

UNIVERSITY OF PUNE
M.Sc. –II: GEOLOGY (Non-Credit)
Revised Syllabus w.e.f. June 2009

SEMESTER-III

- GL-301 : Indian Stratigraphy –Compulsory (Departmental)**
- GL-302 : Exploration Methods**
- GL-303 : Petroleum Geology**
- GL-304 : Engineering Geology and Geotechniques**
- GL-305 : Computer Applications in Geology and GIS**
- GL-306 : Natural Resource Management & Oil field Services**
- GL-307 : Practicals related to above courses- Compulsory (Departmental)**

Students shall choose ANY THREE courses out of Course No. GL-302, GL-303, GL-304, GL-305 and GL-306.

SEMESTER-IV

- GL-401 : Economic Geology**
- GL-402 : Mining Geology, Gemmology and Industrial Mineralogy**
- GL-403 : Environmental Geology**
- GL-404 : Hydrogeology, Water Shed Development & Management**
- GL-405 : Dissertation**
- GL-406 : Field Work Component – Compulsory (Departmental)**
- GL-407 : Practicals related to above courses- Compulsory (Departmental)**

Students shall choose ANY Three courses out of Course No. GL-401, GL-402, GL-403, GL-404 and GL-405.

M.Sc.-II: GEOLOGY- SEMESTER-III
GL-301: INDIAN STRATIGRAPHY

Unit-1: PRECAMBRIAN STRATIGRAPHY OF INDIA:

Part-I: Archaeans:

(12)

- Precambrian stratigraphic framework of India.
- Classification, structure and tectonics of the Dharwar craton.
- Ancient Supracrustal (Sargur type).
- Gold bearing schist belts of Eastern Karnataka (Kolar type).
- Younger Schist belts (Dharwar type)
- Gneiss Complex, Granulites, Charnockites.
- Structure, tectonics and stratigraphy of the OMG, OMTG, Iron Ore Group (Singbhum Craton).
- Stratigraphy of the Sukma, Bengpal and Bailadila series from Central India.
- Ancient granites, viz, Singbhum, Chitradurga etc.
- Archaeans of the Extra Peninsular Region.

Unit-2: PRECAMBRIAN STRATIGRAPHY OF INDIA:

Part-II: Proterozoic

(12)

- Archaean –Proterozoic boundary.
- Stratigraphy, geology, tectonics and evolution of the following Proterozoic basins/ Purana formations in India:
 - Delhi-Aravalli Supergroup
 - Singbhum group
 - Sausar-Sakoli Groups
 - Vindhya
 - Cuddapah
 - Pranhita-Godavari
 - Bhima
 - Kaladgi

**Unit-3: PHANEROZOIC STRATIGRAPHY OF
THE EXTRA PENINSULAR REGION:**

(12)

- Paleozoic stratigraphy of Himalayan sequences from Spiti, Kumaon region. Cambrian of Spiti, Triassic of Spiti, Triassic of Pin Valley.
- Geology of the Indus Ophiolite belt, the Indus group and Sangeluma Group.
- Geology of the Shyok Ophiolite belt.
- The Trans-Himalayan and Karakoram Granite Batholith.
- Stratigraphy and tectonics of the Siwaliks.

**Unit-4: PHANEROZOIC STRATIGRAPHY OF
THE EXTRA PENINSULAR REGION:**

(12)

- Gondwana Nomenclature, Litho-bio-stratigraphy, Age limits, Correlation.
- Jurassic of Kutch.
- Cretaceous of Narmada valley.
- Stratigraphy of the Deccan Volcanic Province.
- Cretaceous-Tertiary Boundary.
- Quaternaries of Peninsular India.
- Neogene-Quaternary Boundary.

