge scholarship related to Earth and its complex systems and processes: the interactions among solid Earth, hydrosphere, biosphere, as they impact society.

The department is committed to excellence in discovery and creation of new knowledge about Earth, enabling life-long learning by all students about Earth processes and the impacts and engagement of faculty, students and the public addressing and solving the challenges associated with stewardship of Earth.

Mission of the Department

The primary mission of the Department of Geosciences (Geology and Geophysics streams)is to:

- Provide quality education;
- Provide cutting-edge research;
- Provide outreach to the citizens of this region extending to the national and international area;
- Advance new understanding of the Earth System and apply these to the needs of society;
- Prepare the next generation of geoscientists (geologists & geophysicists) to conduct research, to find and develop natural resources, and to measure and respond to environmental change.

Short term Goals:

A short –term goal is a goal that canbe achieved in months or less

1. To make the students to learn the various subject to acquire basic knowledge in east semester
2. To make the students consolidate the knowledge of the subjects every year
3. To pre pare study material both the students and the faculty members which will be useful in future career.
4. To train the students in field-oriented programmes to acquire practical knowledge.
5. To train the students in soft skills which include the work ethic, attitude, Communication skills, emotional intelligence and whole host of other personal attributes.

Long term Goals:

A long-term goal is something you want to do further in the future; it is a goal which usually takes 12 months or more

1. To make the students to acquires additional knowledge in all the subjects to face any competitive examinations
2. To make the students to get the P.G Degree with higher ranks
3. To guide the students to plan themselves for a brilliant career in future
4. To train the students well skilled to face any interviews to achieve the goals

5. To prepare the students to carryout any type of field work towards the end of the PG course to carryout field programmes in any related companies.

Strengths:

Availability of sufficient infrastructure;Availability of young and energetic teaching faculty and the students by a senior most professor working as resource Faculty, Availability of eminent people having expertise in applied aspects of

Geology and Geophysics

Weakness:

Lack of sufficient Laboratory facilities at present. Lack of recruitment of perment teaching faculty to strengthen teaching. Lack of useful museum which can improve the practical experience in several subjects. Lack of transport facility to conduct field work

Opportunities:

The mineral resources determine the economic and future prospects of a country.The Department of Geosciences consists of two branches: Geology and Geophysics which can produces students having a good deals of knowledge whichgenerates very good job opportunities for the students in many oil companies, industries and also research opportunities in many educational and research organizations

Challenges:

The jobs related to both Geology and Geophysics are mostly field oriented. Hence it is a challenge to train the students to be competent of hardship on the other hand, the department faculty should take it is a challenge to train the laboratories to make them feel somewhat comfortable to some extent. The students should take it challenge to prepare themselves to work in space research organizations to bring name and fame to the Department

Best practices/innovations of the Department:

The present methods of teaching methods are not sufficient to make the student suitable for the requirements of the concerned field to improve the standards of the Earth Sciences

Future plans of the Department :

1.To get the well suited and high quality infrastructure to provide sufficient

facilities for the students as well as teaching faculty

2. To get the Teaching faculty well trained in field work and surveying methods to train the students

3. To improve the Teaching and laboratory facilities to attract the students to join the department

4. To arrange guest lectures by experienced persons in the field

5. To Introduce another course which is useful to the society and to develop the department

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ANNEXURE-I

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY, SRIKAKULAM
SCHEME OF INSTRUCTION AND EXAMINATION AS PER CHOICE BASED CREDIT SYSTEM (CBCS)
(W.E.F.2019-20 ADMITTED BATCH)

ELIGIBILITY

Course	Qualifying Examination for Admission
M.Sc. (Geology)	B.Sc. With Geology (as main wherever applicable), Mathematics and any other/B.Sc Science degree with any three science subjects including Physical Sciences, Mathematical Sciences and Biological Sciences" However preference will be given to students with Geology at B.Sc level

This programme is essentially a two yearprogramme for the graduate students in the **M.Sc. (Geology)** course, in the Department of Geosciences.

M.Sc. GEOLOGY

Program Objectives & Outcomes

Mission of Geology

Geology is an engaged learning community advancing education and knowledge, enhancing civic and cultural awareness, and fostering partnerships through comprehensive outreach programs. Our students learn by doing through hands-on experience in the laboratory and field, applied technical writing and presentation skill development, and professional growth opportunities. We prepare our post graduates to live wisely in a diverse and global community, and to succeed in postgraduate academic program or meet the demands.

Program Objectives and Outcomes

Over the past years, the faculty members of Dr.B.R.Ambedkar University Geology have been committed to improving curriculum, increasing experiential learning, and identifying best practices in teaching through rigorous assessment and review of our programs. In addition, faculty members have identified five overarching program objectives for students post graduating with a degree from Geology. The goal is for a Post graduating student from our programs to achieve these objectives within 2 years of Post graduating with their degree. Validation of meeting these objectives is conducted through alumni surveys and detailed communications among faculty members and alumni. In addition to program objectives, each Post Graduating degree program has a unique vision and list of learning outcomes.

Geology Program Objectives

Within 2 years of students Post graduating with a degree from Geology at Dr.B.R.Ambedkar University, an alumnus should have the knowledge and skills to:

- Find and evaluate data, models, hypotheses, and conclusions published in publicly available scientific literature. Apply knowledge and techniques from

chemistry, biology, geology, physics, mathematics, and computing to help solve scientific problems.

- Conduct an independent scientific investigation.
- Make cogent presentations of scientific data, observations, interpretations, and conclusions in written and oral formats.
- Be aware of scientific issues that affect society at large. Collaborate with others, including multidisciplinary groups, to solve scientific problems, and to recognize ethical issues in each respective profession.
- Understand the need for, and develop the abilities to engage in, lifelong learning.

M.SC. GEOLOGY – 1ST YEAR, FIRST SEMESTER

Course No	Title of the paper	Credits	Max. Marks		Total Marks	Instructions Hrs/ week	Exam. Duration
			Internal Assessment	Semester Exam			
	Theory						
G101	Principles of Earth System Science	3	25	75	100	4	3
G102	Environmental Geology and Natural hazards	3	25	75	100	4	3
G103	Introduction to Geophysics	3	25	75	100	4	3
G104	Introduction to Remote Sensing and GIS	3	25	75	100	4	3
G105	Communication Skills	2			50	4	3

G 106	MOOC's Course (Swayam)	2			50		
G107	Field Visits/ Society Engagement Programme	1			25		
	Practicals						
G108	Introduction to Geophysics Lab	2			50	3	2
G109	Remote Sensing and GIS lab	2			50	3	2
G110	viva-voce	2			50	3	2
	Total	**23**			**675**		

M.Sc. GEOLOGY – 1ST YEAR, SECOND SEMESTER

Course No	**Title of the paper**	**Credits**	**Max. Marks**		**Total Marks**	**Instructions Hrs/ week**	**Exam. Duration**
			Internal Assessment	**Semester Exam**			
	Theory						
G201	Mineralogy and Crystallography	3	25	75	100	4	3
G202	Stratigraphy and Paleontology	3	25	75	100	4	3
G203	Structural Geology and Engineering Geology	3	25	75	100	4	3
G204	Sedimentology	3	25	75	100	4	3
G205	Communication Skills	2			50	4	3
G206	MOOC's Course (Swayam)	2			50		
G207	Field Visits/ Society Engagement Programme	1			25		

G208	Summer Internship	1			25		
	Practicals						
G209	Mineralogy and Crystallography Lab	2			50	3	2
G210	Stratigraphy and Paleontology Lab	2			50	3	2
G211	Structural Geology &Engineering Geology	2			50	3	2
G212	Sedimentology Lab	2			50	3	2
G213	viva-voce	2			50		
	Total	**28**			**800**		

M.Sc. GEOLOGY – 2nd YEAR, THIRD SEMESTER

Course No	**Title of the paper**	**C**ategory	**Credits**	**Max. Marks**		**Total Marks**	**Instructions Hrs/ week**	**Exam. Duration**
	Theory			**Internal Assessment**	**Semester Exam**			
G301	Igneous and Metamorphic Petrology	Core	3	25	75	100	4	3
G302	Hydrogeology	Core	3	25	75	100	4	3
G303(I)	Economic Geology and Indian Mineral Deposits	Elective	3	25	75	100	4	3
G303(II)	Mining Geology							
G303(III)	Industrial Minerals and Fuels							

G303(IV)	Environmental Geology							
G304(I)	Geochemistry	Elective	3	25	75	100	4	3
G304(II)	Mineral Beneficiation and Ore-dressing							
G304(III)	Advanced Studies in Micropaleontology							
G304(IV)	Digital Image Processing							
G305	Communication Skills		2			50	4	3
G306	MOOC's Course (Swayam)		2			50		
G307	Field Visits/ Society Engagement Programme		1			25		
	Practicals							
G308	Igneous and Metamorphic Petrology Lab	Core	2			50	3	2
G309	Hydrogeology Lab	Core	2			50	3	2
G310(I)	Economic Geology and Indian Mineral Deposits Lab	Elective	2			50	3	2
G310(II)	Mining Geology Lab							
G310(III)	Industrial Minerals and Fuels Lab							
G310(IV)	Environmental Geology Lab							
G 311(I)	Geochemistry Lab	Elective	2			50	3	2
G 311(II)	Mineral							

	Beneficiation and Ore-dressing Lab							
G 311(III)	Advanced Studies in Micropaleontology Lab							
G 311(IV)	Digital Image Processing Lab							
G312	viva-voce		2			50		
	Total		**27**			**775**		

M.Sc. GEOLOGY– 2nd YEAR, FOURTH SEMESTER

Course No	**Title of the paper**	**C**ategory	**Credits**	**Max. Marks**		**Total Marks**	**Instructions Hrs/ week**	**Exam. Duration**
				Internal Assessment	**Semester Exam**			
	Theory							
G401	Mineral Exploration and Mineral Economics	Core	3	25	75	100	4	3
G402	Fuel Geology (Petroleum and Coal)	Core	3	25	75	100	4	3
G403(I)	Geomorphology and Aerial Photo Interpretation	Elective	3	25	75	100	4	3
G403(II)	Mineral Resources							
G403(III)	Marine Geology and Oceanography							
G403(IV)	Isotope Geology							
G404	Project Work		3			100		
G405	Communication Skills		2			50	4	3

G406	MOOC's Course (Swayam)		2			50		
G407	Field Visits/ Society Engagement Programme		1			25		
	Practicals							
G408	Mineral Exploration and Mineral Economics Lab	Core	2			50	3	2
G 409	Fuel Geology Lab	Core	2			50	3	2
G410(I)	Geomorphology and Aerial Photo Interpretation Lab	Elective	2			50	3	2
G410(II)	Mineral Resources Lab							
G410(III)	Marine Geology and Oceanography Lab							
G410(IV)	Isotope GeologyLab							
G411	Final Viva-Voce		2			50		
	Total		**25**			**725**		
Credits &Marks	**Grand Total**		**101**			**2925**		

DEPARTMENT OF GEOSCIENCES

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM
M.Sc. GEOLOGY
I SEMESTER

G101: Principles of Earth System Sciences

Unit I:

Origin of the Universe- The Solar System; The Earth: Origin and age of the Earth; The internal structure of the Earth; The Geologic time scale; Various branches of Earth Sciences and Their inter relation.

Unit II:

Atmosphere of the Earth; Classification of Climates, cyclones and anticyclones; Tsunamis; Wave erosion and beach processes; The concept of estuary; Heavy mineral concentrations in the beaches; Conservation methods of beaches.

Unit III:

Earthquakes and earthquake belts; Volcanoes and their distribution; Concepts of plate tectonics- sea-floor spreading and continental drift; Mid Oceanic Ridges; Deep sea trenches; Island arcs.

Unit IV:

The Earth's gravity and magnetic fields and their origin and effects;Paleomagnetism; Principles of gravity, magnetic, electrical and seismic methods and their applications in mineral exploration.

Unit V : Geological methods of mapping, sampling and principle of mining. Principles of well logging: Electric logs, Radioactive logs, Sonic logs; Applications of Geophysical methods in Engineering problems.

Suggested Reading Books:

1. Principles of Physical Geology, 1992 by Holme's. Chapman & Hall.

2. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment.
3. Emiliani, C, 1992. Cambridge University Press.
4. Earth(second edition), Frank Press and Raymond Seiver, W.H.Freeman and Company, San Francisco.

G102: Environmental Geology and Natural Hazards

Unit-I:

Environmental Geology : Its aims and objectives; Global warming - causes and remedies; Green house effect; Manmade health hazards; Impacts of mining methods of both opencast and underground mining; Disposal of polluted waters and waste solids from industries and fertilizer manufacturing factories; Disposal of domestic usage

Unit-II: Disposal of polluted waters and waste solids from industries and fertilizer manufacturing factories; Disposal of domestic usage,Elements of environmental impact assessment; Soil degradation due to erosion and remedial measures

Unit-III: Legislative measures in India for environmental protection; Applications of GIS in Environmental management, Natural Hazards; Floods, Cyclones, Tsunamis, Coastal erosion, Landslides.

Unit-IV.: Earthquakes- Precautions and preventing methods; Disasters and disaster management; Rehabilitation.Applications of GIS and Remote-Sensing in disaster monitoring; Neotectonics and seismic hazard management

Unit-V: Preparation of seismic hazard maps; Impact of seismic hazards on long and short term environmental conditions; Deforestation and land degradation- their management

Books:

1.Bell, F.G., 1999. Geological Hazards, Routledge, London.

2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.

3. Smith, K., 1992. Environmental Hazards. Routledge, London.

4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International

6. Keller, E.A., 1978. Environmental Geology, Bell and Howell, USA.

7. Patwardhan, A.M., 1999. The Dynamic Earth System. Prentice Hall.

8. Valdiya, K.S., 1987. Environmental Geology – Indian Context. Tata McGraw

G103: INTRODUCTION TO GEOPHYSICS

Unit-I: Gravity method of prospecting: Rock densities, factors controlling rock densities, concept of gravity anomaly; Properties of Newtonian potential: Laplace's and Poisson's equations, Green's theorem, Gauss' law; Gravity prospecting instruments and survey procedures; Gravity surveying for minerals, oil and geological mapping on ground, air and sea, reduction of gravity data of ground, air and sea. Application of gravity methods for regional geological mapping, and hydrocarbon, mineral and groundwater exploration.

Unit II: Magnetic method of prospecting: Origin of magnetic anomalies, induced and remanent magnetizations, demagnetization effect, concept of magnetic anomalies, magnetic susceptibility, factors controlling susceptibility, magnetic classification of minerals and rocks. Magnetic prospecting instruments and survey procedures; Application of magnetic methods in regional geological mapping, hydrocarbon, mineral and groundwater exploration; Reduction of magnetic data of i round, air, and seas or oceans

Unit III: Electrical methods of exploration: Electrical conduction and properties of rocks and minerals; Classification, factors affecting resistivity, Archie's Law; Ohm's Law. Self potential method: Self potentials, origin, field procedures, interpretation and applications; Electrode arrays- Wenner, Schlumberger, Dipole-dipole, Half Schlumberger, Geometric factors, Concept of apparent resistivity; Applications of SP.

UnitIV: Induced polarization technique: Origin, time and frequency domain operations, relation between time and frequency domain measurements; Pseudo –sections; Principles of Electromagnetic methods; Applications of SP, Resistivity, IP and EM methods in regional geology, mineral and ground water explorations, limitations and advantages.

Unit V: Principles of seismic methods: Reflection and refraction seismics, sources and detectors in land and marine surveys, hydrocarbon indicators; Applications of reflection and refraction seismic studies in crustal investigations, engineering and geological applications, mineral deposits, coal, groundwater, oil and gas, and gas hydrates; Principles of well-logging, various tools in the evolution of reservoirs;.

Practicals:

1. Reduction of gravityand magneticdata.
2. Regional-residualseparation by graphical, grid and least-square methods.
3. Second derivative andcontinuation calculationsusingcoefficients.
4. Forwardmodelingofgravityandmagneticanomaliesofsimplegeophysicalmodels–studyof the properties oftheanomalyprofiles.
5. Interpretationofanomaliesofthemodelsin(4)throughthumbrulesandthroughcharacteristic curves
6. Forward modellingof two-dimensionalbodies usinggraticules
7. Demonstrationofmodellingandinversionofgravityandmagneticanomaliesofsedimentary basins,two-dimensionalbodiesofirregular geometryand faults.
8. Calculationofeffective induced magnetization in two-dimensionalbodies
9. Calculation ofresultant magnetization for three-dimensional bodies and effective resultant magnetization intwo-dimensionalbodies.
10. Calculationof SPanomalies ofasheet.
11. Interpretation of SPanomalies of sheets fromcharacteristiccurves.
12. Interpretation of resistivitydataoveratwo layered earth bycurve matching
13. Interpretationof twolayerearth–resistive andconductive substratum– 45^0asymptote.
14. Calculationofapparentresistivityover3layerearthforA,Q,KandHtypemodelsthrough computerprograms.
15. Interpretation of resistivitydatausingfullcurve matching.

16. Interpretation of resistivitydatausingpartialcurve matching.
17. Plottingof IP results-pseudo depth section.

Text books

1. Gravityand magnetic methods ofprospecting, B. S. R. Rao and I. V. R. Murthy,
2. GravityandmagneticInterpretationinExplorationGeophysics,I.V.RadhakrishnaMurthy, GeologicalSocietyof India Memoir No.41.
3. Anintroductiontogeophysicalexploration,PhilipKeareyandMichaelBrooks,Blackwell Science.
4. AppliedGeophysics,TelfordW.M.et.al.,Oxford&IBHPublishingCo.Pvt.Ltd.,New Delhi.
5. Gravityand magnetic methods ofprospecting, B. S. R. Rao and I. V. R. Murthy,
6. GravityandmagneticInterpretationinExplorationGeophysics,I.V.RadhakrishnaMurthy, GeologicalSocietyof India Memoir No.41.
7. Anintroductiontogeophysicalexploration,PhilipKeareyandMichaelBrooks,Blackwell Science.
8. AppliedGeophysics,TelfordW.M.et.al.,Oxford&IBHPublishingCo.Pvt.Ltd.,New Delhi.

G104: Introduction to Remote Sensing and GIS

Unit I: Fundamentals of aerial photography, types and scales of aerial photographs, aerial photo interpretation techniques; Stereogram, Stereo- pairs, Aerial mosaics vs. top sheet; Fundamentals of photogrammetry and photo interpretation – types of photographs; Vertical photographs, principal point, scale, stereoscopy, Overlap, Side lap.

Unit II: Definition of remote sensing,Principles of remote sensing; Electromagnetic spectrum; interaction of EM Radiation with atmosphere and earth surface features; Spectral reflectance patterns of vegetation, water and soil; Platforms: types of platforms, ground, airborne, and spaceborne; Sensors: types of sensors, sensor resolution; spectral, radiometric and temporal; Global and Indian space missions i.e. LANDSAT, METEOSAT, SEASAT, SPOT, RADARSAT & IRS Series of satellites.

Unit III: Satellite Image Interpretation - keys, introduction to Digital Image processing; Classification – unsupervised classification, supervised classification techniques; Change detection analysis, FCC image vs. RGB image, aerial photo vs. satellite imagery; Application of remote sensing in Geology, Geomorphology, Mineral exploration, Land use/Land cover and hydrogeological studies.

Unit IV: Geographical Information Systems – definition and scope; Geospatial data – entities and attributes; Components of a GIS; Geographic coordinate system and datum; Map projections – types of projections, commonly used map projections.

Unit V: Data representation in GIS: Graphic representation of spatial data – vector and raster formats and their relative merits and limitations; Database structures for managing attribute data – Hierarchical, Network, Relational database management systems; Topology: topological elements – points and nodes, lines and arcs, polygons; Digital Elevation Models

Practicals

a. Visual interpretation of aerial photos.
b. Stereoscopic study of aerial photos
c. Visual interpretation of satellites images
d. Introduction to image processing techniques
e. Introduction to GIS techniques
f. Application of GIS for one case study.
g. Exercise on using remote sensing for case study.

