M.PHIL. – APPLIED GEOLOGY

Syllabus for M.Phil. Applied Geology courses w.e.f. 2017-2018 Academic Year

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>C/E/S</th>
<th>Credits</th>
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<td>I SEMESTER</td>
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<tr>
<td>EAS C321</td>
<td>Research Methodology and Data Processing</td>
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<td>EAS C322</td>
<td>Instrumentation Techniques in Earth Sciences</td>
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<td>EAS E321</td>
<td>Exploration Geophysics</td>
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<td>EAS E322</td>
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<td>EAS E325</td>
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<td>EAS E326</td>
<td>Integrated Coastal Zone Management</td>
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<td>Natural Hazards &amp; Disaster Risk Management</td>
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<td>II SEMESTER</td>
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<td>EAS C323</td>
<td>Continuous Evaluation of the Project</td>
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Objective: To impart adequate training in the various techniques used in research methodology and data processing so as to enable the students to enhance his/her competence in systematic preparation, presentation, analysis and interpretation of scientific data.

Unit 1: Research Methodology: Introduction - Meaning and aims of research - Types of research - Research approach - Significance of research - Research Methods vs Methodology - Research and scientific method - Research process - Importance of knowing how research is done - Criteria of good research - Problems encountered by the Indian researchers. Defining a research problem: What is research problem? - Selection of the problem - Necessity of defining the problem - Technique involved in – Conclusion. Research Design: Meaning of research design - Need for it Features of a good design - Important concepts relating to research design - Various research design - Basic principles - Experimental designs - Important experimental designs - Development of the research plan – Conclusion.

Unit 2: Sample design: Census and sample survey - Implications of a sampling design - Steps in sampling design - Criteria for selecting a sampling procedure - Characteristics of a
good sample design - Various kinds of sample designs - Selection of random sample - Random sample from an indefinite universe - Complex random sampling designs – Conclusion. Methods of data collection: Collection of primary data - Collection of data through questionnaires - Collection of data through schedules - Other methods of data collection. Collection of secondary data: Selection of appropriate method for the data collection - Case study of method - Guidelines for constructing questionnaire/schedule - Guidelines for successful interviewing.


Unit 4: Testing of hypotheses: Basic concepts - Tests of hypotheses - Hypothesis testing - Mean Hypothesis testing for comparing two related samples - Hypothesis testing of proportions - Hypothesis testing for difference between proportions - Hypothesis testing for comparing variance - Hypothesis testing for correlation coefficients: Chi square test. Analysis of variance and covariance: Analysis of variance (ANOVA) - Basic principles of ANOVA - ANOVA techniques - Setting up analysis of variance table - Two-way ANOVA - ANOVA in Latin square design - Analysis of covariance. ANOCOVA techniques: Introduction to various techniques in non parametric tests.

Unit 5: Multivariate analysis, techniques: Characteristics – Applications - Classification of multivariate techniques - Variables in multivariate analysis. Factor analysis: Rotation in the factor analysis R mode & Q mode factor analyses - Path analysis - Analysis of time series. Introduction to the processing of data using computers: Basics of computers - Computation of statistical parameters using computers - Representation of data using computers - Filtering techniques - Data interpretation - Introduction to various packages used in data analysis: LOTUS Inversion techniques - Application of statistical and computer techniques to various types of geological data.

Selected text Books and Reference Books:


EAS C 322 Instrumentation Techniques in Earth Sciences All Faculty

Objective: Knowledge in the principle, usage and techniques with regard to various analytical and photographic equipments and instruments is a must for any researcher. The main aim of this course therefore, is to impart intensive training in handling all kinds of scientific equipments and instruments.


Unit II: Principles and applications of the following: Thin layer Chromatography - Gas chromatography - Atomic Absorption Spectrophotometer - Atomic Emission Spectrophotometer - Mass Spectrometer.

Unit IV: Resistivity meter - Gravimeter - Magnetometer - Differential Thermal Analyzer –Seismograph - Gamma ray Spectrometer - Mirror Stereoscope - Stereo zoom transferoscope - Isotope dilution technique.

Unit V: Elements of photography: Film speed – Sensitivity - Shutter settings and aperture setting - Digital Image Processing - Sedimentological techniques: Grain size analysis – Friedman’s and Visher's approaches - Gravel analysis - Significance of roundness, flatness ratio, sphericity and shape - Separation of heavy minerals - Thin section - Particle size analysis- Micropaleontological techniques.

Selected Text Books and Reference Books:


**Objective**: To provide a sound knowledge in ground water geology.

**Unit 1**: Scope and application of geohydrology – Ground water and hydrologic cycle – Components such as precipitation, evapotranspiration, infiltration, surface runoff and subsurface distribution and movement of ground water and their estimation for the purpose of assessing water availability – Lithological, stratigraphical and structural controls in occurrence and movement of ground water - Water-bearing properties of rock formations

**Unit 2**: Porosity, permeability, compressibility of rocks, specific yield, hydraulic conductivity and storativity. Darcy’s experiment, fluid pressure and hydraulic head – Barometric and tidal efficiency of aquifers – Types of aquifers: confined, semi-confined and unconfined aquifers and their characteristics – Springs - Types of ground water flow – Derivation of equations for steady and unsteady flow.
Unit 3: Well hydraulics – Cone of depression, radius of influence, drawdown and specific capacity – Theim-, Theis-, Hantush- and Newman’s equations for various types of ground water flow conditions – Partial penetration and multiple well pumping cases – Flow in bounded aquifers – Tracer tests and slug tests - Water balance studies and ground water budgeting – Ground water levels and water level maps – Safe yield and conjunctive uses – Artificial recharge and methods.