GL-302: EXPLORATION METHODS

Unit-1: GRAVITY AND MAGNETIC METHODS:

(12)

- Concept of scientific methods of exploration- Geophysical and Geochemical exploration.
- Principles of Exploration Geophysics concept of Geophysical Anomaly-factors controlling Geophysical Anomalies.
- Gravity method- Principles behind gravity method Relative measurement of earth gravity- Types of Gravimeter- Field procedure corrections to gravity data- Concept of Bouguer Anomaly- Generalised interpretation of Gravity data- Salient Case Studies.
- Magnetic Method- Principles of magnetic method- Magnetic field associated with the earth- Concepts of total field intensity, Intensity of magnetization and magnetic susceptibility, measurement of magnetic field- Types of magnetometers- Magnetic anomalies and their interpretation- Salient Case Studies.

Unit-2: SEISMIC AND ELECTRIC METHODS:

(12)

- Seismic Method- Principles of seismic method, Types of seismic waves, movement of seismic waves within subsurface- Seismic instruments and field procedures.
- Seismic Reflection Method- Principles of reflection method- Zero offset time- NMO-CDP and Multiple coverage techniques.
- Seismic Refraction Method- Principles of refraction method, Single and multiplayer refraction, Measurement of Seismic velocities and layer thickness.
- Processing of Seismic data- Salient Case Studies.
- Electric Method- Principles of Electrical method- Electrical properties of rocks.
- Resistivity Method- Factors controlling resistivity of rocks, measurement of resistivity- Electrode configurations and field procedures- Interpretation of resistivity data- Salient Case Studies.
- Self-potential Method- Origin of self-potential instrumentation and field procedure- Salient Case Studies

Unit-3: ELECTRICAL METHODS II AND WELL LOGGING: (12)

- Induced polarization method- Electrolytic and electrode polarization- Instruments and field procedure- Salient Case Studies.
- Electromagnetic method- Principles- Instruments- Parallelline and Horizontal loop method Salient Case Studies.
- Well logging- Techniques- Principles and instrumentation of electrical, radioactive, sonic, caliper logging techniques interpretation of logs.

Unit-4: GEOCHEMICAL METHODS: (12)

- Geochemical methods- Geochemical cycle- Dispersion patterns- Geobotonical indicators of minerals- Surface and subsurface methods of sampling.
- Geological principles of ore search-Introduction to Assaying and valuation of minerals deposits.

GL-303: PETROLEUM GEOLOGY

Unit-1: OCCURANCE AN SOURCE ROCKS: (12)

- Classification and composition of Petroleum.
- Physical properties of petroleum.
- Occurrence of petroleum.
- Nature of source rock, composition of biomass.
- Kerogen – composition and types.

Unit- 2: RESERVOIR, TRAPS, ORIGIN AND MIGRATION: (12)

- Reservoir rock, pore space and fluids.
- Reservoir traps.
- Origin, migration and accumulation of petroleum.

Unit 3: PROSPECTING, DRILLING AND LOGGING: (12)

- Geophysical prospecting for petroleum.
- Drilling, logging and subsurface correlation.

Unit-4: INDIAN OIL FIELDS: (12)

- Oil bearing basins of Indian and the world (in brief).
- Indian's position as regards to petroleum and natural gas future prospects.

GL-304: ENGINEERING GEOLOGY AND GEOTECHNIQUES

Unit-1: INTRODUCTION TO ENGINEERING GEOLOGY: (14)

- Scope of Engineering Geology.
- Engineering properties of rocks.
- Methods of determining engineering properties of rocks.
- Behavior of rocks under stress.
- Rock failure mechanisms.
- Engineering properties of soils.
- Methods of soil investigations.

Unit-2: GEOLOGY AND ENGINEERING STRUCTURES: (14)

- Geological considerations for the selection of sites.
- Dam sites and types of Dams and Spillways.
- Forces acting on Dam wall.
- Reservoir competency.
- Silting of reservoirs.
- Tunnels: Tunnel sites and Tunnel alignment.
- Bridges, Y ducts Roads and similar structures.
- Slope stability analysis.
- Types of remedial measures.