Text Books

1. G.L. Prost and P.L. Prost, Remote Sensing for Geologists: A Guide to Image Interpretation (2nd Edition), CRC Press, 2002.
2. R.P. Gupta, Remote Sensing Geology, Springer-Verlag, 2003.
3. N.M. Short (Sr), Remote Sensing Tutorial, NASA 2010 available at http://rst.gsfc.nasa.gov/Front/foreword.html.
4. S. Rajendran et al., Mineral Exploration: Recent Strategies, Eastern Book Corporation, 2007.

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM

M.Sc. GEOLOGY, II SEMESTER

G201: Mineralogy and Crystallography

Unit-I: Unit-I: Crystallography: Morphological relations of crystals, symmetry elements, normal classes of crystal systems. crystallographic laws, kinds of space lattices.

Unit-II: Crystal optics: Concept polarization and pleochroism, Interference colours. Extinction angle, optical axial angle. Accessory plates, Uniaxial & Biaxial crystals. Thin-section and Polished-section making -- Optical Properties of Minerals

Unit-III: 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

Unit- IV: 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.

Unit V: 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..

Unit V: Practical's

a. Megascopic and microscopic identification of important silicate and non-silicate minerals.
b. Calculation of Mineral formula
c. Interpretation of X-ray diffractograms of common minerals
d. SEM photographs of common minerals

TEXT BOOKS:

1. An Introduction to the rock forming minerals by W.A.Deer, R.A. Howie and J. Zussman
2. Dana's Text book of Mineralogy by W.E. Ford
3. Manual of Mineralogy by Klein, C. and Hurlbut, Jr.C.S
4. Descriptive Mineralogy by L.G. Berry and Mason.
5. Book: Introduction of crystallography by F. C. Phillip

G202: Stratigraphy and Paleontology

UNITI: Principles of stratigraphy;Lithostratigraphy, Biostratigraphy,and Chronostratigraphy, Geochronology and their stratigraphic units; The stratigraphic code; Stratigraphic correlation.

UNITII: The importance of stratigraphy.Magnetostratigraphy,CyclostratigraphyandEventstratigraphy. SeismicstratigraphyandSequencestratigrphy,andChemo stratigraphy; Precambrian stratigraphy of India.

UNIT III: Completenessand incompleteness of stratigraphicrecords.Palaeontology: Introduction; Study of mega - fossils: Phylum Mollusca, Phylum Brachiopoda, Phylum Echinodermata, Phylum Arthropoda, and Class Anthozoa of Phylum Coelenterata;Plant fossils:

UNITIV: Gondwana flora and their significance; Different microfossil groups andtheir distribution in India;Study microfossils,; the morphology, ecology and bio stratigraphic importance of Foraminifera, Ostracods,Radioloria, Coccolithophores and pollen and spores.

UNIT–V: Field and laboratory techniques in micro paleontology; Process of fossils accumulation, distribution and preservation of fossils; illustration of fossils, Role of micropaleontology in petroleum exploration. SEM and CCD and its importance.

G206:Stratigraphyand Paleontology Lab

1. Processing and preparation ofsamples forMicroscopic study.
2. Identification ofselected fossils/species of Foraminifera, Ostracoda and Radiolaria under stereo binocularMicroscopewith CCTV.
3. StudyofImportant microfossils from stratigraphicformations ofIndia.
4. Studyof SEM photographs of microfossils.
5. ConstructionofBiostratigraphicrangechartsandpaleoenvironmentalanalysisofwell sections.
6. Preparation of different stratigraphic distribution maps of India.Study of paleogeographic Maps.

Text Books:

1. Stratigraphicprinciplesandpractice,1960.J.MarwinWeller.HarperandRow Publisher.
2. Stratigraphy of India, M.S.Krishnan

3. Haq, B.U and Boersma, A.1978; Introduction toMarine Micropaleontology, Elsevier.
4. Boggs, Sam JR; 1995;Principles of sedimentologyand stratigraphyPrenticeHall.

G203: Structural Geology and Engineering Geology

UNIT–I:
Conceptofstressandstrain; Strainellipsoids andtheirgeological significance; Stress and strain as causes for the occurrence of earthquakes; Identification of areas of occurrence of earthquakes based on stress and strain.

UNIT–II:
Concept of petro fabrics; Fabric elements and types of fabrics, Folds: Mechanism of folding; Strike and dip-their measurements; Classification folds; Diaper folding.

UNIT–III:
Faults: causes of faulting, classification of faults; fractures and joints; causes for the formation of joints; faults and joints in hydrocarbon accumulation; Unconformities: definition Classification and their uses.

UNIT –IV:
Mechanical properties of rocks and soils; Geological investigations of river valley projects–Dams and Reserve oars ,Tunnels; Foundation investigations for the construction of bridges, buildings, factories and for the operation of heavy machinery; Shoreline engineering.

UNIT – V:
Landslides: causes, types, and preventing measures of landslides; Concrete aggregates; Construction of earthquake - resistant structures; Identification of seismic and a seismic belts or areas in India; problems generated by ground water in engineering projects.

G207: StructuralGeology Lab

- Preparation and interpretation ofgeological mapsand sections.
- Structuralroblemsconcerningtoeconomicmineral deposits.
- Recordingand plottingof field data.
- Plottingand interpretation of petrofabricdataon the stereographic nets.

TEXT BOOKS:

1. Structural GeologybyM.P. Billings.
2. Structural Geologyand TectonicPrinciples byP.C. Badgley.
3. Principles of Physical GeologybyA. HolmesandD.L.Holmes.
4. Aspects of Tectonics focus on South CentralIndiabyK.S. Validya.
5. An outlineof structuralGeologybyBruceE.Hobbs.

G204: Sedimentology

Unit-1:

Origin of sediments and sedimentary rocks; Sedimentary processes: Physical-transporting agents; Depositional environments, conditions for deposition of sediments; Structures formed by physicalprocess; Biological process: Conditions for the formation of biogenic sediments. Structures formed by biological process; Chemical process: role of Ph and Eh in the chemical process; Chemogenic sediments, structures formed by chemical process

Unit-II

Structures formed by biological process; Chemical process: role of Ph and Eh in the chemical process; Chemogenic sediments, structures formed by chemical process, Textures of clastic rocks and carbonate rock (Non clastic rocks); Matrix and cement in clastic rocks.

Unit-III

Digenesis and lithification of sedimentary rocks; Classification of sedimentary rocks; Diagenesis of sandstones, mudstones and carbonate rocks and their economic importance; Volcanogenic sediments; Evaporates; clastic petrofacies.

Unit-IV

Depositional environments of sediments: Desert, glacial, fluvial, alluvial and lacustrine environments; Transitional environments-Lagoonal, estuarine, deltaic, and littoral environments.

Unit-V

Grain size measurement: Wentworth scale; Grain size parameters; Mean size, standard deviation, Skegness, Kurtosis; Thin-section staining; Preparation of lithologs; Evolution of sedimentary basins; Applications of SEM and XRD studies.

G208: Sedimentology Lab

- Studyofprimary,secondaryandbiogenicsedimentarystructuresinhandspecimens,ofphotographic atlases,fieldphotographsandwhereverpossibleontheoutcrops.
- Pipetteanalysis–sand,siltandclayseparationandestimationofpercentages
- Sizeanalysis–(sieving),calculationofgrainsizeparameters.
- Heavymineral-liquid separation-bromoformmethod
- Graphicalrepresentationofdata-Preparationofhistograms,triangularcoordinatediagramsandShepardclassificationchart.
- Studyofheavyminerals
- Paleocurrentanalysis

Test books:

1. Bhattacharya,aandChakraborti,C.,2000:Analysesofsedimentarysuccessions,Oxford-IBH
2. BoggsSamJr.m1995:PrinciplesofSedimentologyandStratigraphy,PrenticeHall.
3. SenguptaS.,1997:IntroductiontoSedimentology.Oxford-IBH
4. Nicholas,G.,1999:SedimentologyandStratigraphy.Blackwell.
5. FriedmanG.M.,andJ.ESanders:PrinciplesofSedimentology

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM

M.Sc. GEOLOGY

III SEMESTER

CORE – THEORY

G301: Igneous and Metamorphic Petrology

UNIT – I: Magma generation, primary and modified magmas; Mantle Xenoliths; Differentiation and assimilation of magmas; Magma mixing; Plate tectonics in relation to petrology;

UNIT – II: Bowen's reaction series; phase equilibrium of single, binary and ternary silicate systems and crystallisation. Petro graphic provinces-variation diagrams. Criteria for classification of igneous rocks: Textural, mineralogical and chemical classification. Norm (CIPW)

UNIT-III: Petrographic provinces and associations; Mineralogy, texture and pathogenesis of major igneous rock types: Granites, Basalts, ultramafic rocks, Carbonotites, Lamprophyres, Syenites, & Nepheline Syenites.Nature of Metamorphism and factors controlling metamorphism.

UNIT – IV: Structures and textures of metamorphic rocks; Metamorphic minerals and processes; Metamorphic zones and mineralogical grade; Mineral paragenesis and metamorphic facies; ACF, AKF and AFM diagrams.

UNIT – V: Metasomatism and granitization; migmatites; Mylonites; Plate tectonics and metamorphism; Petrogenetic aspects of important rock suites of India, such as the Deccan traps, layered intrusive complexes, anorthosites, Carbonatites, Charnockites, Khondalites, Gondites and Granitoids.

G305: Igneous andMetamorphic petrology lab

1. Megascopicand microscopic studyof igneousrocks.
2. Calculation ofCIPWnorms. Preparation ofvariation diagrams.
3. Megascopicand microscopic studyof metamorphic rocks.
4. Geothermobarometric calculations.

TEXT BOOKS:

1. Philpots A., 1992. Igneous and metamorphic petrology.
2. Best, M.G., 1986.Igneous andmetamorphic petrology.
3. Yardley,B.W., 1989. An introduction to metamorphic petrology.
4. Raymond,L.A., 1995. Petrology.
5. Middlemost – Magmas and Magmatic rocks.
6. Turner&Verhoogom–Igneous&Metamorphicpetrology.

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM

G302: Hydrogeology

UNIT-I: Source of Ground Water - Hydrologic cycle; occurrence of Ground Water: Zone of aeration, capillary fringe, and zone of saturation; Hydrological properties of rocks: Porosity, Permeability, Specific yield, Specific Retention, Hydraulic Conductivity; Vertical Distribution of Ground Water: Vadose zone, water table – Perched water table, water table maps; Aquifers: Types of Aquifers; Artesian wells ; Hot Springs.

UNIT-II:
Darcy's law of ground water motion and its applications. Measurement of porosity and Permeability; Specific Capacity Method by Slither's Method.; Methods of Groundwater exploration methods; Pumping of wells and pumping equipments.

UNIT-III:
Physical and chemical properties of groundwater; Quality of groundwater for domestic purposes and irrigation and industrial uses; Sources of pollution of groundwater ; Sea water intrusion into ground water resources and precautions to be taken; Rainwater harvesting and artificial recharge methods

UNIT-IV:
Water Well Technology: Well types, drilling methods, construction design, development and maintenance of wells. Water management in rural and urban areas. Coastal water and its management. Arid zone Ground water, Ground water in hard rocks and non-indurated sediments – their management. Groundwater river interactions.

UNIT-V:
Types of Geo environmental hazards: volcanoes, earthquakes, floods and coastal hazards – land desertification, degradation and their management. Impact of mining activities on the resources of ground water waste water disposal methods and Management.

. **G308: Hydrogeology Lab**

1. Hydrogeological surveysin the field
2. Problems on vertical electrical sounding and interpretation of thedata.
3. Well loss estimation from stop drawdown test and graphical presentationof chemical data.
4. Water analysis.
5. Classification ofsuitablewaterfor drinking, irrigation and industrial purposes.
6. Presentation of chemicaldata and plotting chemical classification diagram.
7. Evaluation ofgroundwater pollution.

TEXT BOOKS:

1. Ground water HydrologybyTodd. D.K. John Wiley&Sons. New York.
2. HydrogeologybyKaranth. K.R. Tata McGraw Hill Publ Co New Delhi.
3. Ground water assessment. Development and Management byKaranth K.R. Tata Mc. Graw Hill Publ. Co. NewDelhi.
4. Hydro GeologybyDavis S.N. and Dewiest, R.J.M. John wiley&Son NewYork.
5. Ground WaterbyRaghunath. H.M. WileyEasternLtd. New Delhi.
6. Ground water Resourcesevaluation byWalton. W.C. McGraw Hill Publ. Co. New Delhi.
7. Ground water HydrologybyBouwer H. McGrawHill Book Co. New Delhi.
8. Keller, E.a., 1978. Environmental Geology. Bell and Howell, USA.

CORE – ELECTIVE –THEORY

G303 (I): Economic Geology and Indian Mineral Deposits

UNIT–I: Natureofore-bearingfluids;Principlesofformationofmineraldeposits;Role ofpressureandtemperatureinore-bearingfluids;Metallogenicepochsandprovinces.

UNIT–II: Geological thermometers; Various processes in formation of mineral deposits; porphyries and Skarn deposits.Oremicroscope–preparationofpolishedsection–physicalpropertiesofore mineralsunderreflectingmicroscope–form, colour,hardness,reflectivity–reflection pleochroism,etchtestetc.

UNIT–III: Structures and texturesoforeminerals-Applicationofore microscopic studies inoredressing. Geologicalsettingmodeofoccurrence,genesis,

UNIT–IV: Distributionandusesof chromite, manganese, iron, copper-lead-zinc, bauxite and placers; Ceramic and cement Industries; Abrasives and minerals used in Glass Industry and their distribution in India.

UNIT–V: Geological settingmodeofoccurrence,genesis,distributionandusesofcoal, barites, clays, limestones, mica, phosphates, precious and semi-precious stones; Gold, Silver, rare Earth minerals and refractory minerals.

G307: Economic geology and IndianMineral deposits lab

1. Megascopic identification oforeminerals.
2. Identification oforeminerals under oremicroscope.

TEXT BOOKS:

1. EconomicMinerals Deposits– Bateman, A.M. and Jenson, M.L.
2. OreDeposits– Park Jr. C.F. and MacDiarmid, R.A.
3. OreDeposits inIndia–Gokhale, K.V.G.K. andRao, T.C.
4. Industrial Minerals and rocks inIndia– Deb, S.
5. OreDeposits–Lindgren,W.
6. OrePetrology– Stanton, R.L.
7. OreMicroscopy– Cameron, E.C

G303 (II): Mining Geology

UNIT – I

Introduction – Terminology – Basic Concepts, Factors influencing for selection of Surface/Underground Mining. Development of Benches, Disposal of waste Mine Development– Choice of site for shaft development.

UNIT –II

Alluvial mining methods, Development of tunnels, Adits, levels etc. Open cast and Underground Mining methods.

UNIT – III

Coal Mining Methods. Mine transportation, Mine drainage, Mine Supports.

UNIT- IV

Explosives, - Classification, Methods of charging explosives effects of blasting – Mine – Ventilation – Mine rescue operations.

UNIT-V

Mining legislation, Mining Plans, - Mining Organisation management principles – Writing reports, Mine valuation, Mine safety.

TEXT BOOKS:

1. Shevyako, 1 – Mining of mineral deposits. Foreignanwages publishing.
2. Boky, B-Mining MIR publishers, Moscw.
3. Mc Kinstry, H.E – Mining geology, Prentic Hall.
4. Arogyaswamy, R.N.P. – Courses in mining geology. Exford & IBH, Delhi.
5. Young – Mining.
6. Hooven- Practicals of Mining.

Mining Geology Lab

Determination and evaluation of ores in mines; different sampling calculations; recoverable values; cost of mining; future cost and profits; life of mine; cross

section of mines with the help of available data ;study of coals for rank and grading; coal preparation .

G303 (III): Industrial Minerals and Fuels

Unit 1

The study of the following minerals with reference to origin, mode of occurrence, quality specification, distribution in India and uses. World resources and reserves: mica, vermiculite, asbestos, barytes and gypsum, garnet, corundum, kyanite and sillimanite, graphite, talc, fluorspar, beryl and ochre.

Unit 2

A study of the raw-materials with respect to their occurrences, industrial specifications and distribution in India for following industries: Refractories, abrasives, ceramics and glass industries, fertilizers and chemicals, paint & pigments and cement.

Unit 3

Coal, origin and classification, chemical and mineralogical constituents of the coal, Occurrence and distribution in India. Indian coal reserves. Conservation of coal in India.

Unit 4

Petroleum, natural gas & oil shale. Origin & accumulation of gas & oil traps. Classification of oil and gas reserves. Petroleum bearing regions of India. New gas & oil fields.

Unit 5

Atomic minerals and fuels. Gem minerals (Diamond, ruby, topaz, almandine. Properties, origin, distribution and processing.

Books

1. Sinha, R. K. & Sharma, N. L. (1981): Mineral Economics, Oxford & IBH Pub. Co. Pvt. Ltd.

2. Hussain, A. M. (1985): The Economics and Economic Geology of the Mineral Industries, Allied Pub. (Pvt.) Ltd., New Delhi.

Ref books

3. Chatterjee, K. K. (1993): An introduction to mineral economics, Wiley Eastern Ltd.

Industrial Minerals and Fuels Lab

Study of hand specimens of the minerals; mica vermiculite, asbestos, barites,gypsum,garnet,corundum,kyenite,sellimanite,graphite,talc fluorspar,beryl and ochers;study of hand specimens of coals,thin sections coal for minerals,preparation of contour diagrams,panel diagrams,sediment maps etc.Study of properties of gem-stones.

G303 (IV): Environmental Geology

Unit 1 Definition, scope, concepts, forms of environment: Interaction between man and natural systems. Application of geomorphology in environment. An idea of environmental impact of landslides, earthquakes, volcanoes, large civil engineering structures. Physico-chemical properties of rocks and their engineering geological significance. Primary and Secondary dispersion patterns; biogeochemical anomalies. Distribution and significance of heavy elements in rocks, their weathering products.

Unit 2 Environmental pollution: sampling of soil, water, biological materials. An idea of dating of soils and waters. Radioactive minerals and their impact of the environment. Principles of sedimentation, sedimentary environments. Clay mineralogy and related health hazards. Reservoir petrography of sandstones and limestone; sedimentary petrology in relation to military geology.

Unit 3 River flooding, erosion and sedimentation, coastal subsidence. Cement petrography and its application to pollution. Man as geological agent. Geological consequences of industrialization; Waster; their disposal and management of environment. Physical system, biological system and the oceans. Surface and subsurface water Contamination.

Unit 4 Pollution of atmosphere: Types of energy resources, utilization and effects. Mining hazards, pollution. Geological factors affecting environmental purity. Classification of pathogenic bacteria and their utility in mineral beneficiation.

Unit 5 Silicosis, and other industrial maladies; mine dust. Phthisis and fluorosis; their causes remedies and prevention. Geological factors of environmental health. Environmental elements of medical geology. Anthropogenic activities and environment. Planning and management of land, soil erosion, conservation, urban. Geology and environmental laws.

Books

1. Valdia, K. S. (1987): Environmental Geology, Tata McGraw hills, New Delhi

2. Keller, A. E. (1978): Environmental Geology (5th Edt.) Charis and Merril Pub. Co.

3. Montgometry, C. W. (2016): Environmental Geology, Mc Graw Hall Global education Holding publishers

4. Tonk, W. R. (1986): Environmental Geology, Oxford University Press, New York 1983

Environmental Geology Lab

Study of seismic and flood prone areas in India; hydrochemistry analysis of surface and sub-surface waters; classifications of ground water for use in drinking, irrigation and industrial purpose; evaluation and ground water pollution; study of the pollutions of water and sediments.