Selected Textbooks and Reference Books:

5. Garg, S.P. *Groundwater and Tube Wells*. Oxford-IBH.

**Objective:** To understand the basic principles of Geochemistry and their applications in prospecting for mineral, water, oil and natural gas resources.
**Unit 1:** Origins: Big Bang, properties of nuclei, and the synthesis of the elements - Meteorites and the origin of the solar system - Nature, age and composition of the Sun.

**Unit 2:** Classifications: Goldschmidt’s classification – Geochemical tracers – Cosmic abundance of elements – Patterns of geochemical distribution – Normal background value – Geochemical anomaly – Primary geochemical differentiation of the Earth.

**Unit 3:** Geochemical cycles: Origin of the oceans and atmosphere - Chemical weathering, major element cycles, and biogeochemical cycles on the modern Earth

**Unit 4:** Isotope geochemistry: Radioactive decay schemes and their application to Geochronology and petrogeochronology – Stable and short lived isotopes and their application to earth system processes.

**Unit 5:** Environmental Geochemistry: Major events in atmospheric history (rise of atmospheric $O_2$, regulation of the atmospheric $CO_2$ concentration - Linked changes of climate and the biosphere - The global carbon cycle - Marine Sediments: a record of environmental global history.

**Selected Textbooks and Reference Books:**


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**EAS E 324 Applied Micropaleontology Dr. N.Rajeshwara Rao**

**Unit 1:** Fossil record and geological time-scale. Evolutionary changes in molluscs and mammals in geological time. Principles of evolution. Use of species and genera of foraminifera and
echinodermata in biostratigraphic correlation. Different microfossil groups and their
distribution in India. Functional morphology, evolution and significance of Plant Fossils, Fishes,
Horse, Elephant and Man. Dinosaurs and their extinction. Taphonomy and environmental
factors, Oxygen and Carbon isotope studies of fossils and paleoclimates – Palaeobiogeographic
Provinces.

**Unit 2:** Origin and evolution of life – Phylogenetic and Ontogenic Analysis – Species Concept –
Types of Fossils and Types of Species – Palingensis – Coenogensis – Proterogenesis -
Thanatocoenosis – Biocoenosis – Sidocoenosis - Biomineralisation and Trace Fossils – Fossils
and their uses – Biometrics – Major events in the history of Precambrian and Phanerozoic life.

**Unit 3:** Vertebrate paleontology: Succession of vertebrate life through geologic time. Broad
classification and study of some characteristic Indian vertebrate genera. Indian pre-Tertiary
vertebrate - their distribution and paleogeographic implication; extinction of dinosaurs. Indian
Tertiary vertebrate - Siwalik mammals; phylogeny - Equidae & Proboscidae. Indian fossil
Hominoides and modern theories regarding human evolution.

**Unit 4:** Invertebrate paleontology: an overview. Morphology, classification, evolutionary trend,
composition and structure of shells of selected groups of organisms - Porifera, Bryozoa,
Mollusca, Brachiopoda. Geological history, geographical distribution and description of more
important genera of Trilobita, Echinoids, Coelenterata and Graptoloidea.

**Unit 5:** Micropaleontology: Sampling methods and sample processing techniques. Types of
microfossils. Calcareous Microfossils - Foraminifera - major morphologic groups; Benthic
Foraminifera; depth biotopes, value in paleobathymetric determination. Larger foraminifera –
their utility in Indian stratigraphy. Planktonic foraminifera and calcareous nannofossils.
Ostracoda - outline morphology, paleoecology & geological history. Brief knowledge about
pteropods, calpionellids and calcareous algae.

**Selected Text Books and Reference Books:**

Unwin.
Francisco.
New Delhi.


7. Hecker, R.R. – Introduction to palaeoecology

8. Prothero, D.R. – Bringing fossils to life-An introduction to palaeobiology

| EAS E 325 Remote Sensing | Dr. R. R. Krishnamurthy |

**Objective:** To provide in depth knowledge and exposure to Remote Sensing and GIS technology tools with particular reference to land and ocean applications.


**Unit 3:** Image processing in remote sensing: Digital data recording – Digital data format. Introduction to digital image processing – Pre-processing techniques – Image classification methods – Image enhancement techniques.

**Unit 4:** Applications of remote sensing: Visual interpretation – Different sensors – Data and image interpretation key elements. Exercises on mapping of geology – Land use/land cover and geomorphology based on visual method – Preparation of base maps and transformation of thematic maps. Validation of remote sensing analysis output by ground truth – Accuracy, estimation and introduction to GPS technology.

**Unit 5:** Fundamentals and application of GIS: Concept of GIS – GIS types – Data storage – Retrieval and analysis. GIS database organization and development – Combined use of remote
sensing and GIS. Preparation of spatial decision support system (SDSS). Highlights on different applications using GIS tool with particular reference to Applied Geosciences and Ocean Science.

**Selected Text Books and Reference Books:**


**II SEMESTER**

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