Unit-3: GEO-MATERIAL IN ENGINEERING CONSTRUCTION: (14)

- Building stones and road metals.
- Characteristics of rocks as building stones and road metals.
- Aggregate and its classification.
- Rock testing- Mechanical test, Chemical test, Durability test.
- Aggregate resources development.
 - Requirement of Primary fragmentation.
 - Planning of quarry, Hill slope or open pit.
 - Removal of over-burden and its disposition at suitable site.
 - Selection of drilling, blasting method for main blasting and secondary breaking for given size fragmentation.
 - Selection of equipments for drilling, hauling to crusher site.
- Methods of extraction of aggregate resources.

Unit-4: GEO-TECHNIQUES: (6)

- Use of Remote Sensing methods in Engineering Geology.
- Types of Synthetic materials used as remedial measures.
- Estimation of Over-burden thickness and Rock strata classification
- Preparation of Report and Presentation of Engineering data.

**GL-305: COMPUTER APPLICATIONS IN GEOLOGY AND GEOGRAPHICAL
INFORMATION SYSTEM**

Unit-1: COMPUTER FUNDAMENTALS: (7)

- Basic computer organization, Data representation: Non-positional and Positional number systems, Binary, Octal and Hexadecimal number systems, Computer arithmetic.

Unit-2: COMPUTER CODES: (7)

- Boolean Algebra and Logic Circuits, Computer Software, Operating Systems, Planning the Computer Programme, Algorithms.

Unit-3: INTRODUCTION TO COMPUTER GRAPHS: (10)

- Scientific visualization based on computer graphics technologies, Computer Graphics Applications, Display Techniques, Random- Scan Display Processing Unit, Raster-Scan Display Processing Unit, Mathematical Modeling in Geosciences.

Unit-4: INTRODUCTION TO GIS: (12)

- Definition, Scope, History, Application.
- Hardware and Software requirements.
- Spatial and Non-spatial data Attributes.
- GIS data modes- Vector and Raster.

Unit-5: ANALYSIS IN GIS: (12)

- Digitisation and Rasternisation
- Overlay analysis
- Buffer analysis
- Digital Terrain Model
- Multi-criteria Analysis
- Query Analysis.

GL-306- NATURAL RESOURCE MANAGEMENT & OIL FIELD SERVICES

Unit-1-INTRODUCTION TO NATURAL RESOURCES: (12)

- Description of the Resources
- Classification of the Natural Resources
- Exhaustible resources- Minerals and Mining
- Energy Resources- Oil, Natural Gas, Atomic minerals
- Function and values of the resource
- Supply and demand
- Conflicts concerning the resource
- Politics and legislation concerning natural resources

Unit-2-DEVELOPEMNT AND MANAGEMENT OF NATURAL RESOURCES: (12)

- Management tools and techniques
- Wetland definitions, classification, restoration, protection and construction
- Wastewater treatment
- Soil as resource, types of soils and methods of soil conservation
- Coastal resources and Coastal Process
- Coastal Zone Management
- Application of Remote Sensing Techniques in resource Management
- Environmental Impact Analysis
- Mineral Resources: Conversation and Management
- National Mineral Policy

Unit-3-INTRODUCTION TO OIL WELL DRILLING: (12)

- Introduction to Oil well drilling: types of drilling rigs: onshore, offshore, major components of rigs
- Methods of bore well drilling: rotary and cable tool drilling, directional drilling and monitoring of drilling process i.e. depth, ROP, WOB etc, sampling
- Coring: Coring techniques and core analysis
- Drilling muds, mud hydraulics: uses and functions of mud

Unit-4-WELL LOGGING: (12)

- Mud logging
- Principles, techniques and tools of mud logging, interpretation of gas, drilling parameters and mud parameters
- Wire line logging: Basic principles, tools of self potential, Gamma ray, Neutron, Density, Caliper, Dip meter and Sonic logs, and their interpretation MWD logging: (Measurement while drilling), Principles and tools of MWD. Data analysis and interpretation

GL-307: PRACTICALS RELATED TO GL-301 TO GL-306

A) Practicals for GL-301:

- 1) Study of typical hand specimens of rocks from different litho logical units of Indian Stratigraphy.
- 2) Preparation and study of Palaeogeographical maps of India for different geological periods.
- 3) Study of geological maps of different unit of Indian stratigraphy and construction of geologic cross-sections.