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM

CORE – ELECTIVE –THEORY

G304 (I) Geochemistry

Unit-I: Concept of Geochemistry; Cosmic abundance of elements; Geochemical evolution of the earth, Composition of meteorites; Structure and composition of the Earth; Primary differentiation of elements; Geochemical classification of elements.

Unit-II: Significance of crystal chemistry in Geochemistry; Isomorphism, and diadochy, camouflage; Computing and admission of trace elements; Laws of thermodynamic; Gibbs free energy; Principles of ionic substitution in minerals; Rare earth geochemistry and their abundance and mobility in crust. Law of Radioctivity; Prinicipals of isotope dating: Rb,Sr,U(Th-Pb) methods of dating the rocks.

Unit-III: Geochemical mobility under low and high P-T conditions; Geochemical Dispersion: Primary and Secondary dispersion patterns and their classification; Mineral/mineral assemblages as 'sensors' of ambient environments; Geochemistry of hydrosphere, biosphere and atmosphere; Geochemical Cycles.

Unit-IV: Mineral stability; Water – rock interaction; Migration of elements in endogenic environment: Eh-PH – diagram and natural water environment; Radiogenic isotopes, Radioactive decay and growth; Basic ways of dating; Applications of isotopes in Geology

Unit-V: Sampling procedures and introduction to important analytical techniques used in geochemistry. Stable isotope geochemistry of carbon and oxygen and its applications to Geology. Petrogenetic implications of Sm-Nd, Rb-Sr systems. Introduction to sedimentary geochemistry.

G306: Geochemistrylab

- Samplingand samplepreparation
- Methods ofPreparation 'B' solution (Dissolution procedures)
- Determination of elemental concentration on Atomic absorption spectrometer.

TEXT BOOKS:

1. Principles of Geochemistry – BrianMason & C.B. Moore Geochemistry-Gold Schmidt.
2. Introduction to Geochemistry– Krawskopt,K.B., M.C.Graw Hill Applied Geochemistry–F.R. Siegel.
3. StableIsotopeGeochemistry–SpringerverlagPrinciplesofIsotopeGeology–John willyPublication Faure,G; 1986.

G304 (II) Mineral Beneficiation and Ore-dressing

Unit 1

Planet Earth: Introduction- Scope and relation of geodynamics with other branches of geology; Interior of the earth: crust, mantle and core; Earthquakes: Distribution of epicentres; Intensities and isoseismic lines; Earthquake zones; internal zones of the earth on the basis of seismic data; seismic zones and major earthquakes of India.

Unit 2

Mantle & Core: Heat flow mechanism, core-mantle convection and mantle plumes. Crustal types; Distribution and characters; Age province or structural province; Plate reconstructions; chronological studies; Composition of Archean crust.

Unit 3

Continental Displacement: Concepts of continental drift, geological and geophysical evidences of continental drift.; plate tectonics, plates, lithosphere, asthenosphere, types of plate margins and boundaries and associated geological features like Oceanic ridges and rises; Migrating oceanic volcanoes; ocean trenches; topography of mid-oceanic ridges; magnetic anomaly strips; transform faults; subduction zones; island/volcanic arcs; triple junctions; Plates and their reconstruction: Plate tectonics, mineralization and orogeny. Mechanism Causes of global tectonic and expansion hypothesis. Thermal convection hypothesis.

Unit 4

Palaeo-magnetism: Theory and mechanism of sea floor spreading. Palaeomagnetic evidences; rock as fossilcompasses; normal and reversed magnetism; Palaeomagnetic time scale; Palaeo-position of India and geodynamics of the Indian plate.

Unit 5

Ocean Floor & Geosynclines: Topography, continental shelves and slopes and their geomorphic features; Ocean floor and it's relation to plate motion.Geosynclines, Orogenic belts. Evolution of folded mountains. Structural Tectonics & Mountain building. Tectonics of India & Himalayas. Mobile belts of India. Major tectonic features of the world.

Books:

1. Holmes, A. (1978): Principles of Physical Geology, Wiley,(3rd Ed), 730p.
2. Datta, A. K. (2014): Introduction to Physical Geology, Kalyani Publishers, New Delhi.
3. Singh, S. (1999): Physical Geology, PrayagPustak Bhawan, Allahabad, 555p.
4. Siddharth, K. (2015): The Earth's Dynamic Surface, Kisalaya Pub.(2nd Ed.), 600p.

Ref booka:

5. Condi, K. C. (1989): Plate tectonics and crustal evolution, Pergamon,(3rd Ed.), 504p.
6. Skinner, B. J., Porter, S. C. and Park, J. (2003): The Dynamic Earth: An Introduction to Physical Geology, (5th Ed.), Wiley

Mineral Beneficiation and Ore-dressing Lab

Analysis of the water and ocean sediments; analysis of marine resources; study of heavy minerals from beach sands; drawings representing ocean morphology

G304 (III) Advanced Studies in Micropaleontology

UNIT: 1 Advances in micropaleontology; Kingdoms of life; Field and Laboratory techniques in micropaleontology; Taxonomic categories and systematic nomenclature of fossils; Standard Geologic Time Scale.

UNIT: 2 Taphonomy and preservation of fossils; Ontogeny and variation in fossil assemblages; Identification of fossils: methods of study, description and illustration; Forensic micropaleontology;

UNIT: 3: **Foraminifera**: Classification-test morphology-ecology and distribution of foraminifera – applications of foraminifera – the role of foraminifera in monitoring coastal pollution; **Calcareousnanoplanktons(Coccolithophores)**: test morphology of Coccolithophores – stratigraphic and paleo-ecological significance of coccolithophores. **Ostracoda**: test morphology-ecology of Ostracoda – stratigraphic significance of Ostracoda;

UNIT :4: **Radiolarians**: test morphology – stratigraphic and paleo-ecological significance of radiolarians.; **Diatoms**: test morphology – stratigraphic and paleoenvironmental significations of diatoms; **Conodonts**: test morphology – applications of conodonts; **Pollen and spores:** morphology – stratigraphic signification of spores as pollen.

UNIT :5 Stratigraphic distribution of major microfossil groups; The role of micropaleontology in petroleum exploration; Applications of paleontological data in faunal evolution – Paleontologic evidences in paleogeographic reconstruction.

Reference books:-
Microfossils - by M.V. Brasier
Marine Micropaleontology – An Introduction – by W.A. Berggren
Introduction to Microfossils - by D.J. Jones
Invertebrate Paleontology – by Henry Woods

Practicals: Collection of sediment and rock samples – separation of fossils from matrix – identification of fossils – illustration of fossils – preparation of paleontological range charts.

Advanced Studies in Micropaleontology Lab

Preparation of structural and stratigraphic maps; preparation of cross – sections; geological analyses of water and soils; interpretation of geological logs for geological purpose; applications of geological data in mineral exploration; interpretation of seismic data.

G304 (III) Digital Image Processing

Unit I
Introduction to digital images; remote sensing data sources, image formats and Characteristics; Fundamental steps in digital image processing – image acquisition, Enhancement, restoration, compression, segmentation, recognition.

Unit II Components of Image system – hardware and software Sources of radiometric and geometric distortions and correction methods Image registration and geo referencing Introduction to Image enhancement techniques Radiometric enhancement – point operations and look up tables.

Unit III
Contrast modification in image data; histogram equalization, histogram matching; density slicing Geometric enhancement – neighbourhood operations; convolution operations; Fourier transformation; principal component transformation.

Unit IV
Image smoothing; edge detection and enhancement; line detection.
Introduction to Image classification techniques Supervised classification – maximum likelihood classification; minimum distance classification; parallelepiped classification;
UnitV
Non-parametric classification – linear discrimination; support vector classifiers; neural network classification – delineation of spectral classes; iterative
Optimization; similarity metrics and clustering criteria. Introduction to Image classification techniques Unsupervised.

Reference Books
1. R.C. Gonzalez and R.E. Woods, Digital Image Processing (3rd Edition), Pearson 2008
2. W. Burger, M.J. Burge, Principles of Digital Image Processing, Springer, 2009
3. T.M. Lillisand, R.W. Kiefer and J.W. Chipman, Remote Sensing and Image Interpretation (5th Edition), John Wiley & Sons, 2007
4. G.L. Prost and P.L. Prost, Remote Sensing for Geologists: A Guide to Image Interpretation (2nd Edition), CRC Press, 2002

Digital Image Processing Lab

Familiarization of image processing system – hardware including scanners and software Image data formats – analog and digital images; importing digital image data into the required
format for the system software; image rectification – collection and assigning GCPs from toposheet, GPS and image sources; sub-setting the area of interest (AOI);
Image enhancement – noise reduction; contrast stretching; edge enhancement; multispectral transformation of image data – PCA, Tasseled CAP, indices Image classification – supervised

CORE —THEORY

DR. B.R. AMBEDKAR UNIVERSITY, ETCHERLA, SRIKAKULAM

M.Sc. GEOLOGY

IV SEMESTER

G401: Mineral Exploration andMineral Economics

UNIT–I:
Mineral Exploration–Introduction; Surfaceandsubsurfaceexploration; Mapping:Reconnaissance mapping and detailed mapping; Different types of guidesfor searching for minerals.

UNIT–II: Sampling methods: Surfaceandsubsurface sampling and labelling; Mining methods: Opean cast and underground mining,Geological,Geo-chemical, andGeobotanbicalprospectingforminerals.

UNIT–III: Prospectingfor Bauxite, Chromites,Coal,Copper,LeadandZinc,Manganese andPhosphorites, Geophysicalmethodsofprospecting formetallicandnon-metallicmineraldeposits.

UNIT-IV: Gravity method, Electricalmethod, Magnetic method, Seismic methodandRadioactivitymethod.Remote sensingtechniques of prospecting,Minerals Economics: Introduction; Demand&supplyofminerals.

UNIT-V: Conservationandsubstitutionofminerals; Strategic,CriticalandEssentialminerals and their differentiation; Mineral based industries in India with special reference to Andhra Pradesh; Marine mineral resources.

G405: Mineralexplorationand mineral economics lab

1. Problems on average assayvalues, Problems on orereserve estimation.
2. Grademapsand lithofacies mapsand theirinterpretation.
3. Plottingof theassayvalues.
4. Anomalymapsand theirinterpretation.
5. Basicconcepts ofgeophysical data interpretationformineral exploration

TEXT BOOKS:

1. MiningGeologybyMCkinstryGeochemical MineralBachi Viva.
2. Field Geologybylatee.
3. Mineral Economics bysatirical &Sharma
4. Practical manualof exploration &Prospect byS.K. Babu.
5. Geo-Chemistryin mineral exploration byHakess /webb.

G402: Fuel Geology (Petroleum and Coal)

Unit-I:

Petroleum: Introduction;Occurrences of petroleum:surface occurrences and sub- surface occurrences; Reservoir rocks - classification and origin; Porosity andpermeability of reservoir rocks;Oilfield waters;

Unit-II: Physical and chemical properties of crude oil; Composition and impurities of Natural gas, Explorationandexploitation of oil and gas; Origin of petroleum; Migration and accumulation of oil and gas; Reservoir traps-structural and

Unit-III: Stratigraphic traps; Salt domes;Evaluation of reserves and resources; Oil and gas gathering systems. Principles of well logging; Electric logs**,** Radioactive logs, sonic logs; Systems of oil field development;

Unit-IV: Elements of well drilling: Cable tool drilling – Rotary drilling; Application of geophysical methods in prospecting for petroleum; Tectonics and hydrocarbon political of K-G basin,Bombay High, Mahanadi Basin and Cauvery Basin.

Unit-V: Origin of coal; Physical and chemical properties of different types of coals; The Gondwana Group of coal; Mining methods of coal; Fundamentals of coal preparation; Rank and Grade of coal; Coal bed methane; Different coal fields of India with special reference to Raniganj coal-fields, Jharia coal–fields and Singareni coal fields.

G406 Practical:

Preparation of differenttypesofstructural maps, (contour maps) and stratigraphic cross section; Development of stratigraphic panel diagrams; Preparation of intertonguing maps, and sedimentary maps; Drafting of columnar section in graphic symbols; Preparation of palaeontologic range chart; Identification of magascopic coal samples.

CORE – ELECTIVE –THEORY

G403 (I): Geomorphology and Aerial Photo Interpretation

Unit-I: Basic principles of Geomorphology; Weathering, erosion, transportation and deposition of Earth's material; Formation of soil; Physiographic features and river basins in India; Mass wasting, influence of climate on processes, concept of erosion cycles – concept of drainage basin, drainage patterns and slopes - slope analysis and drainage basin analysis.

Unit–II: Geomorphic processes and resulting landforms: exsogenitic processes of geomorphic principles fluvial processes and land forms: meandering, oxbow lakes, flood plains and deltas; Paleo-channels, buried channels; Marine processes and landforms**:** coastal erosion, coast line changes, coral reefs and landforms.

Unit -III: Glacial processes and landforms, Aeolian processes and landforms - Landforms in relation to rock types – karst landscapes; Geomorphic mapping; Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies; Geomorphology of India.

Unit – IV Fundamentals of photogrammetry and photo interpretation; types of photographs; Vertical aerial photographs; Geometric elements of vertical photographs; Photo coordinate system; Scale on aerial photographs; stereoscopy; End lap and Side lap; Vertical exaggeration in stereo viewing – factors involved and determination

Unit - V Determination of horizontal ground lengths, directions and angles from photo coordinates; Relief Displacement on vertical aerial photographs; Parallax and parallax measurement – monoscopic and stereoscopic methods; Elements of aerial photo interpretation – (a) landforms; (b) surface drainage patterns; (c) erosion features, (d) gray tones; (e) miscellaneous elements. Summary of aerial photographic applications in geosciences

G 407 Practical's:

Description of landform models
Topographic profiles – Serial, Superimposed, Projected and Composite profiles
Preparation of relative relief maps and slope maps
Stream profiles from topographic maps
Drainage Morphometry
Landform interpretation from topographic maps
Field visits to identify structural, piedmont, fluvial and coastal landforms in the region
2) Interpretation of topographic maps .
3) Interpretation of stereograms and stereopairs of vertical aerial photographs (using stereoscopes)
4) Measurement with Parallax bar on stereo pairs of vertical aerial photographs
5) Visual interpretation of satellite images.

TEXT BOOKS:

1. Geomorphology by A.L. Bloom, Waveland Pr.Inc. 2004
2. Principles of Geomorphology by W.D. Thornbury, Wiley Eastern, 1984
3. Landscape Systems by T.L. McKnight, Pretice-Hall International, 1987
4. Fundamentals of Geomorphology by R. Huggett, Routledge, 2007
5.Elements of Photogrammetry, P. R. Wolf and B.A. Dewitt, McGraw-Hill, 2004
6. Remote sensing and Image interpretation, Lillesand, Keifer and Chipman, JohnWiley, 2007
7. Essentials of GPS, N.K. Agrawal, Spatial Networks Pvt.Ltd., 2004
8. GPS: Theory and Practice, B. Hofmann-Wellenhof, H. Lichtenegger and J.Collins, 5th Revised Edition, Springer, Wien, New York, 2001.

G403 (II): Mineral Resources

Unit 1

Definition of mineral. Classification of minerals, Ore Mineral forming processes. Chemical composition, physical and optical properties of minerals, Composition of Mamga.

Unit 2

Metallic Mineral Deposits of India with reference to thin mode of excursuses Diagnostic physical properties, chemical composition, uses, modes of occurrence & distribution in India of following: 1) Economic Minerals: Gold, Silver, Copper, Lead, Zinc, Iron, Manganese, Chromium, Tin, Aluminium; 2) Industrial Minerals: Asbestos, Barite, Graphite, Gypsum and Mica; 3) Abrasives: Diamond, Corundum, Emery garnet, Abrasive sand, Tripoli, Pumice, Sand feldspar, Limestone, Clay, Talc; 4) Refractories: fireclay, graphite, Dolomite & sillimanite group of minerals, diaspore, pyrophillite, zircon; 5) Ceramic minerals: Clay, Feldspar, Wollastonite.

Unit 3

Abrasives: Diamond, Corundum, Emery garnet, Abrasive sand, Tripoli, Pumice, Sand feldspar, Limestone, Clay, Talc; Refractories: fireclay, graphite, Dolomite & sillimanite group of minerals, diaspore, pyrophillite, zircon; Ceramic minerals: Clay and gem minerals.

Unit 4

Fossil fuels: coal and lignite, uses, classification, constitution, origin and distribution in India. Petroleumcomposition, uses, theories of origin, oil traps, & important oil fields of India. A brief account of mineral deposits in Beacs Sand of Kerala. Significance of minerals in National Economy. Strategic, critical & essential minerals. Mineral wealth of Madhya Pradesh Environmental impact of mineral exploration.

Unit 5

Radioactive Mineral, Composition, type, Radioactive metals: Thorium, Uranium, Titanium; Distribution of Radioactive minerals

Books

1. Craig, J. R. and Vaughan, D. J. (1994): Ore microscopy and ore petrography, John Wiley & Sons.
2. Evans, A. M. (1992): Ore geology and industrial minerals, Blackwell Science.
3. Jensen, M. L. & Bateman, A. M. (1981): Economic mineral deposits, John Wiley & Sons.
4. Misra, K. C. (1999): Understanding Mineral Deposits, Kluwer Academic Publishers.

Ref books:

5.Mookherjee, A. (1998): Ore genesis - a holistic approach. Allied Publishers.

6. Stanton, R. L. (1981): Ore Petrology, McGraw Hill.1. Gokhale and Rao Ore deposits of India.

7. Jensen and Bateman A.M. – Economic Mineral Deposits, Year

8. Krishnaswamy, S. Indian Mineral Resources

9. Park and Macdiarmid -Ore Deposits 10. Umeshwer Prasad- Economic geology

Mineral Resources: Practical

Study of metallic and non-metallic minerals in hand specimens; study of optical property of minerals in thin sections; megascopic study of different varieties of coals,study of minerals of coal in their sections study of heavy minerals from beach sand.

G403 (III): Marine Geology and Oceanography

Unit 1

Origin of seas and oceans. Ocean morphology, oceanic crust and ocean margin; sea bottom topography - continental margin, shelf, slope, submarine canyon; ocean basin

floor; abyssal hills, plains and gaps; mid-oceanic rise; mid-oceanic ridges- origin, crust and flank province.

Unit 2

Ocean circulation: turbidity current, submarine and sedimentation processes. Oceanic sediments and microfossils. marine stratigraphy, correlation and chronology. Tectonic history of oceans. Mineral resources of the oceans.

Unit3

Historical development of oceanography. Methods of measuring the properties of sea. Deep sea record. Sea level processes and sea level changes. Major oceanographic events in the Cenozic.

Unit 4

Definition, history and facts about oceanography; Importance of study of oceans and its relevance to current science and technology; Concept of oceanography, marine sciences, meteorology, climatology and their relationships. Various oceans on earth.

Unit 5

Fundamentals and basic principles of Physical, Chemical oceanography's, Oceanographic Meteorology; Study of various aspects of meteorology for devising various models in climate prediction; Dynamic Oceanography; Properties of ocean waters – tides and waves; Oceanographic Climatology: Climate change and anthropogenic activities in Oceans; Ocean pollution; Different types of ocean pollutants and remedial measures.

Ref books:

5.Mookherjee, A. (1998): Ore genesis - a holistic approach. Allied Publishers.

6. Stanton, R. L. (1981): Ore Petrology, McGraw Hill.1. Gokhale and Rao Ore deposits of India.

7. Jensen and Bateman A.M. – Economic Mineral Deposits, Year

8. Krishnaswamy, S. Indian Mineral Resources

9. Park and Macdiarmid -Ore Deposits 10. Umeshwer Prasad- Economic geology

Marine Geology and Oceanography Lab

Preparation of structural and stratigraphic maps; preparation of cross – sections; geological analyses of water and soils; interpretation of geological logs for geological purpose; applications of geological data in mineral exploration; interpretation of seismic data.

G403 (IV): Isotope Geology

Unit-1: Introduction to isotopes and nuclear systematics analytical techniques and mass spectroscopy, equations of radioactive decay and radiogenic growth, geochronology, review of mineral structure.

Unit-2: K-Ar Method: Principles, methods and applications; Ar-Ar method: Principles methods and advantages; Rb-Sr method principles, Rb-Srisochron and limitations, Sm-Nd method: Decay scheme, evolution of Nd with time, Nd model ages and applications of Nd to petrogenesis.

Unit-3: U-Th –Pb method: decay schemes, U-Pbisochron, U-Pb mineral dating and application; Stable isotopes and their fractionation; common isotope systems and their application; recent developments and novel applications in stable isotope systems.

Unit-4: Principles of oxygen, Corban and sulfur isotope geochemistry and their application in geology; isotope geochemistry of the earth's mantle. O and H isotopes in the hydrosphere, Atmosphere and Lithosphere.

Unit-5: Isotope fractionation in biosphere system; applications of Cosmo genic radionuclide in geosciences; principles applications of fission track and radio Corban methods of dating; recent developments in isotope geology.

Reference Books:

I

sotope geology by clandeAllegre.

1. Radiogenic Isotope geology by Dickin,A.P.
2. Stable Isotope geochemistry by JochenHoefs.
3. Principles of Isotope Geology by Guntur Faure and Teresa M.Mensing.

- **Isotope GeologyLab**
- Samplingand samplepreparation
- Methods ofPreparation 'B' solution (Dissolution procedures)

Determination of elemental concentration on Atomic absorption spectrometer

CHOICE BASED CREDIT SYSTEM IN P.G.COURSES

M.SC. GEOPHYSICS

Scheme of Instructions and Examination
Effective from the Academic Year 2020-2021

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY
ETCHERLA, SRIKAKULAM

ANNEXURE-I

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY, SRIKAKULAM
SCHEME OF INSTRUCTION AND EXAMINATION AS PER CHOICE BASED CREDIT SYSTEM (CBCS)
(W.E.F.2019-20 ADMITTED BATCH)

ELIGIBILITY

Course	Qualifying Examination for Admission
M.Sc. (Geo-Physics)	B.Sc. With Physics (as main wherever applicable), Mathematics and any other non-biological science subject

This programme is essentially a two year programme for the graduate students in the M.Sc. (Geo-Physics) course, in the Department of Geosciences.

M.SC. GEOPHYSICS

PROGRAMME EDUCATION OBJECTIVES:

1. The two year post graduate course in M.Sc Geophysics comprises both pure and application aspects of Geophysics. The basic objective in designing the syllabus is to make the student to understand about mother earth its constitution, the physical fields associated with it, Geodynamic processes that are taking/took place, natural hazards like earthquakes, volcanoes etc., Environmental problems besides providing a thorough understanding of Oceans.
2. The student will be given enough knowledge on all geophysical exploration methods, both with respective theory & practical skills. He will be thought application of all geophysical methods for exploring ground water, minerals, Hydrocarbons besides their application in environmental & engineering problems.
3. The student will be doing a project work in as a part of course curriculum in the final year at any of the professional/ research/ organizations/ oil industries makes him to tackle a problem on his own an arrive at its solution.

   After completing two year of the MSc in Geophysics programme, you may go for Higher studies like M.Tech, M.S, Ph.D. programme etc.

PROGRAMME OUTCOMES:

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So, with their regresses theoretical/ practical knowledge the student become eligible for his recruitment in any of the employing organizations ONGC, GSI, RELIANCE, SCHLEMBERGER, APPSC GROUND WATER BOARD, WAPCOS, NIO, OIL INDIA LIMITED (OIL), NRSC, GAIL, BARC, SCL, AMD, UCL, INFOTECH, INCOIS and UPSC GEOSCIENTISTS etc

M.SC. GEOPHYSICS – 1ST YEAR, FIRST SEMESTER

Preamble:

In view of the University Grants Commission advice, the syllabus has been redesigned. In first semester, the new revised syllabus is concentrating on overall view on various branches of earth sciences and their inter-relationship with each other, their role in the exploration of various energy resources namely minerals, oil, gas, ground water etc., the basic principles of Geophysics and their application towards the exploration of energy resources, which are essential to the growth and development of human race. The knowledge of these papers is very much useful to the society. The temporary Industrial needs are inter related with the new designed syllabus.

Course No	Title of the paper	Credits	Max. Marks		Total Marks	Instructions Hrs/ week	Exam. Duration
			Internal Assessment	Semester Exam			
	THEORY						
GP101	Principles of Earth System Sciences	4	25	75	100	4	3
GP102	Geo-Mathematics	4	25	75	100	4	3
GP103	Geology - I	4	25	75	100	4	3
GP104	Introduction to Remote Sensing and GIS	4	25	75	100	4	3
GP105	Communication Skills	2			50	4	3
GP 106	MOOC's Course (Swayam)	2			50		
GP107	Field Visits/ Society Engagement Programme	1			25		
	PRACTICALS						
GP108	Geo-Mathematics Computations / Lab	2			50	3	2
GP109	Geology-I Lab	2			50	3	2
GP110	Remote Sensing and GIS lab	2			50	3	2
GP111	Viva-voce	2			50	3	2
	Total	**29**			**725**		

M.SC. GEOPHYSICS – 1ST YEAR, SECOND SEMESTER

Preamble:

In view of the University Grants Commission advice, the syllabus has been redesigned. In second semester, the new revised syllabus is concentrating on Physics of the various earth's processes& phenomena, physical & engineering properties of various earth materials, different geophysical exploration methods namely gravity, magnetic& electrical methods, their role and application towards the exploration of various energy resources that are hidden in the earth's crust, which are essential to the growth and development of of human race. The knowledge of these papers is very much useful to the society and the

welfare of mankind. The contemporary Industrial needs are inter related with the new designed syllabus.

Course No	Title of the paper	Credits	Max. Marks		Total Marks	Instructions Hrs/ week	Exam. Duration
			Internal Assessment	Semester Exam			
	THEORY						
GP201	Physics of the earth	4	25	75	100	4	3
GP202	Gravity and Magnetic methods	4	25	75	100	4	3
GP203	Electrical Methods	4	25	75	100	4	3
GP204	Geology-II	4	25	75	100	4	3
GP205	Communication Skills	2			50	4	3
GP206	MOOC's Course (Swayam)	2			50		
GP207	Field Visits/ Society Engagement Programme	1			25		
GP208	Summer Internship	1			25		
	PRACTICALS						
GP209	Gravity and Magnetic Methods Practical	2			50	3	2
GP210	Electrical Methods Practical	2			50	3	2
GP211	Geology-II Lab	2			50	3	2
GP212	Viva-voce	2			50		
	Total	**30**			**750**		

M.SC. GEOPHYSICS – 2nd YEAR, THIRD SEMESTER

Preamble:

In view of the University Grants Commission advice, the syllabus has been redesigned. In third semester, the new revised syllabus is concentrating on digital signal processing & inversion theory, various techniques to filter an process the geophysical data acquired from the field prior interpretation of the data, different geodynamical surface processes associated with the earth's interior , different geophysical exploration methods namely seismic, electromagnetic & well logging (bore-hole geophysics) methods, their role and application towards the exploration of energy resources that are hidden in the earth's subsurface , which are essential to the growth and development of human race. Also, a special focus is made on the subject of ground water resources and management, its storage and the utilization. The knowledge of these papers is very much useful to the society and the welfare of mankind. The contemporary Industrial needs are inter related with the new designed syllabus.

Course No	Title of the paper	Category	Credits	Max. Marks		Total Marks	Instructions (Hrs/ Week)	Exam. Duration
	THEORY			**Internal Assessment**	**Semester Exam**			
GP301	Signal processing and Inversion Theory	Core	4	25	75	100	4	3
GP302	Seismic Methods	Core	4	25	75	100	4	3
GP303 (I)	Mining, Ground water and Environmental Geophysics	Elective	4	25	75	100	4	3
GP303 (II)	Ground Water Resources and Management							
GP303 (III)	Seismology							
GP303 (IV)	Solid Earth Geophysics							
GP304 (I)	Marine Geophysics	Elective	4	25	75	100	4	3
GP304 (II)	Geomagnetism							
GP304 (III)	Tectonics & geodynamics							
GP304 (IV)	Environmental Hydrology & Water Quality							
GP305	Communication Skills		2			50	4	3
GP306	MOOC's Course (Swayam)		2			50		
GP307	Field Visits/ Society Engagement Programme		1			25		
	PRACTICALS							
GP308	Signal processing & Inversion theory Practical	Core	2			50	3	2
GP309	Seismic Methods Practical	Core	2			50	3	2
GP310 (I)	Mining, Ground water and Environmental Geophysics Practical	Elective	2			50	3	2
GP310 (II)	Ground Water Resources and Management Practical							
GP310 (III)	Seismology Practical							

GP310 (IV)	Solid Earth Geophysics Practical							
GP311 (I)	Marine Geophysics Practical	Elective	2			50	3	2
GP311 (II)	Geomagnetism Practical							
GP311 (III)	Tectonics & Geodynamics Practical							
GP311 (IV)	Environmental Hydrology & Water Quality Practical							
GP312	Viva-voce		2			50		
	Total		**31**			**775**		

M.SC. GEOPHYSICS – 2nd YEAR, FOURTH SEMESTER

Preamble:

In view of the University Grants Commission advice, the syllabus has been redesigned. In fourth semester, the new revised syllabus is concentrating on general geo-physics of the various earth's processes& phenomena, geophysics applied in the exploration of mining, ground water and petroleum resources, resources in mining & ground water investigations, and also importance of geophysics in the understanding the environmental problems, which are essential to the substance and development of human race. The knowledge of these papers is very much useful to the society and the welfare of mankind. The contemporary Industrial needs are inter related with the new designed syllabus.

Course No	Title of the paper	Category	Credits	Max. Marks		Total Marks	Instructions (Hrs/ Week)	Exam Duration
				Internal Assessment	Semester Exam			
	THEORY							
GP401	Electromagnetic methods	Core	4	25	75	100	4	3
GP402	Well Logging and Reservoir Analysis	Core	4	25	75	100	4	3
GP403 (I)	Petroleum Geology and Geophysics	Elective	4	25	75	100	4	3
GP403 (II)	Disaster Management							
GP403 (III)	Engineering Geophysics							
GP403 (IV)	General Meteorology and Oceanography							
GP404	Project Work		4			100		
GP405	Communication Skills		2			50	4	3
GP406	MOOC's Course (Swayam)		2			50		
GP407	Field Visits/ Society Engagement Programme		1			25		
	PRACTICALS							
GP408	Electromagnetic methods Practical	Core	2			50	3	2
GP409	Well Logging and Reservoir Analysis Practical	Core	2			50	3	2
GP410 (I)	Petroleum Geology and Geophysics Practical	Elective	2			50	3	2
GP410 (II)	Disaster Management Practical							
GP410 (III)	Engineering Geophysics Practical							
GP410 (IV)	General Meteorology and Oceanography Practical							
GP411	Final Viva-Voce		2			50	3	2
	Total		**29**			**725**		

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY
ETCHERLA, SRIKAKULAM
M.SC. (GEOPHYSICS)

FIRST YEAR-FIRST SEMESTER SYLLABUS

CORE - THEORY

GP 101: PRINCIPLE'S OF EARTH SYSTEM SCIENCES

Unit I : Origin of the Universe- The Solar System; The Earth: Origin and age of the Earth; The internal structure of the Earth; The Geologic time scale; Various branches of Earth Sciences and Their inter relation.

Unit II : Atmosphere of the Earth; Classification of climates, cyclones and anticyclones; tsunamis; wave erosion and beach processes; The concept of estuary; heavy mineral concentrations in the beaches; conservation methods of beaches.

Unit III : Continental drift hypothesis, concepts of sea-floor spreading and plate tectonics; mid-oceanic ridges; deep sea trenches; transform faults and island arcs; Earthquakes and

Unit IV : Geodynamics: Oceanic and continental crust composition, upper mantle & lower mantle composition, inner and outer core composition.

Unit V: Geophysical methods: Principles of Gravity, magnetic, electrical & electromagnetic, seismic & well logging methods, their applications; Geological methods of mapping and sampling , principle of mining.

Text Books:

1. Fundamentals of geophysics by William Lowrie
2. Principle of Engineering Geology: K. M. Bangar.
3. A text book of Geology: G.B. Mahapatra.
4. A text book of Physical Geology: G. B. Mahapatra

Reference Books:

1. Principles of Physical Geology, 1992 by Holme's. Chapman & Hall.
2. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment.
3. Emiliani, C, 1992. Cambridge University Press. Earth(second edition), Frank Press and Raymond Seiver, W.H.Freeman and Company, San Francisco

GP 102: GEOMATHEMATICS

Unit I: Mathematical methods and physical fields in Geophysics: Properties of scalars, vectors and tensors, Elements of vector analysis, Gradient, Divergence and Curl, Gauss's divergence theorem, Stokes theorem; Line Integrals, Green's theorem in two-dimensions. Complex Integration, Cauchy's Integral theorem, Cauchy's Integral formula, Types of Residues, Cauchy's Residue Theorem.

Unit II: Matrices: Principles and definitions, Singular value decomposition method. Introduction to various generalized inversion techniques and their properties. Well posed and ill posed problems, Least square polynomial approximation: the principle of least squares, least square approximation over discrete sets of points, Chebysev Polynomial.

Unit III: Numerical Analysis; finding the roots by numerical methods- bisection method, False position method, Newton-Raphson method. Interpolation: finite difference, symbolic relations. Interpolation by Newton's formula. Gauss's Central difference formula, Bessel's formula, Lagrangian formula and Richardson's extrapolation. Numerical differentiation and Integration: Maximum and minimum of a tabulated function. Numerical Integration- Trapezoidal rule, Simpson' s rule, Romberg integration, Weddle's formula.

Unit IV: Numerical solution of differential equations- Introduction, Solution by Taylor series, Picard's method of successive approximation, Euler's method, Runga-Kutta method. Finite element methods: Basic concept of the finite element method. Boundary and Initial value problem, Variational formulation of boundary value problem, Variational methods of

approximation- The Ritz method. Introduction to finite element analysis of I-D and 2-D problems.

Unit V: Data presentation: frequency tables and bar charts, frequency polygons, measures of central tendency; mean, mode, median, geometric mean, standard deviation, variance and coefficient of variance. Probability: Sample Spaces and Events, Definitions of probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Baye's Theorem, Random variable, Discrete Random Variable, Probability Distributions and Probability Mass functions, Mean and Variance of a Discrete Random variable, Binomial Distribution, Poisson Distribution. Introduction to Classical Optimisation Techniques, Introduction to Linear Programming and Non-linear Programming, One dimensional minimization methods- Introduction, Fibonacci method. Introduction to unconstrained optimisation techniques. Introduction of Steepest descent method, gradient techniques and Marquardt's method.

Text Books:

1. Higher mathematics for Engineering and Science, M.K.Venkata Raman
2. Engineering mathematics, M.K.Venkata Raman
3. Introduction to Numerical analysis, S.S.Sastry

Reference Books:

1. Complex Variables, R-C.Churchill
2. Matrix theory for scientific and engineers, Jennings
3. Generalized inverse of matrices and its application, C.K.Rao&S.R.Mitra
4. An Introduction to Finite Element Method, J.N.Reddy
5. Introduction to Numerical analysis, F.B.Hiderbrand
6. Fundamentals of geophysics by William Lowrie, Cambridge University Presss
7. 10.Applied Geophysics by Telford W.M. Geldart L.P., Sheriff, R.E. and Keys D.A.

GP 103: GEOLOGY- I

Unit – I: Introduction to Geology– Branches of Geology - Scope of Geology and its relation with Geophysics.Weathering and erosion Phenomenon – Physical, chemical and Biological weathering - products of weathering. Wind erosion and its features - Sediment transport by wind - various types of Dunes. Geological work of Glaciers – Types – Movement - Erosional features. Glacial Transport – Deposition and related features.

Unit-II: Geological work of Rivers - Initial, Young and old stages of their development - Canyon, base level of erosion, meandering point bars, oxbow lakes, flood plains and natural levees. Erosion, denudation, peneplains, monad nocks, deltas and types. Volcanoes – Types, Products, Volcanic eruptions, and distribution of Volcanoes.

Unit-III: Fundamental concepts of Geomorphology. Various near shore morphological features developed due to geological work of sea. Waves and currents and transportation by sea.Features of Marine erosion and deposition and related features. Evolution of major geomorphic processes in India, Field and laboratory map scales, Topographic maps Thematic maps.

Unit-IV: Definition of Petrology –Bowen's reaction series – Differentiation of Igneous, Sedimentary and Metamorphic rocks. Origin and forms of Igneous rocks – textures – structures and classification of Igneous rocks. Origin of sedimentary rocks, textures – structures and classification of sedimentary rocks. Types of Metamorphism - Textures and structures of metamorphic rocks.

Unit V: Definition of a mineral – Physical properties of minerals: Mohs scale of hardness, colour, streak, transparency, luster, tenacity, cleavage, fracture, specific gravity, - Isomorphism and Polymorphism – Structure and chemistry of Quartz, Feldspars, Mica Pyroxenes, Amphiboles, Garnet groups of minerals. Clay minerals, Elements of Crystallography.

Text Books:

1. Principle of Engineering Geology: K. M. Bangar.
2. A text book of Geology: G.B. Mahapatra.
3. A text book of Physical Geology: G. B. Mahapatra.

Reference Books:

1. Physical Geology: G. Gorshkov, A. Yakushova.
2. Physical Geology: A.K. Datta
3. A text book of Geology: P.K. Mukherjee.
4. The Principle of petrology: G.W. Tprell.
5. Rutleys mineralogy: H. M. Read.
6. Physical Geology: Arthur Holmes.
7. Engineering and general Geology: Parbinsingh.

GP 104: INTRODUCTION TO REMOTE SENSING AND GIS

Unit – I: Fundamentals of Aerial Photography, Types and scales of aerial photographs, Aerial photo interpretation techniques, Stereogram, stereo pairs, Aerial mosaics vs. toposheet. Fundamentals of Photogrammetry and Photo Interpretation – types of photographs; vertical photographs, principal point, scale, strereoscopy, Overlap, sidelap.

Unit-II: Definition of Remote sensing,Principles of Remote Sensing, Electromagnetic spectrum, lnteraction of EM Radiation with atmosphere and earth surface features, Spectral reflectance patterns of vegetation, water and soil, Platforms: types of platforms, ground, airborne, and spaceborne, Sensors: types of classification of sensors, sensor resolution-spectral, radiometric and temporal. Global and Indian space missions i.e. LANDSAT, METEOSAT, SEASAT, SPOT, and RADARSAT & IRS Series of satellites.

Unit-III: Satellite Image Interpretation - Keys, Introduction to Digital Image processing, Classification – unsupervised classification, supervised classification techniques, Change detection analysis, FCC Image vs. RGB image, Aerial photo vs. satellite imagery. Application of Remote sensing in Geology, Geomorphology, Mineral exploration, Land use/Land cover and hydro geological studies.

Unit-IV: Geographical Information Systems – definition and scope; Geospatial data – entities and attributes; Components of a GIS; Geographic coordinate system and datum; Map projections – types of projections, Commonly used map projections.

Unit V: Data representation in GIS: Graphic representation of spatial data – vector and Rasterformats and their relative merits and limitations; Database structures for Managingattribute data – Hierarchical, Network, Relational database management systems;Topology: topological elements – points and nodes, lines and arcs, polygons.

Text Books:

1. Lillisand and Kiefer R.W. Remote Sensing and Image Interpretation.
2. George Joseph..Fundamentals of Remote SensingA.N. Rencz and R.A. Ryerson (Eds), Remote Sensing for earth Sciences (Manual of Remote Sensing 3rd Edition), American Society for Photogrammetry and Remote Sensing, 1999.