B) Practicals for GL-302:

- 1) Study of patterns of geophysical responses from various geological mediums
- 2) Plotting a Drift curve for a gravimeter application of elevation correction to observed gravity data-Plotting and interpretation of gravity profiles-Simulations of causative bodies.
- 3) Analysis of seismic refraction data for velocities and thickness of sub-surface layers.
- 4) Plotting and interpretation of resistivity data.
- 5) Plotting and analysis of self-potential data.
- 6) Simple interpretation geophysical well logs.

C) Practicals for GL-303:

- 1) Lithofacies analysis.
- 2) Preparation of Structural contour maps.
- 3) Preparation of Isopach maps.
- 4) Preparation of Carbonate concentration maps.
- 5) Correlation of electrical logs.
- 6) Preparation of geological cross-section from well data.

D) Practicals for GL-304:

- 1) Various methods of Surveying used in engineering geology.
- 2) Chain Surveys.
- 3) Plane table surveys.
- 4) Use of surveying equipments.
- 5) Determination of engineering properties of geological materials.
- 6) Interpretation of bore-hole data.
- 7) Preparation of bore logs/ lithologs

E) Practicals for GL-305:

- 1) Designing a Logical Database.
- 2) Querying and Reporting.
- 3) Preparation of computer maps and terrain models.
- 4) Piper and Stiff diagrams.
- 5) Conversion of data into vector, wire frame, image, shaded relief and post maps.
- 6) Statistical data analysis in Geosciences.

F) Practicals for GL-306:

- 1) Introduction to the methods of Environmental Impact assessment.
- 2) Delineation of natural resources by using remote sensing techniques.
- 3) Cost benefit analysis.
- 4) Description and identification of well cutting based on their physical properties.
- 5) Percentage Lithology and master log preparation.
- 6) Gas curve identification and gas ratio plotting.
- 7) Wire line log interpretation.
- 8) Well hydraulic calculations such as lag time calculations, annular volume calculations etc.
- 9) Description and identification of core samples.
- 10) Calculations of shale density.

TEXT BOOKS FOR SEMESTER-III

- 1) *Wadia*: Geology of India and Burma.
- 2) *Krishnam*: Geology of India.
- 3) *Naqui and Rogers*: Precambrian Geology of India.
- 4) *Saha A.K.*: Crustal Evolution of Singhbhum North Orissa.
- 5) *Geological Society of India*: Purana Basins of India.
- 6) *Geological Society of India*: Quaternary of India.
- 7) *Geological Society of India*: Precambrian of the Aravalli Mountain.
- 8) *Geological Society of India*: Geology of the Central and Western India.
- 9) *Geological Society of India*: Geology of Karnataka.
- 10) *Todd, D.K.*: Groundwater Hydrology.
- 11) *Karanth, K.R.*: Groundwater Assessment Development and Management.
- 12) *Raghunath, H.M.*: Groundwater.
- 13) *Davis S.N. and Dewiest R.J.M.*: Hydrogeology.
- 14) *Freeze and Cherry*: Groundwater.
- 15) *Levenson*: Geology of Petroleum.
- 16) *Russel*: Petroleum Geology.
- 17) *Brown and Day*: India's Mineral Wealth.
- 18) *Dobrin*: Introduction to Geophysical Prospecting.
- 19) *Kearey and Brooks*: An Introduction to Geophysical Exploration.
- 20) *Soroie*: Geology for Engineers.
- 21) *Krynine and Judd*: Principles of Engineering Geology and Geotechniques.
- 22) *Rise and Wateson*: Elements of Engineering Geology.
- 23) *Faure*: Principles of Isotope Geology.
- 24) *Panigrahi D.C.*: Mine Environment and Ventilation.
- 25) *Singh B.*: Blasting in Ground Excavation and Mines.
- 26) *Sinha R.K.*: Mineral Economic.
- 27) *Gouletlin*: Ore Dressing.
- 28) *Banter & Parks*: Examination and Valuation of Mineral Property.

- 29) *Macnestry*: Mining Geology.
- 30) *IADC*: Primer of Oil Well Drilling.
- 31) *Bhagwan Sahay*: Mud Logging.
- 32) *Person*: Geological Well Drilling Technology.
- 33) *Cray and Cole*: Oil and Well Drilling Technology.
- 34) *Kennedy*: Fundamentals of Drilling.
- 35) *Hearst and Nelson*: Well Logging for Physical Properties.
- 36) *Shenk T.M. and A.M.Franklin*: 2001, Modeling in Natural Resource Management Development, Interpretation and Application, Island Press.
- 37) *Wondolleck J.M. and S.L. Yaffee*: 2000, Making Collaboration Work Lessons from Innovation in Natural Resource Management, Island Press.
- 38) *Paine D.P.*: 1981, Aerial Photography and Image Interpretation for Resource Management, John Wiley and Sons, New York, 571 p.
- 39) *Richason B.F., Jr.*: ed. 1978, Introduction to Remote Sensing of the Environment, Kendall/ Hunt Publishing Company, Dubuque, Iowa, 496 p.
- 40) *Spurr S.H.*: 1960, Photogrammetry and Photo-Interpretation. The Ronald Press Co., New York, 472 p.
- 41) *Burroughs P.A.*: (1986), Principles of Geographical Information Systems for Land Resources Assessment, Oxford University Press.
- 42) *Environmental Systems Research Institute*: (1993), Understanding GIS: The Arc Info Method Training Course for GIS for Resource Management and Development Planning
- 43) *Government of India*: Lecture Notes, VI: GIS Fundamentals and Techniques.
- 44) *Berhardsen, Tor*: (1999), Geographic Information Systems: An Introduction, John Willey and Sons.
- 45) *Clarke, Keith C.*: (1999), Getting Started with Geographic Information Systems, Prentics Hall.
- 46) *Dermrs, Michael N.*: (2000), Fundamentals of Geographic Information Systems, John Willey.
- 47) *Haywwod, Ian*: (2000), Geographical Information Systems, Longman.
- 48) *Chang, Kang-taung*: (2000), Introduction to Geographic Information Systems, Tata McGraw-Hill.
- 49) *Rajaraman V.*: Fundamentals of Computers.
- 50) *Shrivastava C.*: Fundamentals of information Technology.
- 51) *Sinha Pradeep*: Computer Fundamentals.

M.Sc.-II: GEOLOGY-SEMESTER-IV
GL-401: ECONOMIC GEOLOGY

Unit-1: ORE FORMING PROCESS (I): **(12)**

- Scope and Application of economic geology.
- Genetic classification of ore deposits.
- Concept of the terms ore, gangue, grade, tenor, resources, reserves etc.
- Mineralisation related to Plate tectonics, Structural controls on ore localization.
- Broad tectonic setting magmatism associated with various types of ore deposits.

Unit-2: ORE FORMING PROCESSES (II): **(12)**

- Magma and its relation to mineral deposits.
- Ore forming fluids: Origin, Types, Nature and Migration.
- Magmas as ore forming fluids.
- Hydrothermal fluids, Types, Composition and Transport, Wall rock alteration.
- Physico-chemical principles of ore-deposition.
- Primary and secondary ore forming process.