Reference Books:

1. G.L. Prost and P.L. Prost, Remote Sensing for Geologists: A Guide to Image Interpretation (2nd Edition), CRC Press, 2002.

2. R.P. Gupta, Remote Sensing Geology, Springer-Verlag, 2003.

3. N.M. Short (Sr), Remote Sensing Tutorial, NASA 2010 available at http://rst.gsfc.nasa.gov/Front/foreword.html.

4. S. Rajendran et al., Mineral Exploration: Recent Strategies, Eastern Book Corporation, 2007.

PRACTICALS

GP 108: GEOMATHEMATICS COMPUTATIONS / LAB

Practical No.I

1. One question on Newton-Raphson Method
2. One question on Newton-forward interpolation formula
3. One question on Gauss-Backward interpolation formula
4. One question on LaGrange's interpolation formula
5. One question on Richardson extrapolation.

Practical No.II

1. One question on False position method
2. One question on Newton-Backward interpolation formula
3. One question on Gauss-Forward interpolation formula

4. One question on the application of Bessel's formula
5. One question on solving an equation using the method of Bisection.

Practical No.III

1. Two questions on finding the maximum and Minimum values of the function y = f(x) from the given data.
2. One question on Trapezoidal rule
3. Two questions on Simpson's 1/3rd rule

Practical No.IV

1. One question on Simpson's 3/8th rule
2. Two questions on Romberg integration
3. Two questions on Weddle's rule.

Practical No.V

1. One question on Taylor's series method
2. One question on Euler's method
3. One question on Runga-Kutta 2nd order method
4. One question on Runga-Kutta 3rd order method

Practical No.VI

1. One question on 4th order Runga-Kutta method
2. One question on Modified Euler's method
3. One question on Picard's method of successive approximation.

Practical No. VII

1. One question to construct a frequency table to the given data
2. One question to draw a bar chart of the given data
3. One question to draw a frequency polygon for giving data.
4. One question to find Mean, Median and Mode for the given data.

Practical No.VIII

1. One question to find Geometric mean of the given data
2. One question to find Standard deviation of the given data
3. One question to find Variance of the given data.
4. One question to find Coefficient of Variation to the given data

Practical No.IX

1. One question on the application of addition theorem of probability
2. One question on the application of multiplication theorem of probability
3. One question on the application of total conditional probability.
4. One question on the application of Baye's theorem

Practical No.X

1. One question on the construction of Probability mass function from given data.
2. One question to find the Mean and Variance of the Discrete Random variable using the given data
3. One question to find the Mean and Variance of a Binomial Distribution using the given data
4. One question to find the Mean and Variance of a Poisson Distribution using the given data.

GP 109: GEOLOGY-I LAB

1.Mineralogy Lab: Megascopic and microscopic identification of important silicate and non-silicate minerals. Identification of various minerals under microscope

2. **Petrology Lab:**

Megascopic and microscopic study of igneous, metamorphic rocks & Sedimentary Rocks.

3. Geomorphology Lab

Study of topographical maps & Identification of different landforms from topographical maps

GP: 110 REMOTE SENSING AND GIS LAB PRACTICALS

a. Visual interpretation of aerial photos.
b. Stereoscopic study of aerial photos
c. Visual interpretation of satellites images
d. Introduction to image processing techniques
e. Introduction to GIS techniques
f. Application of GIS for one case study.
g. Exercise on using remote sensing for case study.

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FIRST YEAR- SECOND SEMESTER SYLLABUS

CORE – THEORY

GP 201: PHYSICS OF THE EARTH

Unit – I: Size and shape of the earth; Isostasy and different theories of isostatic compensation, isostatic anomalies and crustal structure; Geospheres: Scope of study of various geospheres, Atmosphere, Ionosphere, Asthenosphere, lithosphere-hydrosphere and Biosphere. Atmosphere: composition; Earth's radiation balance, Air masses, Monsoons, Jet streams, tropical cyclones, Hurricanes, tornadoes and waterspouts, El Nino, Cloud classification, climate changes; Ocean Systems.

Unit-II: Paleomagnetism: Remanent magnetism in rocks, hysteresis curve, Isolation of remanance, AF demagnetization, thermal demagnetization; concepts of archeomagnetism; Subduction and obduction, ocean ridges, triple junction of world oceans, their evolution, trenches and island arcs, hot spots, thermal hot plumes.

Unit-III: Rock Physics and Petro physics: Different physical and Engineering properties of rocks Laboratory measurements of the physical properties of rocks namely Density, Seismic wave velocities, magnetic susceptibility, Electrical resistivity, thermal conductivity, porosity and permeability. Geothermics: Heat sources, Geothermal flux distribution; Geochronology and age of the earth.

Unit-IV: Seismology: Natural and Artificial seismology and its relation to other Earth System sciences. Classification of Earth quakes, Causes and propagation of different seismic waves and fundamental laws, Seismometry: Introduction, Principle of Seismometer, Vertical motion seismometer, and Horizontal motion seismometer. Broad Band seismometer; Interior of the Earth and Earth quake prediction.

Unit V: Hydrology - definition, hydrologic cycle, vertical distribution of groundwater, types of aquifers, Darcy's law, Concept of Hydro-Geology, concepts of confined,

unconfined and leaky aquifers – Water bearing Properties of aquifers – Storage properties porosity, permeability – laboratory measurement, quality of Groundwater, concepts of water balance, sea water intrusion in coastal aquifers.

Text Books:

1. Fundamentals of geophysics by William Lowrie
2. Principle of Engineering Geology: K. M. Bangar.
3. A text book of Geology: G.B. Mahapatra.
4. A text book of Physical Geology: G. B. Mahapatra

Reference Books:

1. P.V. Sarma, 1976, Geophysical Methods in Geology, Elsevier.
2. Howell, 1959, Introduction to Geophysics, McGraw Hill Book Co. New York.
3. R.E. Sheriff, 1989, Geophysical Methods. Prentice Hall Engle Wood Cliffs. New Jerssy.
4. I.K. Kaul, S. Senugupta and A.K. Bhattacharya, 1990, General and Applied Geophysics, (An introduction), Associate of, Geophysics.
5. F.D. Stacey, 1977, Physics of the Earth, John Wiley and Sons, New York.
6. Rezhevisky and Novik, 1971, Physical properties of Rocks, Mir Publications.
7. Richter, C.F. 1969, Elementary Seismology, Eurasia Publishing house, Pvt. Ltd. New Delhi.
8. Geomagnetism, Solid Earth and Upper Atmosphere Perspectives, Nathani**Basavaiah,** Springer
9. Debate about the Earth, H. takenchi, S. Uyeda and H. Kanam.

GP 202: GRAVITY & MAGNETIC METHODS

Unit I: Geophysical potential fields (gravity and magnetic), Inverse square law, Earth's Gravity field, Properties of Newtonian potential, Laplace's and Poisson's equations, Green's theorem, Gauss law, Spatial and temporal variations; Geodesy: International gravity formula, the figure ofthe earth, Clairaut'stheorem, the geometric and gravitational flattening, geoid and spheroid, Earth's main magnetic field, origin, internal and external fields, separation , Rock magnetism, Densities & Susceptibilities of different rocks.

Unit II: Principles of gravity prospecting and magnetic prospecting, concepts of gravity anomaly andmagnetic anomaly. Gravity prospecting instruments – Static gravimeters,

Astatization, Zerolength spring, Worden & Lacoste Romberg Gravimeters. Types of magnetometers- Astaticand Spinner Magnetometers, Proton precession magnetometer, fluxgate magnetometer;demagnetization effects.

Unit III: Plan of Gravity & Magnetic surveys – Establishment of gravity bases, magnetic bases, corrections in gravity data - drift correction, topographic correction, terrain correction**,** Bouguer correction, Eotvos correction. Corrections in magnetic data - Diurnal correction, Normal correction; Dependence of magnetic anomalies on latitude and orientation.

Unit IV: Interpretation of gravity and magnetic data – Qualitative interpretation- study of contour maps over 2d & 3d bodies. Regional and residual separation – graphical, average, grid and curve fitting methods, use of filters, vertical derivative calculations, upward and downward continuation of anomalies, Reduction to pole of magnetic anomalies. Calculation gravity and magnetic anomalies over simple geometries (Spheres, cylinders, disc, sheet, fault, dyke, anticlines & synclines etc.) Characteristic properties of gravity and magnetic anomaly profiles.

Unit V: Interpretation by simple thumb rules and characteristic curves. Interpretation of magnetized dyke-Koloumzine method, forward modelling of gravity & magnetic anomalies: Two dimensional and three-dimensional bodies of arbitrary shape. Inversion of gravity & magnetic anomalies – Polygon body, sheet, fault, dykes & basement, Fourier and Hilbert transforms in gravity & magnetic, Frequency domain interpretation;. Mass estimation in gravity; Application of gravity and magnetic methods for regional geological mapping, geodynamic studies, Oil exploration, Ground water exploration, mining, engineering and environmental applications.

Text Books:

1. Gravity and magnetic Interpretation in Exploration Geophysics, I.V.Radhakrishna Murthy.
2. Gravity and magnetic methods, Rao, B.S.R and Murthy, I.V.R
3. Applied Geophysics, W.W.Telfordet. al
4. Introduction to Geophysical prospecting, M.B.Dobrin

Reference Books:

1. The Earth and its gravity field, A.A.Heiskanen and F.A Vening
2. Gravity and magnetics in oil prospecting, L.L.Nettleton
3. Marine Gravity, Peter Denelinagar
4. Interpretation theory in Applied Geophysics, F.S.Grant and West
5. Geomagnetism: Solid Earth and Upper Atmosphere Perspectives, Nathani Basavaiah
6. Special issue on Geomagnetic methods and Lithospheric structure, Proc. Of Earth and Planetary Sciences, Indian Academy of Sciences, Vol.99 (4), 1990

GP 203: ELECTRICAL METHODS

Unit-I: Basic Principles of electrical methods of prospecting. Classification of methods**:** Electrical properties of Rocks and minerals; Influence of mineral composition, moisture and salinity, Temperature on resistivity; Flow of current through the earth media- Description of the Potential and electrical field due to simple Source of current.; Current and potential distribution. Electrical current theory propagation in DC Resistivity methods, DC Laboratory determination of Resistivity.

.**Unit-II:** Basics of Resistivity methods of prospecting: Different types of electrode arrays: Wenner, Schlumberger, Dipole- Dipole, Half-Wenner, Half-Schlumberger- Geometric factors and theoretical derivations for apparent resisitivity for different electrode configurations. Concepts of True and Apparent resistivities Principle of reciprocity; Resistivity methods, sounding and profiling field procedures.

Unit-III: Vertical Electrical Sounding (VES): Apparent Resistivity over a layered earth. Master curves - Types of two, three and multiplayer VES curves. Principles of Equivalence and Principle of suppression; Construction and interpretation of VES curves by graphical (Curve matching) and Computer technique; Buried electrode method: Principle of operation of charged body (buried electrode) method & its uses.

Unit-IV: Electrochemical Methods: S.P. Sources, origin of self-potentials - theories, nature of electro-chemical processes (spontaneous polarization) in the earth. Exploration

of sulphide ore bodies; Typical responses over sphere and rod like bodies. Field procedure for S.P. surveys and interpretation techniques & Applications.

Unit -V: Induced Polarization (IP) Method: sources of IP, membrane and electrode polarizations, Time domain and Frequency domain measurement of IP, chargeability, percent frequency effect and metal factors. Field Procedure. Plotting methods – Pseudo section plotting. Spectral Induced Polarization(SIP) – Magnetic Induced Polarization (MIP) method; Applications of IP Methods.

Reference Books:

1. D.S.Parasnis, 1977, Introduction to Apllied Geophysics, Published by Chapman & Hall, London
2. E.I. Parkhomenko – 1967 Electrical Properties of Rocks – Plenum Press, NewYork.
3. Stanislav Mares et al.. 1984, Introduction to Applied Geophysics, D.Reidel Publishing.
4. Koefeed C, 1980, Principles of Geoelectrical Soundings, Elsevier.
5. Ward S.H., 1969 Mining Geophysics, SEG.
6. Electrical Imaging surveys for environmental and engineering studies. By M.H.Loke
1. Keller and Frischkeicht, 1966, Electrical methods in Geophysical Prospecting
7. Pergaon

GP 204 : GEOLOGY II

UNIT-I: Stratigraphy: Introduction - principles of Correlation. Fossils - uses of fossils - their importance in statigraphy Physiographic divisions of India - Peninsular India, Indogangitic plain and Extra peninsular India. Geological time scale and Stratigraphic units of India.

UNIT-II: Important Indian groups and systems: Archean and Dharwar System – Introduction, distribution, classification and economic importance. Study of Cuddapah – Vindhyan – Gondwana group – Deccan traps – Siwaliks and Quaternary formations.

UNIT-III: Structural features of rocks.Stress and strain. Primary and secondary structures – dip and strike. Folds: Introduction – classification and origin. Faults: Introduction – classification and recognition and causes of faulting. Joints: Introduction – classification and origin. Unconformities: Definition – Origin and types.

UNIT-IV: Economic mineral deposits: Origin of ore deposits – Igneous, sedimentary and metamorphic. – Metallic and Non metallic types - Placer minerals. Classification of coals - Origin, migration and entrapment of petroleum deposits with special reference to KG basin.

UNIT-V: Physiographic divisions of seas and world oceans, Seamounts and guyots – Properties of sea water: Temperature, salinity and density — Hotspot mechanism – turbidity currents – Mid oceanic ridge system – Coral reefs and their formation – Island arcs – trenches – Deep sea sediments: placers on the beach and shelves - Conditions for formation of polymettallic nodules.

REFERENCE BOOKS:

1) Physical and engineering geology: S.K. Garg
2) A text book of geology: G.B. Mahapatra.
3) Principles of engineering geology: K.M. Bangar.
4) Submarine geology: P.H. Kunen.
5) Submarine geology: F.P. Sheppard.
6) Stratigraphy of India: M.S. Krishnan.
7) Structural geology: M.P. Billings.
8) Economic mineral deposits: A. M. Bateman.
9) Text book of Physical geology: G.B. Mahapatra.

PRACTICALS

GP 209: GRAVITY AND MAGNETIC METHODS PRACTICAL

1. International Gravity formula
2. Reduction of gravity data by applying corrections to any real field example
3. Preparing gravity anomaly contour map from field data
4. Regional-residual separation by a) Graphical method b) Grid Methods
5. Construction of gravity profiles on some simple simple geometrical models (Sphere, Horizontal circular cylinder, fault and prism)
6. Mass estimation in gravity prospecting
7. Second derivative calculations

8. Reduction of magnetic data by applying corrections to any real field example
9. Preparing magnetic anomaly contour map from field data
10. Magnetic profile interpretation of any published data
11. Total magnetic field anomaly over single pole and a dipole
12. Vertical magnetic anomalies over a horizontal circular cylinder, dyke, fault, sheet.
13. Interpretation of magnetic anomalies over a dyke
14. Magnetic anomalies over a dyke using Fourier transform.

GP 210: ELECTRICAL METHODS PRACTICAL

1. Self potential field survey and interpretation
2. Computation & interpretation of S. P. anomaly over a buried polarized rod.
3. Computaion& interpretation of S.P. anomaly over a buried polarized sphere
4. Computation of geometric factors & apparent resistivity for various resistivity field layouts.
5. Graphical construction of VES curves
6. Analytical construction of VES curves
7. Interpretation of VES resistivity data of Wenner configuration
8. Interpretation of VES resistivity data of Schlumberger configuration
9. Interpretation of VES data by curve matching techniques
10. Qualitative interpretation of resistivity data obtained with profiling technique.

GP 211: GEOLOGY -II PRACTICAL

Structural Geology Lab:

1. Preparation and interpretation of geological maps and sections.
2. Structural problems of Folds, faults and joints concerning to economic mineral deposits
3. Recording and plotting of field data.

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY
ETCHERLA, SRIKAKULAM
M.SC. (GEOPHYSICS)

SECOND YEAR-THIRD SEMESTER SYLLABUS

CORE – THEORY

GP 301: SIGNAL PROCESSING AND INVERSION THEORY

Unit I: Introduction, Definition of signal and noise, various signal classes such as continuous, piece wise continuous, absolute integrable, singularity, unit impulse, unit step, etc. Fourier series and Fourier Transforms: Time and frequency domain, relations between various operations in both the domain, Fourier Transform and its properties, Fourier Transforms of some important functions: Rectangular, exponential functions, singularity functions and periodic functions.

Unit II: Time-series analysis: Discrete time signals, Correlation and convolution functions, impulse response and Transfer function spectrum of observational data: Discrete Fourier Transform (DFT), FFT, Z-Transforms and its properties, inverse Z – transforms Delay properties of wavelets.

Unit III: Band limited signals: Properties, Sampling Theorem, Nyquist frequency, Aliasing, Sampling of band and time limited signals; Effect of sampling on spectrum and vice-versa; reproduction of continuous function from sampled data. Importance and effects of Windowing, Gibbs phenomenon, spectral leakage, various types of windows; power spectrum; Estimation of power spectrum, Wiener Khinchin theorem, use of various windows in power spectrum computation, spectrum computation via Auto-correlation and Periodogram.

Unit IV: Digital filtering: Design of digital filters, amplitude and phase response of various filters; one-sided and two sided filters, low-pass, high pass and band-pass, optimum filters, Butter worth filter, Recursive and non-recursive filters, optimal and Weiner filters, Deconvolution and predictive deconvolution, Signal enhancement for gravity and magnetic

maps; regional residual separation, continuations, evaluation of derivatives, pseudo gravity transformations, reduction to poles and equator, Improvement of signal to noise ratio, source and geophone arrays as spatial filters. Earth as low pass filter.

Unit-V: Inversion Theory: Introduction, Fundamental concepts of inverse theory, Basic definition of inversions with application to Geophysics, Probability, Inverses with discrete and continuous models. Forward problems versus Inverse problems. Formulation of inverse problems and their relation to a matrix problem. Linear Inversion, Assessing the uncertainty in inverted models. Earthquake location problem, tomography problem. Probabilistic approach of inverse problems, maximum likelihood and stochastic inverse methods, Backus-Gilbert method, Global optimization techniques, genetic algorithm, simulated annealing methods, examples of inverting geophysical data. Non-Linear Inversion, Incorporating prior information, Parametric Inversion.

Reference Books:

1. 2. Theory and application of digital signal processing, Rabiner,L.R and Gold, B.
3. Digital signal processing and time series analysis, Enders A.Robinson
4. Statistical theory of communication, Y.W.Lee
5. Analysis of Geophysical Potential Fields, P.S.Naidu&M.P.Mathew
6. Seismic Filtering, Nathan Rothenburg, SEG publication
7. Time sequence analysis in Geophysics, E.R.Kanasewich
8. Signal Analysis, B.P.Lathy
9. Inverse problem theory, Tarantola.A,1987
10. Solutions of ill-posed problems, Tikhonov.A.V, and Arsenin.V.Y, 1977
11. Computational methods for Inverse problems, Vogel.C.R, 2001
12. Optimisation theory and application, S.S.Rao, Frank Press and Raymond Seiver, W.H.Freeman and Company, San Francisco.

GP 302: SEISMIC METHODS

Unit –I: Principles of elasticity: stress and strain, Hook's law, Elastic moduli, wave equations, Huygen's& Fermat's Principles, Zoeppritz equations, refraction, reflection, critical refraction, diffraction, attenuation & absorption of seismic waves, acoustic impedance, surface waves, dispersion multiples, reflection and transmission coefficients. Elastic wave velocities of rocks, laboratory and field measurements, dynamic modulii, P and S-wave velocities, anisotropy, attenuation, factors affecting velocity, different types of velocities.

Unit- II: Electromagnetic geophone and its performance, damping coefficient, hydrophones, different arrays, streamer, analog data acquisition, amplifiers, filters, gain control and recording types. Seismic energy sources for land and marine surveys – Dynamite thumper, deposes, vibroseis, land air gun, pinger, boomer, sparker, airgun, water gun, vaporchoc etc. Controlled explosions, shot control, source arrays, energy content, frequency. Geometry of ray paths, refraction and reflection, horizontal layers and dipping layers, NMO and dip move out, velocity inversion, low velocity layer, blind zone, hidden layer problem.

Unit-III: Digital data acquisition, digital field system, Telemetry systems, wire line and radio telemetry, telemetry system configuration and specifications. Dynamic range of signals, noise. Ambient and electrical noises and their nature and attenuation requirements. Single channel and multi channel surveys, field layouts and shooting procedures for land and marine 2D surveys, split spread and end-on spreads, CDP procedures for land and marine surveys, stacking chart. 3D surveys, 3D layouts.

Unit-IV: Refraction data processing: Reduction of refraction data, Long refraction profiles, reversed and un-reversed profiles, interpretation of refraction data, analysis of refraction records, plus-minus, delay time & reciprocal methods, forward modelling, reduction and interpretation of sonobuoy data. Reflection data processing: static and dynamic corrections, seismic velocities, velocity determination. Velocity analysis – Velocity spectra & scans, Semblance, whitening, Digital filtering - time variant frequency filtering, inverse filtering (Deconvolution), apparent velocity filtering. AVO analysis, different methods of migration, Pre-stack & Post-stack migration, automatic migration, wavelet processing. Vertical seismic profiling (VSP), applications, 3D data processing and interpretation.

Unit –V: Preparation of seismic sections, analysis of analog records, automatic processing of digital seismic data, Seismic section plotting, display types, picking of events, marking-isochron & isopach of maps, Concepts of seismic stratigraphy – depositional patterns, seismic sequence, seismic facies, reflection character, synthetic seismogram, modeling concepts, 4C,4D recording, seismic tomography, reservoir applications of petrophysics concepts,Vp/Vs as lighology indicator, hydrocarbons detection.

Text Books:

1. Introduction to geophysical prospecting, M.B.Dobrin.
2. Applied Geophysics, W.M.Telfordet. al.
3. Exploration seismology, Sheriff. R.E.
4. Seismic exploration fundamentals, J.A.Coffeen.

Reference Books:

1. A hand book for seismic data acquisition, Brain J Evans
2. Designing seismic surveys in two and three dimensions, Dale G Stone
3. An introduction to seismic interpretation, R. Mcquillin et.al.
4. Seismic stratigraphy-application to hydrocarbon exploration Ed. By Charles Payton.
5. Fundamentals of seismic tomography, Lo and Inderweisen
6. Reservoir studies, SEG publication.

CORE – ELECTIVE –THEORY

GP 303 (I): MINING, GROUND WATER AND ENVIRONMENTAL GEOPHYSICS

Unit I: Crustal layers-upper and lower, Different elements in the crust, Precious and other useful substances in the upper crustal layers, Metallogenic provinces and periods. Classification of mineral deposits – Metallic and non metallic, Classification of metallic deposits-Ferrous and non ferrous, Base and noble metals, Sulphides, Oxides, Silicates and Carbonates, Processes of formation of mineral deposits – Igneous activity, Sedimentation, Metamorphism, Weathering and Erosion, Hydrothermal processes.

Unit II: Mineral deposits of India -Base metals and Ferrous metals, Geological mapping Geophysical methods, Sulphide ores-Massive and disseminated ores-Prospecting strategies examples, Iron ores-Strong and weak magnetic iron ores, genesis- prospecting. Manganese, Chromium, Placers-Prospecting strategies, Diamonds, Genesis of coal deposits of India Geophysical prospecting, Logging in mineral exploration, Synergic interpretation.

Unit III: Occurrence of water in different forms, water cycle, recharge and discharge, water balance, Ground water occurrence – Igneous-Metamorphic and sedimentary rocks, Types of aquifers and their hydrological significance, Vertical distribution of water, Water bearing properties of aquifers – Storage properties – porosity, specific yield, specific retention factors influencing porosity of rocks –Determining porosity of rocks in field and in laboratory. Permeability, transmissivity, coastal acquifers and storage coefficients – Ground Water Movement - Darcy's Law, ground water and well hydraulics. Sea water intrusion. Dependency of ground water quality and yield recharge, Litholog and structural features. Ground water in hard rock, soft rock and coastal aquifers, surface investigations of groundwater: Geological method-Remote sensing and geochemical methods.

Unit IV: Principles of geophysical prospecting of ground water: Review of electrical resistivity and seismic refraction methods – Groundwater exploration Electromagnetic frequency sounding and applications – Seismic prospecting methods –Reflection and Refraction and Interpretation of seismic data in ground water problems. Gravity and magnetic methods – their role in ground water exploration, geothermal methods – principle and application in solving ground water problems – Remote sensing and Airborne geophysical

methods for assessing ground water potentialities on regional basis, Geophysical well logging methods for solving ground water problems.

Unit V: Geophysics and earth's environment, Environmental problems amenable to solution by geophysical means, Engineering Geophysical problems, Survey procedures in - Gravity, Magnetic, Seismic, Electrical, E.M, Radioactive and Geothermal tectonics for Environmental and Engineering Geophysical problems.

Text Books:

1. Applied Geophysics, W.M.Telfordet. al.

2. Ground water Hydrology, D.K.Todd

Reference Books:

1. Mining Geophysics, SEG, Volume-I
2. Geophysical practice in mineral exploration and Mapping, T.S.Rama Krishna

GP303 (II): GROUND WATER RESOURCES AND MANAGEMENT

UNIT I Concept of Hydrology - Hydrology as a science - Historical development of Hydrology –The significance of water in different fields of anthropogenic human activities and its role in the development of civilization – water resources of the Earth – Global water budget – Interrelation between hydrological processes and atmosphere, hydrosphere and Lithosphere – Surface water bodies – Hydrologic cycle

UNIT II Elements of Hydrometeorology: Water Vapor – Atmospheric Humidity – Formation and Types of Clouds – India Weather systems and Monsoons – Precipitation formation processes – Measurement of Precipitation – Evaporation and Evapotranspiration processes – Measurement of Evaporation and Evapotranspiration

UNIT III Elements of Groundwater Hydrology: Occurrence & Distribution of groundwater – Darcy's law – porosity, specific yield, specific retention - permeability, hydraulic conductivity, Transmissivity – Aquifers – Aquiclude,

Aquifuge and Aquitard - Confined and Unconfined aquifers - Artificial recharge Methods: Basin method, stream channel method, ditch and furrow method, flooding method, irrigation method, pit method and recharge well method - Rainwater Harvesting - Dug and tube wells. Ground water & Well hydraulics

UNIT IV Water quality & Environmental Hydrology: Chemical dissolved constituents – major, minor and traces in groundwaters – sampling of waters from different water bodies – measurement of major ions – pH and conductivity – Representation of Water quality data – Suitability of water for drinking , agriculture, industry and recreational use – Drinking water standards, BIS,WHO

UNIT V Watershed Management concept: Land use pattern of a Watershed – Contour Demarcation, leveling and shaping, Bunding, Check dams, Gulley control– Different types of irrigation systems – Socio Economical planning of watershed management – Sustainable Development and Management of Water Resources An integrated approach

Suggested Readings:

1. Groundwater Resources Evaluation, W.C.Walton
2. Physical principles of water percolation and seepage, J. Bear et al
3. Groundwater Hydrology, D.K.Todd
4. Theory of Groundwater, A.Varrujt
5. Advances in Hydro-sciences, Ven Te Chow
6. Computer simulation Techniques in Hydrology, George Fleming
7. Hydrology, H.M.Raghunath
8. Introduction to Hydrology, W. Viessman
9. Groundwater, H.M.Raghunath
10. Applied Hydrogeology , E.W.Fetter
11. Watershed Management, J.V.S.Murthy
12. Facets of Hydrology, John C Rodda
13. Watershed Development, V.V.J.Sarma, C.Subba Rao and N.V.B.S.S.Prasad
14. Hydrology &Watershed Management, B.Venkateswara Rao
15. A Text book of Hydrology – P.Jayarami Reddi

GP303 (III): SEISMOLOGY

Unit I: Introduction : History of seismology ,elasticity of rocks, stress and strain, Linear stress-strain relationship, elastic module, Body waves(P & S waves), surface waves(Rayleigh & love waves), dispersion

Unit II: Rays paths, Travel time curves and delay times, seismic phases and nomenclature seismic wave energy, geometrical spreading, Reflection and transmission coefficients attenuation.

Unit III: Seismometry: Inertial pendulum system, Introduction to Seismograph: Principle and brief description of mechanical type seismograph. Milneshaw, wood Andersen seismograph, electromagnetic seismograph and broadband seismograph Selection of seismographs sites

Unit IV: Seismology and earth's structure, seismic discontinuities, reflectance and scatterers, lateral heterogeneities, global Seismicity, Seismicity of India

Unit V: Earthquakes, locating earthquakes, Seismogram interpretation, determining focal mechanism of an earth quake, Magnitude, intensity and Moment, Earthquakes statistics, Seismicity and plate tectonics, micro earth quakes, Reservoir induced Seismicity, Prediction of earthquakes.

Suggested Readings:

1. Fundamentals of Geophysics, William Lowrie
2. Modern Global Seismology, Thorne Lay
3. The Earth, Jeffreys,S.H.
4. Elementary Seismology, Charles.F. Richter
5. Earthquakes, Bolt, B.A.,
6. Introduction to Seismology, Markus Bath

GP303 (IV): SOLID EARTH GEOPHYSICS

Unit I Origin of the earth and solar system, primary differentiation of earth and composition of various zones, abundance of elements in the earth, rotation of the earth, salient concepts of plate tectonics

Unit II The earth's gravity field, force of gravity and surface of the earth, figure of the earth, geoid and spheroid, gravity potential, Isostasy: Pratt-Hayford, Airy-Heiskanen systems

Unit III Geomagnetism and Geo-electricity: The main Magnetic field, Magnetic observatories, Magnetic charts, Magnetic field of internal and external origin, Origin of the earth's Magnetic field, Electrical fields in Geophysics, Electrical properties of the earth, Electrical Resistivity surveying

Unit IV Geochronology, Radioactive decay, dating of rocks, the earth's heat and thermal properties, the measurement of terrestrial heat flow, relationship of heat flow to the radioactivity of the earth.

Unit V Seismology: Introduction, earthquakes and plate tectonics, subduction zones, continental earthquakes and tectonics, seismic zoning, earthquake intensity, magnitude, frequency, concepts of epicenter determination.

Suggested Readings

1. Introduction of Geophysics, Howell
2. Physics and Geology, Jacobs and Russel
3. Physics of the earth, Stacy
4. The interior of the earth, M.H.P. Bott
5. Topics in Geophysics, P.J. Smith
6. Fundamentals of Geophysics, William Lowrie
7. General Climatology, HJ. Critchfield
8. Earth, Press & Siever

GP 304 (I): MARINE GEOPHYSICS

Unit I: Physiography and divisions of the sea floor, continental shelves, slopes and aprons, submarine canyons and deep sea channels, sea mounts and abyssal plains, turbidity currents and submarine sedimentation, the mid oceanic ridge systems and its structure, aseismic ridges, various types of ridges in the Indian ocean region, the continental fracture system and island arcs, occurrence of offshore mineral deposits and hydrocarbons, hotspots, mineral resources of the sea: surficial deposits of the shelf and deep sea, heavy mineral placers, calcareous shells, pearl oysters, phosphorites, glauconite, barium sulfatecarcretions, sand and gravel, extensions of ore deposits,

hydrocarbon potential of the shelf and offshore sedimentary basins.

Unit II: Geophysical instrumentation and surveys: Adaptation of geophysical instruments for marine surveys, Measurements at the sea surface and under water, geophysical equipment currently in use and board research vessels, equipment on board the survey ship and layout of equipment, towing logistics, survey procedures and planning of survey lines, marine magnetometers, marine gravimeters, surface and under water gravimeters, Graf Askanian, Lacoste Romberg and vibrating string gravimeters, calculation of marine gravity anomalies.

Unit III: Map projections: Different kinds of map projections, Position fixing at sea: long range and Short Range systems, integrated satellite navigation, Global Positioning System (GPS), Bathymetry: echosounding, bathymetric charts, bathymetry as an adjunct to geophysical surveys, submersible seabed mapping by side scan sonar, multibeam, lider and other surveys, seabed sampling, dredging and coring, marine geophysical surveys for sealed resources, site selection for production platforms, tunnelling, waste disposal etc.

Unit IV: Oceanic magnetic anomalies, sea floor spreading, Vine-Mathews hypothesis, geomagnetic time scale and dating the ocean floor, linear magnetic anomalies.Heat flow: Earth's internal sources of heat, transfer of heat within the earth, measurements at the ocean bottom, heat flow probes and measurements, factors affecting the Heat flow measurements in sea, oceanic heat flow, ocean ridges and ocean basins, marginal basins, rift valleys.

Unit V: Objectives of marine geophysical surveys, marine geophysical surveys for sea bed resources, engineering investigations, deep sea geological mapping, delineation of continent-oceanic boundary, geological mapping in the coastal zone. Results of some rare studies. Geophysical anomalies of trenches, active and passive margins, ridges, island arcs, Large scale and small-scale structural features of the oceanic crust from seismic surveys (velocity structure).

Text Books:

1. Introduction to geophysical prospecting, MB Dobrin
2. Fundamentals of geophysics, William Lowrie
3. Applied geophysics, WM Telford, et. Al.

Reference Books:

1. Marine geophysics, EJW Jones
2. Physics and geology, Jacobs, Russel and Wilson
3. Applied geophysics, WM Telford, et. Al.
4. Geodynamic, Turcuttoe
5. The interior of the Earth, MHP Bott.

GP 304 (II): GEOMAGNETISM

Unit I: The main magnetic field, magnetic observatories, Instruments: Declination-Inclination, proton precession, flux gate, optical pumping & SQUID magnetometers, magnetic elements & anomalies, vector diagram & magnetic relations, magnetic charts, the magnetic dipole, the magnetic field of an electric current, separation of geomagnetic fields of external & internal origin, the magnetic field of the external origin, Ionosphere, S_q, D & L variations, magnetic storms & Aurora.

Unit II: The magnetic field of the external origin, IGRF, the dipole field, the non-dipole field, secular variation, westward drift, magnetic fields of the Sun, Moon & Planets, theories of the origins of the earth's magnetic field – the permanent magnet hypothesis, Blackett's theory, the earth as a dynamo, the disc dynamo, dynamo of Lowes an Wilkinson

Unit III: Rock Magnetism: Magnetic properties of rocks – Dia, Para, Ferro, Antiferro & Ferrimagnetism, the ternary oxide system of magnetic minerals, the titano-magnetite series, the magneto-hematite series, other ferromagnetic minerals, Magnetic susceptibility of rocks. NRM in rocks, measuring instruments – Astatic & Parastatic magnetometers, Spinner & Cryogenic magnetometers.

Unit IV: Paleomagnetism : Remanent magnetism in rocks - TRM, DRM, CRM, VRM etc., hysteresis curve, Isolation of remanance, cleaning methods, AF demagnetization, thermal demagnetization, laboratory procedures, tests for stability, concepts of archeomagnetism

Unit V: Reversals of the geomagnetic field: Polarity of the geomagnetic field & its reversals, Magnetostratigraphy geomagnetic time scale, projective methods of presenting

paleomagnetic data, magnetic latitude and co-latitude, calculation of mean direction of VGP's, paleomagnetic poles & reconstruction, Paleomagnetism & plate tectonics – Continental drift, northward drift of India, results from different continents

Suggested Readings:

1. Debate about the Earth, by H. Takenchi, S.Uyeda & H. Kanamori
2. Fundamentals of Geophysics by William Lowrie
3. Geomagnetism by Sydney Chapman
4. Geomagnetism: Solid Earth and Upper Atmosphere Perspectives, Nathani Basavaiah
5. Encyclopedia of Geomagnetism and Paleomagnetism, David Gubbins, Emilio Herrero-Bervera
6. Applications of Paleomagnetism by E. Erwing
7. Paleomagnetism and Continents by JDA Piper
8. Paleomagnetism and plate tectonics by MW McElhimy
9. Principles and applications of paleomagnetism by D.H.Tarling
10. History of Earth's magnetic field by David W. Strangeway

GP 304 (III): TECTONICS AND GEODYNAMICS

Unit I: When the earth moves: An introduction to vertical and horizontal tectonics through history of geologic thought. Continental drift: Super continents, Pangea,Gondwana land and its break up, Geophysical Evidences for continental drift and drift of India, Indian Ocean floor its evolution and active lithospheric processes.

Unit II: The lithosphere, Distribution of Plates, Major and Minor plates, Kinds of Plate Margins- Constructive, destructive and conservative plates, Characteristics and processes at accreting and consuming plate boundaries, Stability and stress distribution with in plates, active and passive continental margins, marginal basins, transform faults.

Unit III: Differences between plate tectonics and continental Drift, magnetostratigraphy, paleomagnetism, Plate tectonics and mountain building, relative motion of the plates, Methods of measuring plate motions, Causes of plate motions, Eulers pole of rotation, Forces acting on the lithospheric plates, the Wilson cycle, Continental collisions, seismicity and Intraplate earthquakes.

Unit IV: Eustatic movements, Evidences of sea level changes, Global sea level changes, sea level changes during the Quaternary period, Pre-quaternary sea level changes, Mechanism of sea level change, Impact of sea level changes. Brief description of structure and composition

of the oceanic and continental crusts, upper and lower mantle and core (inner and outer), Rheological effects of lithosphere, Brittle and ductile deformation, creep mechanism in the earth, Rigidity of Lithosphere, flexure of plates and compensation models in lithospheric studies. Stresses in the Lithosphere and their sources.

Unit V: Convection: Mantle viscosity, Concepts of mantle convection Models, Coupling between plates and mantle convection, Hot spots and Mantle plumes, Plume generation Mechanism, Evidence for mantle plumes from seismology and Geoid, Deep Continental structure of India-Sources of data, Suggested crustal column, seismic velocity structure, Heat flow and seismicity structure, evaluation of tectonic stress, Plate tectonics and evolution of Himalayas, models based on gravity, DSS data and seismicity (Brief description only).

Suggested Readings:

1. Plate tectonics and geomagnetic Reversals, Allan Cox, Free Man and Company,1973.
2. Developments in Geotectonics, Xavier Le Pichon, Jean Francheteau and Jean Bonnin, Elsevier Scientific Publishing Company, 1973.
3. The earths Dybnamic Suirface, K Siddhartha, Kisalaya Pub Pvt. Ltd. 1999
4. Fundamentals of Geophysics, William Lowrie, Cambridge Low Price Edition, 1997.
5. Geodynamics by Turcotte
6. Interior of Earth by M.H.P. Bott
7. The Encyclopedia of Solid Earth Geophysics by David E. James
8. Plate Tectonics and Crustal Evolution by Kent C. Condie
9. Deep Continental structure of India: A review, T.M.Mahadevan, Memoir 28, Geological Society of India, 1994.
10. Geodynamics of the Indian Peninsula and the Indian Plate Margin, R.K.Verma, Oxford & IBH Publishing Co. Pvt. Ltd, 1991.
11. Gravity field, seismicity and tectonics of Indian peninsula and the Himalayas by R.K. Verma

GP 304 (IV): ENVIRONMENTAL HYDROLOGY & WATER QUALITY

UNIT-I: Occurrence and distribution of Ground Water: Origin of Water - Hydrologic cycle - Hydrological properties of rocks, Porosity, Specific yield, Specific Retention, Hydraulic Conductivity, Storativity, and Transmissivity - Vertical Distribution of Ground Water - Types of Aquifers, Unconfined, Confined, Semi - Confined & Perched – Springs.