Unit-3: INDIAN ORE DEPOSITS (I): **(12)**

- Mode of occurrence, geological and geographic distribution, classification and genesis of the following mineral deposits.
 - Chromium
 - Iron
 - Manganese
 - Copper
 - Skarn deposits

Unit-4: INDIAN ORE DEPOSITS (II): **(12)**

- Mode of occurrence, geological and geographic distribution and genesis of the following mineral deposits:
 - Lead and Zinc
 - Gold
 - Aluminum (Bauxite)
 - Barite
 - Uranium
 - Coal
 - Introduction to Mineral Economics

GL-402: MINING GEOLOGY, GEMMOLOGY AND INDUSTRIAL MINERALOGY

Unit-1: GUIDES TO ORE: (12)

- Ringed Target and Intersecting loci.
- Regional and Topographical Guides.
- Mineralogical Guides.
- Structural guides.
- Stratigraphic Guides.

Unit-2: DRILLING METHODS: (12)

- Types of Drills:
 - Percussion drills
 - Rotary drills
- Mining Methods:
 - Alluvial mining
 - Open cast mining
 - Under ground mining.
- Principles of ore dressing.

Unit-3: GEMMOLOGY: (12)

- Introduction to Gems- Basic properties of gems- Formation of gems.
- Gem instruments and their use in gem stone identification (Hand lens, Dichroscope, Polariscope, Refractometer, Spectroscope, Microscope, UV light and X-rays)- Causes of colours in gem stones.
- Description of following gem species with respect to their varieties (colourwise), Chemical composition, Crystal system, Physical and optical properties, Characteristic inclusions and Occurrence.
 - Corundum
 - Beryl
 - Garnet
 - Felspar
 - Silica
 - Tourmaline
 - Topaz
 - Opaque gem varieties.
- Treatments of gem stones and their detection.
- Imitation and composite stones.
- Gem synthesis and distinction between Synthetic and Natural gem stones.

Unit-4: INDUSTRIAL MINERALOGY: (12)

- Industrial Mineralogy- Introduction to industrial specifications of raw materials used in following industries:
 - Ceramics and Refractories, Abrasive, Construction, Cement, Fertilizers, Paints, Electronics etc.- Outline of techniques used in testing raw materials.

GL-403: ENVIRONMENTAL GEOLOGY

Unit-1: INTRODUCTION TO ENVIRONMENTAL GEOLOGY AND SCOPE: (12)

- Fundamental concepts of environmental geoscience, its scope and necessity.
- Definition, structure, composition and general characteristics of lithosphere, hydrosphere, atmosphere and biosphere.
- Biogeochemical cycles of carbon, nitrogen, phosphorus and sulfur.

Unit-2: ENVIRONMENTAL ISSUES: (12)

- Water pollution and other Issues: Drinking water sources, quality criteria and standards, Characteristics of water, Types of water pollution, Groundwater pollution source, Pathways and mechanism, Attenuation process, Case histories of natural (arsenic and fluoride poisoning) and man made water pollution.
- Soil pollution: Soil formation, Classification and properties, Soil salinity and alkalinity, Characteristics of saline/ alkali soils, Soil amendments. Soil pollution sources, causes and effects. Soil pollution control measures.

**Unit-3: NATURAL HAZARDS, ZONING,
RISK ASSESSMENT AND MANAGEMENT: (12)**

- Extreme events and hazards, Catastrophic geological hazards, Study of landslides, Subsidence, Floods, Droughts, Earthquake, Volcanoes, their causes, classification, assessment, prediction and prevention. Coastal hazards, cyclones, tsunamis and shoreline and sea level changes. Strategies for hazards mitigation.

Unit-4: MINING AND ENVIRONMENT: (12)

- Mining and its impact on environment, Wastes from mining industry, Waste disposal methods, Acid mine drainage, Heavy metal pollution due to mining, Environmental impacts of coal utilization, Fly ash, Recycling of resources and management.