UNIT-II: Darcy's law and its Application; Determination of Permeability in laboratory and in field; Steady State, Unsteady State and Radial Flow equations; Tracer Studies; Pumping Tests- Methods, Estimation of T & S by Theis, Jacob and Theis Recovery Methods,

Specific Capacity Method by Slither's Method. Groundwater exploration methods

UNIT-III: Types of wells, Drilling Methods, Pumping equipment - Physical and Chemical properties of groundwater; Quality criteria for domestic, irrigation and industrial uses; Graphical presentation of Water quality data. Sources of pollution; Sea water intrusion and its controls; Problems of Arsenic, Fluoride and Nitrate; Radioisotopes for Ground Water Studies. Overexploitation and Ground Water Mining; Rain water Harvesting and artificial recharge methods, Groundwater provinces of India, Watershed Basin Management, water contamination, waste disposal and management

UNIT-IV: Groundwater fluctuations: Secular, Seasonal and Short-term fluctuations due to stream flow, Evapotranspiration, Meteorological phenomena, tides. Urbanization, Earthquakes and External load. Land subsidence. Artificial Recharge of Groundwater: Concept, Recharge methods. Basin method. Stream channel method. Ditch and Furrow method. Flooding method, Irrigation method, Pit method and Recharge well method, Incidental recharge. Water spreading. Waste water recharge. Recharge mounds and Induced recharge.

UNIT-V: Groundwater quality & Management: Chemical dissolved constituents - major, minor and traces in groundwaters - sampling of waters from different water bodies - measurement of major ions - pH and conductivity - Representation of Water quality data - Suitability of water for drinking, agriculture, industry and recreational use - Drinking water standards, BIS,WHO-Concepts of Groundwater contamination processes and Mass Transport Modeling of groundwater. Salt water intrusion of coastal aquifers: Occurrence of salt water intrusion, the Ghyben – Herzberg interface concept

TEXT BOOKS:

1. Ground water Hydrology by Todd. D.K. John Wiley & Sons. New York.
2. Hydrogeology by Karanth. K.R. Tata Mc Graw Hill Publ Co New Delhi.
3. Ground water assessment. Development and Management by Karanth K.R. Tata Mc. Graw Hill Publ. Co. New Delhi.
4. Hydro Geology by Davis S.N. and Dewiest, R.J.M. John wiley & Son New York.
5. Ground Water by Raghunath. H.M. Wiley Eastern Ltd. New Delhi.
6. Ground water Resources evaluation by Walton. W.C. Mc Graw Hill Publ. Co. New Delhi.

7. Ground water Hydrology by Bouwer H. Mc Graw Hill Book Co. New Delhi.
8. Keller, E.a., 1978. Environmental Geology. Bell and Howell, USA.
9. Submanian, V., 2001. Text book in environmental Science, Narosa Publication, New Delhi.
10. Hand book of Applied Hydrology, Ven Te Chow.

PRACTICALS

GP308: SIGNAL PROCESSING & INVERSION THEORY PRACTICAL

1. Computing DFT coefficients of a time series and estimating energy spectra
2. Computing convolution and cross correlations of two time series
3. Investigating the effect of various windows in reducing the energy leakage
4. Estimating energy spectrum of a signal from autocorrelation function
5. Computing FFT of a signal and investigate the effect of padding zones to a short time series in estimated energy spectrum
6. Computing the response of Butterworth and Chebyshev filters and evaluating their performances
7. Designing a Notch filter to eliminate a power line frequency from an observed signal
8. Designing a spiking deconvolution filter using (i) Spectral division (ii) Weiner filtering
9. Investigating the properties of different types of wavelets and converting a mixed phase wavelet to a minimum phase wavelet
10. Computing the probability density function, mean and variance of a given random process
11. Design commonly used signal enhancement filters, viz. continuations, second vertical derivation etc.
12. Compute 2D FFT and estimate radial spectrum
13. Compute the frequency response of a source/receiver array
14. Performing spectral analysis of a signal composed of a primary and echo

GP 309: SEISMIC METHODS LAB

Practical

1. Attenuation and absorption characteristics of seismic waves
2. Calculation of reflection and transmission coefficients for different geological interfaces
3. Response of the geophone array
4. Computation of travel-times for direct, reflected and refracted waves
5. Construction of refraction travel time curves for three layer case
6. Analysis of travel times
7. Velocity inversion process
8. Construction of travel times for 3-layer medium when middle layer is thin
9. Interpretation of refraction data (Dipping layers)
10. Calculation of average and interval velocities using well data
11. Preparation of stacking chart
12. Preparation of depth section from intercept times

GP 310 (I): MINING GEOPHYSICS PRACTICAL

1. Location of mineralized zone from the apparent resistivity values obtained from an IP survey
2. Pseudo-depth section plotting of metal factor and apparent resistivity values to locate the copper mineralization
3. IP survey over a massive sulphide zone
4. Bouguer anomaly contour map over Los Angles basin
5. Regional- Residual separation of gravity
6. Radiometric methods for uranium exploration from given scintillation readings
7. Mass estimation of iron ore
8. Gravity interpretation of a salt dome
9. Seismic refraction survey for coal exploration
10. Estimation of anomalous, actual masses and depth of chromite ore deposit

GP 310 (II): GROUND WATER RESOURCES AND MANAGEMENT PRACTICAL

1. Soil moisture content estimation studies
2. Specific gravity measurement of a given soil sample
3. Porosity of a given sample
4. Statistical parameters of Grain size
5. Pipette analysis
6. Granulometric analysis
7. Derivation of relation between porosity, specific yield and specific retention
8. Infiltration capacity
9. Theis method of pumping test analysis'
10. Jacob method of pumping test analysis
11. Chow method of pumping test analysis
12. Papodopulus method of pumping test analysis
13. Problems on pumping tests
14. Problems on geohydrological problems
15. Problems on groundwater recharge estimation
16. Demonstrations on various geohydrological instruments

GP 310 (III): SEISMOLOGY PRACTICAL

1. Visit to nearest seismological observatory: objectives and present status.
2. Identification of different phases on seismogram and to determine the epicentral distance of an earthquake
3. Determination of group velocity from a record and draw the group velocity dispersion curve
4. Use of stereoscopic projection map for locating the epicentre of an earthquake
5. To prepare the intensity map and find out the epicentre and focal depth of an earthquake
6. Determination of magnitude of an earthquake from given seismic records
7. To draw travel time curves for body waves and find out the velocities of the upper

mantle

8. Identify P- and S-phases on the seismogram. Estimate i) ts-tp, ii) τ, and iii) M_d. Interpret the characteristic features of the earthquake event.
9. Identify the various phases for both body and surface waves on the given three components record. Locate the earthquake also.
10. Plotting of time distance curve for reflection and diffraction data.
11. Construction of CDP stacking chart.
12. Study of zero-offset VSP records and identification of down going, up going and multiples events.
13. Generation of response curves for various source receiver arrays.
14. Study of field reflection seismic records acquired for various spread configurations.
15. Find the locations of the two earthquakes whose travel-time parameters are given in the following table. Identify the origin time and focal depth of each earthquake. Consider the velocity of P-wave, V_p = 6.0 km/sec.
16. Identify all the phases on the tele-seismic record.
17. The amplitude correction for the local magnitude computation is given in the table for California and Tehri region. Compute the magnitude of two earthquakes recorded in Tehri on standard Wood Anderson seismograph yielding maximum amplitude of 10 mm and 2 mm at 26 km and 260 km. Comment on the change in difference in magnitude so calculated using California and Tehri region amplitude corrections.
18. Compute LogA and $-\text{Log}A_O$ of the same earthquake, as in problem 6, if recorded on another seismograph - having the following response curve and 10000 magnifications, in Tehri region. What is the difference in the energy estimated for an earthquake recorded at 40 km yielding 10 mm on Wood Anderson seismograph if computed from the two sets of amplitude corrections?
19. The given intensities assigned to various localities on the basis of a field survey and the data collected through the earthquake questionnaire. Draw the iso-seismal lines and write a short note about the isoseismal map so prepared.
20. Compute the angle of incidences of P-waves for a shallow focus earthquake (h=0.00 km) on the surface of the earth starting from a epicentral distance (Δ) of 20 at an interval of 1° using J-B table. Assume velocity of P-wave at the focus = 7.75km/sec. Plot i_h in the range of Δ = 20° to 60°, and plot $i_h \sim \Delta$.

21. Draw both the nodal planes (data given in the following table) based on lower hemisphere stereographic projection. Considering one as a fault plane find the following parameters: (i) Poles of two planes, (ii) P- and T-axes, (iii) Null and Slip vectors and slip angle, (iv) Details of dip and strike of the fault plane, and (v) type of fault with direction of motion along fault plane through a block model

GP 310 (IV): SOLID EARTH GEOPHYSICS PRACTICAL

1. Computations on the shape and size of the earth.
2. Computation of radius, gravity field of the earth at various latitudes and polar flattening estimation
3. Analysis of radiometric data.
4. Determination of ages of rocks.
5. Presentation of data on physical properties of rocks and minerals and their analysis.
6. Statistical Analysis of physical properties of Rocks.
7. Laboratory measurements of physical properties of rocks.

a) Density

b) Seismic wave velocity

c) Magnetic susceptibility

d) Electrical resistivity

e) Porosity

8. Determination of earthquake parameters computations
9. Interpretation of Earthquake records.
10. Geothermal flux measurement and estimation of heat flow over continents and oceans

GP 311 (I): MARINE GEOPHYSICS PRACTICAL

1. Identification of coast, shelf and slope of oceans
2. Qualitative study of bathymetric profiles
3. Computation of marine gravity anomalies
4. Computation of marine magnetic anomalies
5. Study of geomagnetic time-scale chart
6. Calculation of magnetic spreading anomalies by Vine-Mathews hypothesis
7. Travel Time Analysis of marine seismic reflection data

8. Analysis of marine seismic refraction data
9. Interpretation of well logging data in marine environment
10. Study and discussion of some case studies of interpreted marine geophysical data from published literature

GP 311 (II): GEOMAGNETISM PRACTICAL

1. Calculation of Geomagnetic or paleomagnetic pole position using published data: Site position latitude (λ_s) = 16.37° N, Site position latitude (φ_s) = 73.84° E, Declination (D_m) = 155.1 °, Inclination (I_m) = 48.7°

2. Assume that the geomagnetic field of the Earth is a geocentric dipole with a North Pole at 80° N, 45° E and a magnetic moment 8×10^{22} Am^2 . Calculate for a point with geographical coordinates 45° N, 30°W the components NS, EW, and Z of the Earth's magnetic field, the declination and inclination, and the geomagnetic longitude. Earth's radius: 6370 km and the constant C = $10^{-7}\ \frac{H}{m}$ (this value is used in all problems).

3. Assume that the geomagnetic field is produced by a geocentric dipole of magnetic moment 8×10^{22} Am^2, with North Pole at 80°N, 70°W, and that the Earth's radius is 6370 km. Calculate for a point with geographical coordinates 60°N, 110°E: (a) Its geomagnetic coordinates, the components of the Earth's magnetic field (X, Y, Z, H), the total field, the declination, and the inclination. (b) The equation of the line of force passing through it.

4. Assume that the geomagnetic field is produced by a geocentric dipole of magnetic moment 7.5×10^{22} Am^2, with North Pole at 75° N, 65° W, and that the Earth's radius is 6372 km. Calculate:

(a) The NS and EW components for a point on the Earth's surface at which the inclination is 67° and the geomagnetic longitude is -120°.

(b) The geographical coordinates of that point.

(c) The geomagnetic coordinates, field components, declination, and inclination of the point on the geographical equator of zero geomagnetic longitude.

5. Assume that the geomagnetic field is that of a dipole with North Pole at 75° N, 0° E. What is the conjugate point of that of geographical coordinates 30° N, 30°E?

6. Assume the centred dipole approximation, with the coordinates of the Geomagnetic North Pole being 65° N, 0° E, and the magnetic moment of the dipole 8×10^{22} Am^2. Calculate, for a point on the Earth's surface at geographical coordinates 30° N, 30° E. Earth's radius: 6370km.

(a) The geographical coordinates of the conjugate point.

(b) The declination, inclination, and vertical and horizontal components of the field at both points. Compare and contrast the results.

7. The Earth's magnetic field is produced by one dipole in the direction of the axis of rotation (negative pole in the northern hemisphere) and another with the same moment in the equatorial plane which rotates with differential angular velocity v with respect to the points on the surface of the Earth (consider that the Earth doesn't rotate). Its negative pole passes through the 45°E meridian at time t = 0 and completes a rotation with respect to that point in 24 hours. Consider a point of geographical coordinates 45°N, 45° E.

(a) Calculate the magnetic field components (B_r, B_θ, B_λ) at that point.

(b) Illustrate graphically how each of them varies with local time.

8. Calculate the magnetic anomaly produced at a point with geographical coordinates 38° N, 30°W by a horizontal dipole buried at a depth of 10 m with Cm = 5×10^{-5} Tm^3 which is in the vertical plane of geographical east, and with the negative pole to the west. Also calculate the total values of the field in the NS, EW, and vertical directions, and total field F, as well as the variations in the magnetic declination and inclination due to the existence of the dipole. Consider the Earth's magnetic field to be produced by a centred dipole with North Pole at 72°N, 30°W, and with B_0= 32 000 nT.

9. At a point with geographical coordinates 40°N, 45°E, measurements are made of the magnetic field components, obtaining the values (in nT), h (hours):

At 06:00 h: X = 19 204; Y = 0; Z = 38 195

At 12:00 h: X = 11 544; Y = 0; Z = 44 623

Buried at a depth of 20 m below this point is a dipole of magnetic moment Cm = 0.01

T m^3, oriented in the NS plane at an angle of 45° with the vertical towards the south, and the positive pole upwards. Given that the external field at 12:00 h is twice that at 06:00 h. Determine:

(a) The geomagnetic constant Bo and the coordinates of the northern geomagnetic pole.

(b) The magnitude and direction of the external field. How does the magnitude of the external field vary with time?

10. At a point with geographical coordinates 60°N, 60°W, a 1 cm^3 sample was taken of a rock with remanent magnetism, age 10 000 years, specific susceptibility 0.01 cm^{-3}. The magnetization components of the rock were: X = 40, Y = -30, Z = 50 nT (N, E, nadir). The current field is B_0 = 30 000 nT and the geomagnetic pole coincides with the geographical pole. Calculate:

(a) The coordinates of the virtual geomagnetic pole which corresponds to the sample.

(b) The magnetic moment of the terrestrial dipole 10 000 years ago.

(c) The secular variation of F, D, and I in nT and minutes per year assuming that the variation since that time has been constant.

11. The following table gives the demagnetization data for a sample that was subjected to stepwise thermal demagnetization of its natural remanent magnetization (NRM). Calculate the direction of each stable component identified by the demagnetization curve.using the following data:

Demagnetization temperature (°C)	**Declination (D,°E)**	**Inclination (I,°)**	**NRM Intensity (J, mA/m^{-1})**
20	32	33	0.056
100	36	22	0.056
200	38	12	0.057
300	39	4	0.058
400	41	-5	0.058
500	41	-5	0.050
600	41	-5	0.016
650	41	-5	0.009
700	300	55	0.000

12. A palaeomagnetic study of a late Jurassic limestone outcrop near Alhama de Granada (37° N, 4°W) in southern Spain yielded a well-defined primary remanent magnetization whose directions are given in the table below. Calculate the mean direction of the primary remanence of the seven samples. Compare this direction with that defined by the reference late Jurassic palaeomagnetic pole for the stable Iberian tectonic plate (252°E, 58° N). How much vertical axis rotation has the studied outcrop suffered with respect to stable Iberia?

Declination (D, °E)	**Inclination (I, °)**
30	43
28	39
34	44
25	45
32	38
35	44
26	40

GP 311 (III): TECTONICS AND GEODYNAMIS PRACTICAL

22. Computation of approximate spreading rates at the oceanic ridges from the available data – South Atlantic, S. Indian, N. Pacific and S. Pacific oceans
23. Triple junction problem - Determination of strike and spreading rate of the ridge from the given data
24. Computation of apparent density of the rock formation from the available gravity measurements
25. Determination of depth of the mountain root system in isostatic equilibrium
26. Calculation of latitude and longitude of paleomagnetic pole position for the Italian limestone using given data
27. Computation of the expected European and African directions at the Italian site using the given paleomagnetic pole data of European and African plates

GP 311 (IV): ENVIRONMENTAL HYDROLOGY AND WATER QUALITY PRACTICAL

1. Hydrogeological surveys in the field
2. Problems on vertical electrical sounding and interpretation of the data.
3. Well loss estimation from stop drawdown test and graphical presentation of chemical data.
4. Water analysis.
5. Classification of suitable water for drinking, irrigation and industrial purposes.
6. Presentation of chemical data and plotting chemical classification diagram.
7. Evaluation of ground water pollution.

DEPARTMENT OF GEOSCIENCES
DR.B.R.AMBEDKAR UNIVERSITY
ETCHERLA, SRIKAKULAM
M.SC. (GEOPHYSICS)

SECOND YEAR-FOURTH SEMESTER SYLLABUS

CORE – THEORY

GP 401: ELECTROMAGNETIC METHODS

Unit-I: Principles of Electromagnetic Prospecting: Primary and Secondary fields & their relation amplitude, phase, real and imaginary components, elliptic polarization, Maxwell's equations, Boundary conditions, Wave equation, Quasi static condition, Solution of wave equation, Plane wave characteristics, propagation of plane waves in conducting media, Wave number, Impedance, Skin depth.

Unit-II: Active EM: Surface low frequency methods: Effect of the change in the Frequency on the primary field, conductivity and magnetic permeability on the secondary field, discussion using the response of a conducting permeable sphere and cylinder in uniform E.M. field. Effect of over burden and ore bearing rocks on the response of local conductor (only discussion)

Unit-III: Surface Transient Methods: Different current functions and loop configurations, field procedures, interpretation. Surface High Frequency Methods: Equipment, field procedure and interpretation of VLF and Ground-penetrating radar**;** EM Sounding equipment, field procedure and interpretation. Airborne EM Methods – Principles, continuous wave, pulse transient (INPUT) and Rigid boom helicopter systems of Airborne versions of VLF & AFMAG.

Unit-IV: Passive EM: Magneto Telluric method: Sources of MT signal, impedance tensor. MT response over multi layered earth. Equipment & Field procedure. Processing & interpretation of MT data, Swifts optimum, stastic shift rotation, polar diagrams, tipper, skew, ellipticity, TE and TM modes. Remote Reference & Magneto-Tellurics.

Unit- V: Telluric Current Method – field procedure, equipment, interpretation of telluric data. Geomagnetic depth sounding: Origin and classification of long period geomagnetic Variations, separation of magnetic field of internal and external origin, normal and anomalous fields, Magnetometer array studies. Interpretation of Geomagnetic depth sounding data, Applications of EM prospecting in geological mapping, mineral and Groundwater exploration.

Text Books:

1. Keller, G.V. Electrical Methods in Geophysical Prospecting –Frischnett, Pergamon.
2. Patra, H.P. &Mallick, K., Principles of GeoelectricSoundingsVol. II – Elsevier.
3. Telford, W.K., Geldart, L.P., Sheriff, R.F. and Keys, D.A. Applied Geophysics – Cambridge Univ. Press.
4. Fundamentals of geophysics by William Lowrie

Reference Books:

1. Parasnis, D.S., 1973, Mining Geophysics – Elsevier
2. Patra, H.P. &Mallick, K., Principles of GeoelectricSoundingsVol. II – Elsevie

GP 402: WELL LOGGING AND RESERVOIR ANALYSIS

Unit-I: Basic concepts and objectives of well logging; Reservoir rocks and their petro physical properties, Reservoir Thickness, Permeability-Porosity relations, Formation resistivity factor (FR); relation between FR and water saturation. Need of drilling fluid and its properties; Borehole environment, invasion effect and invasion profile; Classification of well logging tools, well logging unit and logging setup. Reservoir geometry, temperature and pressure.

Unit-II: Electrical logging: SP Log- Origin and occurrence of Self Potential, PSP&SSP/ Determination of Water Salinity and shale volume from Sp log; Resistivity in well logging: factors affecting the resistivity of electrolyte bearing rocks, Unfocussed Resistivity Devices single –electrode, normal and lateral resistivity tools and their limitations ; Focussed

Resistivity Devices- principles of measurement, LL3,LL7 and dual laterologs, factors influencing resistivity measurements; Microresistivity measurements- Micro normal, micro lateral, Micro spherically focussed logs applications and limitations; Induction resistivity measurements-principles.

Unit-III: Porosity Logs- Acoustic Log: Principles; factors affecting acoustic wave velocity; single and double receiver type tools; Density Log: Interaction of gamma rays with matter; principles of density log; single and double detector type; litho-density log; Neutron Log: Interaction of neutrons with matter, neutron sources and neutron detectors, neutron logging tools.

Unit-IV: Radioactive logs- Radioactivity of shales and clays; simple and spectral gamma ray tool including radiation detectors; calibration; factors affecting log response, qualitative and quantitative uses of simple and spectral gamma ray log; Miscellaneous tools; Logging While Drilling (LWD), Dipmeter, Caliper log and its variants, side wall coring tool, Casing Collar Locator/casing inspection tools, Repeat formation tester, Modular Dynamic tester, CBL/VDL tools.

Unit V: Formation Evaluation: Cross plots, M-N plots. Determination of water saturation (SW) of clean formations, Quick look interpretation and detailed interpretation of clean sands and shaly sands, Identification of Hydrocarbon zones. Application of well logging in ground water, ore mineral and Hydrocarbon exploration; Production Logging: Flow in vertical pipes, Flow Types, Reynolds Number, Perforations, Water Holdup, Water Cut, Slippage velocity, Production Logs: Temperature Log, Flow meters, different types of flow meters, radiomanometer, Radioactive tracer logs. Injection Wells, Interpretation of Flow meter & Temperature logs in Injection/Production Wells.

Text Books:

1. Schlumberger, 1972 ,Essential of log interpretation Practice . Schlumberger ., France
2. Schlumberger, 1969 ,Log interpretation Principles and charts, Schlumberger. Ltd.,USA.
3. Serra, 1984, Fundamentals of well log interpretation-1.The acquisition of Logging data., Elsevier Science Publishers ,B.V

4. Serra, 1986, fundamentals of well log interpretation-2.The acquisition of Logging data., Elsevier Science Publishers ,B.V

Reference Books:

1. Vaish, J.P.1997, Geophysical Well logging: Principles and practices, Asian Books PVT.Ltd.,NewDelhi
2. John T.Dewan, 1983, Essential of Modern open –hole log interpretation, Pennwell Books Pennwell Publ.Co.,Tusla, Oklahoma
3. Brock, James .G. 1986. Applied open – hole log analysis, Gulf Publ. Co.,Houston,Texas
4. Itenberg,S.S. 1971, Study of oil and gas series from Well logs, Mir. Pub.Moscow
5. Ed.J.Lynch .,1964, Formation and evaluation, Harper and Row , Japan and US
6. Syllvin, J,Pirson,1963., Hand Book of Well log Analysis, Prentice ., Hall , Inc.
7. Bore hole Geophysics Applied to Ground water investigations by W.Scott Keys.US Geological Survey Open File Report, 87-539
8. Dresser Atlas, 1982 Well Logging and Interpretation techniques - Dresser Industries Inc
9. The Geological Interpretation Of Well Logs. By M.H.Rider-1986.

CORE – ELECTIVE –THEORY

GP 403 (I): PETROLEUM GEOLOGY AND GEOPHYSICS

Unit I: Petroleum – occurrence – distribution- chemical and physical properties – Origin Varioustheories, source rock, organic matter – Maturation into petroleum – P&T conditions, Migration – primary and secondary**.**

Unit II: Reservoir – rocks – properties – Fluids, water – oil- Natural gas- properties, Traps- structural– stratigraphic – combination, seals, sedimentary basins – cratonic – convergent and divergent margin basins – classification, Category-1 basins of India.

Unit III: Gravity and Magnetic methods in petroleum exploration – surveys – Land and ocean areas – differences – data processing operations, Gravity anomalies – salt domes –

stratigraphic traps. Gravity and Magnetic methods – modeling and inversion, sedimentary basins, basement mapping and delineation, computer oriented methods.

Unit IV: Seismic data processing – outlines, preparation of seismic section, Reflection character- structure, pitfalls – migration 2D & 3D significance – velocity pull up, structure identification. Basic geologic concepts in petroleum exploration – Refraction and reflection interpretation concepts, modelling.

Unit V: Seismic stratigraphy – Unconformities – seismic sequences and facies – reflection pattern – depositional environment – basin history – construction, Modeling concepts – Rock Physics and Petrophysics, Reservoir applications, Reservoir parameters – forward and inverse,seismic attributes, AVO analysis, direct detection of hydrocarbons, interpretation Vp/Vs as lighology indicator, Bright spots, flat spots and dim spots, Gas hydrates, Coal bed methane.

Text Books:

1. Applied Geophysics, W.M.Telfordet. al
2. Introduction to Geophysical Prospecting, Dobrin, M.B

Reference Books:

1. Geology of Petroleum, A.I.Levorson
2. Basic concepts of Petroleum Geology, R.C.Selly& David C.Morri
3. Simple seismics, N.A.AusteySeismic Stratigraphy, Robert Sheriff

GP 403 (II): DISASTER MANAGEMENT

Unit I: Concepts of disaster: Types of disaster. Natural and manmade: Cyclone, flood, land Slide, land subsidence, fire and earthquake. Landslides, Types of slope failure, Slope Mass Rating (SMR) classification, Causative factors, Landslide Hazard Zonation, Factor of Safety analysis, Slope stabilization measures. Sinkholes and Subsidence.

Unit II: Earthquakes and Faults, Measures of an Earthquake, Earthquake Hazards, Earthquake Control and Prediction, Magma: Origin and Types, Volcanic Products and Hazards, Monitoring, Risk Evaluation, Prediciton, Tectonics and Climate.

Unit III: The Atmosphere and Hydrosphere and Related Hazards: Thunder storms & lightening, tornadoes & hurricanes: Fluvial hazards –flooding, channel migration, bank erosion, catchment erosion, Storm surges, Tsunamis, Coastal Hazards I: Sea Level Rise and its Dynamics. Our Shoreline Retreat, Coastline Changes.

Unit IV: Pollution – Physical, Chemical and Biological Pollution of Coastal and Estuarine Environments: Alien Species and Emerging Diseases, Concept and definition of Environmental Geology. Soil degradation and changing land use pattern. Concepts of natural ecosystems on the earth. Environmental changes due to anthropogenic and natural activities over nature dominated system.

Unit V: Disaster Mitigation, and Preparedness; Techniques of monitoring and design against the disasters. Management issues related to disaster. Pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation; disaster related infrastructure development. Remote-sensing and GIS applications in real time disaster monitoring, prevention and rehabilitation. Disaster Process: Concept and components of relief, reconstruction; rehabilitation – objectives, prerequisites and constraints; resource mobilization, Disaster policy in India; Disaster Management Act of 2005; National and International Agencies: NDMA, NIDM, NCMC; UN, UNDRO, UNESCO, UNDP; Role of NGOs.

Suggested Books:

1. Bell, F.G., 1999. Geological Hazards, Routledge, London.
2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.
3. Smith, K., 1992. Environmental Hazards. Routledge, London.
4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International
6. Keller, E.A., 1978. Environmental Geology, Bell and Howell, USA.
7. Patwardhan, A.M., 1999. The Dynamic Earth System. Prentice Hall.
8. Valdiya, K.S., 1987. Environmental Geology – Indian Context. Tata McGraw Hill.

GP 403 (III): ENGINEERING GEOPHYSICS

UNIT I: Rock Physics Principles for Near-Surface Geophysics: Identity and properties of components, Volume fractions of components; Geometry of the components; Interactions between components.

UNIT II: Role of various engineering geophysical methods: Gravity, magnetic, electrical, electromagnetic, seismic, radiometric and well logging techniques and survey procedures Geophysical exploration in the solution of engineering geological problems: Investigation of foundation and leakage, geothermal tectonics and geotechnical surveys etc.

UNIT III: Elastic and Electromagnetic Properties of Near-Surface Soils Geophysical Methods in Near Surface Geophysics (Seismic, Resistivity, EM, GPR and Magnetic)

UNIT IV: Concept of various Geotechnical studies using seismic methods. Multichannel Analysis of Surface Wave (MASW), Refraction Microtremor (ReMi) Study, Estimation of various Geo-engineering properties.

UNIT V: Concept of various tomography and their application for near surface investigations. Near Surface Geophysical Case Studies. Electroseismics: Concept and Application

Suggested Readings:

1. Applied Geophysics. Telford.WH.1976. Cambridge Univ. press.
2. Environmental and Engineering Geophysics by Prem V. Sharma, University of Copenhagen
3. An Introduction to Applied and Environmental Geophysics by John M. Reynolds
4. Environmental Geophysics: A Practical Guide (Environmental Engineering) (Hardbound) By Dieter Vogelsang
5. Mining Geophysics, Vol.I Ed Ward SM.1967, SEG.publ.
6. Mining Geophysics. DS.Parasnis. 1973. Elesvier Publ.
7. Introduction to geophysical Prospecting for ore Deposits. Taakhov. AG.1965 CEG.publ.
8. Geophysics in Mining and Environmental Protection by Idziak, Adam F.; Dubiel, Ryszard (Eds.)

GP 403 (IV): GENERAL METEOROLOGY AND OCEANOGRAPHY

Unit-I: Climatology: Fundamental principles of climatology. Earth's radiation balance; latitudinal and seasonal variation of insolation, temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance. Air masses, monsoon, Jet streams, tropical cyclones, and ENSO. Classification of climates – Koppen's and Thornthwaite's scheme of classification. Climate change.

Unit-II: Physical Meteorology: Thermal structure of the atmosphere and its composition. Radiation: basin Laws - Rayleigh and Mie scattering, multiple scattering, radiation from the sun, solar constant, effect of clouds, surface and planetary albedo. Emission and absorption of terrestrial radiation, radiation windows, radiative transfer, Greenhouse effect, net radiation budget. Thermodynamics of dry and moist air: specific gas constant, Adiabatic and isoentropic processes, entropy and enthalpy, Moisture variables, virtual temperature; Clausius – Clapeyron equation, adiabatic process of moist air; thermodynamic diagrams: Hydrostatic equilibrium: Hydrostatic equation, variation of pressure with height, geopotential, standard atmosphere, altimetry. Vertical stability of the atmosphere: Dry and moist air parcel and slice methods. Tropical convection. Fair weather electric field in the atmosphere and potential gradients, ionization in the atmosphere. Electrical fields in thunderstorms, theories of thunderstorm electrification.

Unit-III: Cloud Physics: Cloud classification, condensation nuclei, growth of cloud drops and ice-crystals, precipitation mechanisms: Bergeron, Findeisen process, coalescence process. Dynamic Meteorology: Basic equations and fundamental forces: Pressure, gravity, centripetal and Corolis forces, continuity equation in Cartesian and isobaric coordinates. Momentum equation Cartesian and spherical coordinates; scale analysis, inertial flow, geostrophic and gradient winds, thermal wind. Divergence and vertical motion Rossby, Richardson, Reynolds and Froude numbers. Mixing length theory, planetary boundary layer equations, surface layer, Ekman layer, Linear Perturbation Theory: Internal and external gravity waves, inertia waves, gravity waves, Rossby waves. Numerical Weather Prediction and Climate Modelling: MJO (Madden-Julian oscillation), ENSO, QBO (quasi-biennial oscillation) and sunspot cycles. Global Climate Model, General Circulation Model (GCM), Contour Analysis. Inter Tropical Convergence Zone (ITCZ), Meteorological satellites – Polar orbiting and geostationary satellites.

Unit-IV: Physical Oceanography: T-S diagrams; mixing processes in the oceans; characteristics of important water masses. Wind generated waves in the oceans; their characteristics; shallow and deep water waves. Propagation, refraction, and reflection of waves. Wave spectrum, principles of wave forecasting. Tide-producing forces and their magnitudes; prediction of tides by the harmonic method; tides and tidal currents in shallow seas, estuaries and rivers. Factors influencing coastal processes;

transformation of waves in shallow water; effects of stratification; effect of bottom friction, phenomena of wave reflection, refraction and diffraction; breakers and surf; littoral currents; wave action on sediments – movement to beach material; rip currents; beach stability, ocean beach nourishment; harbour resonance; seiches; tsunami; interaction of waves and structure.

Unit -V: Estuaries: classification and nomenclature; tides in estuaries; estuarine circulation and mixing; depth – averaged and breadth – averaged models; sedimentation in estuaries; salinity intrusion in estuaries; effect of stratification; coastal pollution; mixing and dispersal of pollutants in estuaries and near-shore areas; coastal zone management. The global wind system; action of wind on ocean surface; Ekman's theory; Sverdrup, Stommel and Munk's theories; upwelling and sinking with special reference to the Indian ocean. Inertial currents; divergences and convergences; geostrophic motion; barotropic and baroclinic conditions; oceanic eddies, relationship between density, pressure and dynamic topography; relative and slope currents. Wind driven coastal currents; typical scales of motion in the ocean. Characteristics of the global conveyor belt circulation and its causes. Formation of subtropical gyres; western boundary currents; equatorial current systems; El Nino; monsoonal winds and currents over the North Indian Ocean; Somali current; southern ocean.

Books Recommended:

1. General Climatology, Howard J. Critchfield
2. Climatology An Introduction, John E. Oliver and John J. Hidore
3. Meteorology Today by C. Donald Ahrens, 10th Edition.
4. Physical meteorology by Houghton, Henry G.
5. An Introduction to Dynamic Meteorology, Volume 88 (International Geophysics) 5th Edition by James R. Holton and Gregory J. Hakim.
6. Handbook of Weather, Climate and Water: Dynamics, Climate, Physical Meteorology, Weather Systems, and Measurements 1st Edition by Thomas D. Potter and Bradley R. Colman.
7. Descriptive Physical Oceanography, M.P.M. Reddy.
8. Introduction to Physical Oceanography, Robert H. Stewart

PRACTICALS

GP 408: ELECTROMAGNETIC METHODS PRACTICAL

1. Calculation of longitudinal conductance from MT data
2. Attenuation of Electromagnetic wave
3. Skin depth calculations
4. Bostick depth inversion
5. Karous - Hjelt filter for computing VLF current density at a depth
6. Computation of forward response & AMT response of two layer earth
7. Interpretation of quadrature system Air-borne E.M. data over a half-plane.
8. Interpretation of airborne double-dipole system data over a vertical sheet
9. Double dipole AEM response of spherical conductor
10. Interpretation of conductivity and depth for a vertical sheet using nomograms
11. Vertical sheet data interpretation using coaxial coil airborne E.M. nomogram.
12. Interpretation of thin vertical dyke over a maximum coupled airborne system
13. Nomogram interpretation of conductivity, air-craft height for a conductive half-space.
14. Estimating telluric parameter from triangle method
15. Estimating dip & amplitude correction of a given half-plane

GP 409: WELL LOGGING & RESERVOIR ANALYSIS PRACTICAL

1. Variation of resistivity of water with temperature and salinity
2. Determination of cementation factor using Archie's equation
3. Determination of formation water resistivity using Arp's empirical formula
4. Estimation of shale content through SP-curve
5. Determination of water saturation through empirical resistivity ratio method
6. Computation of the formation water resistivity from SP-log
7. Determination of water saturation through nomogram method

8. Determination of formation water resistivity from SSP-charts
9. Estimation of shale content through shale indicator (or) gamma-ray log
10. Estimation of porosity from sonic log
11. Estimation of porosity from density log
12. Computation of following reservoir properties from well logging data
    a) Formation water
    b) Porosity from resistivity, density, neutron & acoustic logs
    c) Water saturation
    d) Hydrocarbon saturation

GP410 (I): PETROLEUM GEOLOGY AND GEOPHYSICS PRACTICAL

1. Interpretation of geological structures from surface geological maps.
2. Interpretation of geological structures from borehole data
3. Reconstruction of structural developments through different time planes
4. Preparation of structural contours
5. Preparation of isopach maps of reservoir facies
6. Finding oil-water contact from borehole data
7. Calculation of oil reserves in defined structures
8. Calculation of drift correction in respect of a local gravity base in a field survey
9. Computation of free-air and Bouguer gravity anomalies for a set of field stations.
10. Geomagnetic field components, and their variation across continental India.
11. Procedures for ground magnetic field surveys.
12. Reduction of magnetic field data
13. Calculate elastic constants (K, E, m & s) of geologic formation from given P- and S-wave velocity data
14. Calculate depth of single horizontal interface using seismic refraction data
15. Calculation of depth of basement in a dam-site area from shallow seismic refraction survey.
16. Calculation of dip and vertical depth of single dipping interface using seismic refraction data.

17. Demonstration of geophone and computation of its response
18. Interpretation of Seismic Reflection Data by Modeling
19. Modeling of Bouguer and free-air gravity anomaly using available software for petroleum exploration
20. Gravity anomaly model across a vertical fault/fracture and estimation of ore mass using available software.

GP410 (II): DISASTER MANAGEMENT PRACTICAL

1. An efficient network for disaster management: Model and solution
2. A multi-objective relief chain location distribution model for urban disaster management
3. An exact solution approach for multi-objective location–transportation problem for disaster response
4. Before and after disaster strikes: a relief supply chain decision support framework
5. A dynamic model for costing disaster mitigation policies

GP410 (III): ENGINEERING GEOPHYSICS PRACTICAL

1. Gravity profile interpretation of any published data
2. Magnetic profile interpretation of any published data
3. Self potential field survey and interpretation
4. Interpretation VES resistivity data by curve matching techniques.
5. Study of soil / land contamination using magnetic techniques
6. Determination of ground water contamination by qualitative study
7. Electrical resistivity surveys for locating groundwater contaminated zones
8. Self Potential surveys for locating buried pipes etc.,
9. Resistivity profile surveys over zones of contaminants.
10. Study of resistivity psuedosection images of polluted zones from published work.

GP410 (IV): GENERAL METEOROLOGY AND OCEANOGRAPHY PRACTICAL

1. Familiarisation with meteorological instruments and record surface meteorological observations.
2. Study of surface weather and upper air codes.
3. Exercises in coding and decoding.
4. Exercises in plotting station models.
5. To compute the soil moisture index by Mavi and Mahi's method.
6. Estimation of components of hydrological cycle

   (a) Precipitation (b) Surface run off (c) Deep drainage (d) Change in water storage
7. Computation of evaporation and evapotranspiration by water balance equation.
8. Forecasting of crop yield on the basis of weather parameters.
9. Weather forecast for agriculture, study of farmer's weather bulletin and agromet advisory bulletin.
10. Basic analysis of global distribution of mean climatic parameters.
11. Computation of weighted and running means of a time series.
12. Computation of rainfall variabilities and coefficient of variation.
13. Computation of mean wind, resultant wind, prevailing wind and persistence.
14. Computation of zonal index.
15. Computation of climatic types according to Koeppen and Thornthwaite.
16. Exercise in curve fitting, least square, correlation and regression.
17. Exercise on Ekman's theory of wind-driven ocean currents
18. Calculation of geothermal flux of heat upwards through the seafloor and into the deep ocean.
19. Derive and sketch the flow in the atmosphere just above the water.
20. Problems on typical thermocline depth of (H) and vertical turbulent diffusivity of (κ) of the ocean

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