**GL-404: HYDROGEOLOGY, WATER SHED
DEVELOPMENT AND MANAGEMENT**

Unit-1: HYDROSPHERE AND GROUNDWATER EXPLORATION: (12)

- Scope and importance of Groundwater.
- Hydrosphere- Evaporation, condensation, precipitation, interception, runoff (surface, subsurface and groundwater), infiltration.
- Factors that affect occurrence of groundwater- Climate, Topography, Geology.
- Exploration techniques- Integrated approach to groundwater prospecting: Role of toposheets and remote sensing in groundwater exploration, hydro chemical methods: Surface and subsurface Geophysical methods, Tracer techniques, Exploratory Borewell programme, Use of computer software in exploration of groundwater.

Unit-2: GROUNDWATER ACCUMULATION AND MOVEMENT: (6)

- Aquifer properties- Concepts of Transmissivity and Storativity.
- Behaviour of sedimentary, crystalline and volcanic rocks as aquifers- factors controlling hydrologic aquifer properties and yield of wells in different rock types.
- Pumping tests- Principles, Types of pumping tests, procedures, concept of well hydraulics, and determination of aquifer properties and well Characteristics by simple graphical methods- Significance of transmissivity and storativity data.

Unit-3: QUALITY OF GROUNDWATER: (6)

- Quality of groundwater- Geochemical processes in the groundwater, Water types and water quality, Classification- Interaction of water its ambient environment, Types of interaction: Chemical, physical, kinetic. Assessment of groundwater quality.
- Groundwater provinces of India. Groundwater in Maharashtra state. Concept of groundwater legislation.

Unit-4: Watershed Development: (12)

- Concept of watershed- Watershed characteristics- Importance of water resources in watershed- Concept of watershed development in relation to water resources- Salient features of development measures like counter budding, gully plugs, stream bunds, percolation tank, subsurface dams, afforestation etc.- Significance of geology in watershed development measures- Role of NGOs and State Government in watershed development.

Unit-5: Watershed Management: (12)

- Concept of watershed management in relation to water resources- Water balance equation for watershed- Sustainability of water resources- Conjunctive use of surface and groundwater resources- Concepts of peoples participation in community based watershed management- Concept of water users group- Role of NGOs and State Government in watershed management.

GL-405: DISSERTATION

Field studies, Laboratory studies/ data processing, reference work and presentation of the thesis are four major components of the course. Students opting for this course should adhere to the following procedure.

- 1) Precise title and outline of work is to be submitted to the Head of the Department.
- 2) The student shall spend about one week in the field.
- 3) The field work shall be carried out only during vacation or holidays, and in no case student will be permitted to be absent from regular teaching on account of dissertation.
- 4) The student shall maintain field diaries and other record relevant to dissertation.
- 5) Every month the student shall submit the progress report and laboratory work done, through the supervisor to Head of the Department.
- 6) The student shall do dissertation at his own cost. The department will not spare funds for this purpose.
- 7) The student shall give a seminar before the submission of the dissertation.
- 8) The student shall submit the dissertation before the commencement of practical examination.
- 9) Non compliance of any of the above rules will disqualify students for grant of terms.

Three copies neatly typed on thesis size paper, well bound together with maps and illustration of the Dissertation, on the basis of the work carried out by the student, will be submitted, through the supervisor concerned, to the Head of the Department of Geology, before the commencement of the practical examination, for being forwarded to the Board of Examiners.

In case of student receiving help (training and / or participation in ongoing research activities) from other Institution / Organization for their dissertation work, the associated scientist from that Institute/ Organization will function as co-supervisor.

Assessment of Dissertation will be out 100 marks and shall include a viva voce examination carrying 20 marks. The Dissertation will be examined at the time of the practical examination at the end of IVth Semester, by the board of examiners. The Board of Examiners consist of supervisor, Head of the Department and one teaching faculty member appointed by Head of Department in consultation with the supervisor.

GL-406: FIELDWORK COMPONENT

Semester-I & II:

Students shall carry out two weeks field work in a selected area to learn the geological mapping techniques during first year of M.Sc. degree course. Students should submit report based on the mapping and laboratory work related to the data and samples collected during the field work.

Semester-III & IV:

Students should attend a geological excursion of about two weeks duration organized by the department. This will include visits to geological importance areas in India and geological organizations/ institutions etc. related to respective theory courses of Semester III & IV. Students should submit a tour along with the specimens.

The field work should be treated as a part of course No. GL-406 and will be assessed at the end of the Semester-IV.

GL-407: PRACTICALS RELATED TO GL-401 TO GL-404

A. Practicals for GL-401:

- 1) Study of ores in hand specimens.
- 2) Preparation of charts showing distribution of importance ore deposits in India.
- 3) Mineralogical and textural study of common ores under microscope.
- 4) Chemical analysis of ore minerals assaying.
- 5) Megascopic characterization of banded coals.
- 6) Proximate analysis of coal.
- 7) Microscopic examination of polished coals (Identification of macerals in coal).

B) Practicals for GL-402:

- 1) Mine valuation and calculation.
- 2) Uniform spacing on rectangular co-ordinate.
- 3) Included area problems related to valency.
- 4) Area influenced methods of combining irregular spaced assay.
- 5) Triangle grouping of irregular spaced assayed.
- 6) Veins problems (linear groups, minimum stoping widths).
- 7) Visual observation of gem stones.
- 8) Use of refractometers and determination of specific gravity.
- 9) Identification of Anisotropic and Isotropic gem stones.
- 10) Observation of inclusions to identify synthetic from natural gem stones.
- 11) Study of physical properties of industrial minerals and materials required for different industries.
- 12) Preparation of charts showing specifications of materials required for different industries.

C) Practicals for GL-403:

- 1) Water and Soil analysis.
- 2) Preparation of map showing hazards.
- 3) Preparation of hazards zonation maps.

D) Practicals for GL-404:

- 1) Analysis of rainfall data.
- 2) Preparation of water level contour maps and their interpretation.
- 3) Analysis of pumping test data by simple graphical methods for determination of aquifer and well characteristics.
- 4) Plotting and analysis of hydro-geochemical data.
- 5) Hydro geological significance of morphometric parameters of a watershed.
- 6) Use of computer.
- 7) Salient points for the constructive of contour bunds, stream bunds, percolation tank subsurface dams etc.
- 8) Use of morphometric analysis in planning watershed development.
Calculation of water balance for a watershed.

TEXT BOOKS FOR SEMESTER-IV

- 1) *Craig and Vaughan*: (1981) Ore petrography and Mineralogy, John Wiley.
- 2) *Mookherjee*: (2000), Ore Genesis- A Holistic Approach, Allied Publication, New Delhi.
- 3) *Sawkins*: (1984), Metal Deposits in relation to Plate Tectonics.
- 4) *Stanton*: (1972), Ore Petrology, McGraw Hill, New York.
- 5) *Guilbert and Park*: (1986), Geology of Ore Deposits.
- 6) *Taylor, et.al.*: (1998), Organic Petrology, Gebruder Borntraeger, Stuttgart.
- 7) *Singh (ed)*: (1998), Coal and Organic Petrology.
- 8) *Chandra*: (2000), Textbook of Coal (Indian context), Tara Book Agency, Varanasi.
- 9) *Dahlkamp*: (1993), Uranium Ore Deposits, Springer Verlag, Berlin.
- 10) *Kennet*: Marine Geology.
- 11) *Menard*: Marine Geology.
- 12) *Krumbin and Graybill*: An Introduction to Statistical Methods in Geology.
- 13) *Fergusson*: Mathematics in Geology.
- 14) *Rajaraman V*: Fundamentals of Computers.
- 15) *Tonge, Fred M.*: Computing- Introduction to Procedures.
- 16) *Roger C. Parker*: MS Office for Windows 95
- 17) *Tom Badgett*: Compact Guide to Word.
- 18) *Dan Gookin*: Word for Windows 95.
- 19) *Gerg Harvey*: Excel for Windows 95.
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