M.PHIL. – APPLIED GEOLOGY

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

Course Code	Course Title	C/E/S	Credits
I SEMESTER			
EAS C321	Research Methodology and Data Processing	C	5
EAS C322	Instrumentation Techniques in Earth Sciences	C	5
EAS E321	Exploration Geophysics	E	5
EAS E322	Geohydrology	E	5
EAS E323	Environmental Geochemistry	E	5
EAS E324	Applied Micropaleontology	E	5
EAS E325	Remote Sensing	E	5
EAS E326	Integrated Coastal Zone Management	E	5
EAS E327	Natural Hazards & Disaster Risk Management	E	5
II SEMESTER			
EAS C323	Continuous Evaluation of the Project	C	6
EAS C324	Dissertation	C	10
EAS C325	Viva-voce	C	5

I – SEMESTER

EAS C 321	Research Methodology and Data Processing	All Faculty

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 3: Interpretation and Report writing: Meaning of interpretation - Its need - Technique of the interpretation – Precautions - Importance of report writing - Various steps in writing report - Layout of research report - Types of reports - Oral presentation - Mechanics of writing research report - Precautions for writing research reports - Conclusions. Statistical analysis: Introduction - Basic concepts - Mean and Variance of data - Frequency distribution – Probability - Measures of central tendency – Dispersion - Filtering of geological data. Sampling techniques: Definition - Important sampling distribution - Central limit theorem - Sampling theory Concept of standard error - Estimation of population mean - Determination of sample size through various approaches.

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 :

1. Gunter Faure and Teresa M.Mensing. (2009). Isotopes Principles and Applications. Wiley India Pvt.Ltd.

2. N.M.Naidu (2009). Geoinformatics and Geostatistics. SBS Publications and Distributors Pvt.Ltd, New Delhi.
3. David D. Hanagal (2009). Introduction to Applied Statistics. Narosa Publishing House, NewDelhi.
4. C B Gupta (1995). An Introduction to Statistical Methods. Vikas Publishing House Pvt Ltd.
5. N. Gurumani (2010). Scientific Thesis Writing and Paper Presentation. MJP publishers.
6. C.Vijayalakshmi and C.Sivaprakasam.(2008). Research Methods tips and techniques. . MJP publishers.
7. David Dooley (1994). Social Research Methods. Prentice Hall Englewood Cliffs, N.J. 07632.
8. W. Lawrence Neuman (1991). Social Research Methods, London.
9. Jack Levin and James Alan Fox (1994). Elementary statistics in social research. Harper Collins College publishers.
10. Robert R. Pagano (1990). Understanding Statistics in the behavioural sciences. West Publishing Company, New York.

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 I: Preparation of rock samples: Theory - Principles – Instrumentation. Applications of the following instruments in Earth Sciences: Flame photometer – Colorimeter - IR and UV Spectrophotometer - Nephelometer – Turbidity meter.

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

Unit III: E1ectron Microprobe - Scanning Electron Microscope - Transmission Electron Microscope – Polarograph - X ray Diffractometer - X ray Fluorescence Spectrometer - Isodynamic separator.

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 :

1. P.R.J.Naidu. (1958). 4-Axes Universal Stage. All right reserved by the author.
2. Albert V. Carozzi. (1960). Microscopic Sedimentary Petrography. John Wiley & Sons, INC., New York and London.
3. Charles S. Hutchison. (1974). Laboratory Handbook of Petrographic Techniques. A Wiley-inter science Publication, John Wiley & Sons, New York.
4. Arnold H. Bouma. (1969). Methods for study of Sedimentary Structures. Wiley-inter science publication, John Wiley & Sons, New York.
5. Dougles W.Lewis and David McConchie. (1937). Analytical Sedimentology. CHAPMAN and HALL, Newyork.
6. Robert Wynn Jones. (2014). Foraminifera and their Applications. Cambridge University Press.
7. Devesh K. Sinha. (2007). Micropaleontology Applications and Paleoceanography. Narosa Publishing House, NewDelhi.
8. Hand Book for TWAD Hydrogeologists. (2002). Tamilnadu Water Supply and Drainage Board.
9. Magnus Wangen. (2010). Physical Principles of Sedimentary Basin Analysis. Cambridge University Press.
10. Peter M. Shearea. (2009). Introduction to Seismology. Second Edition. Cambridge University Press.
11. Susanta Lahiri. (2008). Trace Analysis. Narosa Publishing House, NewDelhi.

12. T.S.Ramakrishna. (2006). Geophysical practice in Mineral Exploration and Mapping. Geological Society of India, Bangalore.
13. J.W.Einax, H.W.Zwanziger and S.GeiB. (1997). Chemometrics in Environmental Analysis. VCH, A Wiley Company.
14. Wolfgang Jacoby and Peter L.Smilde. (2009). Gravity and Interpretation Fumdamentals and application of gravity inversion and geological interpretation. Springer.
15. Dougal Jerram and Nick Petford. (2004). The field description of Igneous rocks. A Wiley-Blackwell, John Wiley & Sons, New York.
16. Walter G. Kropatsch. (2004). Digital Image Processing. Selected techniques and applications. Springer International Edition.
17. Victor C. Miller. (1961). Photogeology. McGraw-Hill Book Company, INC Newyork.
18. Philip D. LaFleur. (1974). Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis – Volume II. NBS Special Publication.
19. John Glasson, Riki Therivel and Andrew Chadwick. (2012). Introduction to Environmental impact assessment. Routledge Taylot and Francis Group, London.
20. H.M.Saxena. (2010). Environmental Management. Rawat Publications, Chennai.

EAS E 322	**Geohydrology**	**Dr. S.G.D. Sridhar**

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 sub-surface 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 – Theims-, 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.

Unit 4: Types of water wells – Drilling techniques – Rotary and percussion drills – Well design and construction. Water well development methods – Collector wells and infiltration galleries – Types of pumps – Chemical quality of ground water – Source of impurities, physical and chemical properties, and their estimation – Graphical presentation of water analyses - Ground water contamination and pollution – Urban, agricultural and industrial contamination, remedial measures.

Unit 5: Sea water intrusion in coastal aquifers, hydrodynamic equilibrium of fresh and saline water – Methods of controlling sea water intrusion – Exploration for ground water – Geological methods, Remote Sensing techniques, geomorphological inputs, gravity, magnetic, seismic and electrical methods of exploration – Basics of ground water modeling – Physical, analog and mathematical models, finite difference modeling – Ground water regimes in India – Hydrostratigraphic units – Hydrogeology of arid zones of India – Hydrogeology of wetlands.

Selected Textbooks and Reference Books:

1. Todd, D.K. (1980) *Groundwater Hydrology*.John Wiley & Sons, New York.
2. Davies and DeWeist (1966) *Geohydrology*. John Wiley & Sons, New York.
3. Freeze, R.A. and Cherry, J.A. (1979) *Groundwater*. Prentice-Hall.
4. Karanth, K.R. (1987) *Groundwater Assessment, Development and Management*. Tata McGraw-Hill.
5. Garg, S.P. *Groundwater and Tube Wells*. Oxford-IBH.
6. Singh, V.P. (1994) *Elementary Hydrology*. Prentice-Hall.
7. Pitchaiah, S. (Ed.) *Groundwater*. Scientific Publishers.
8. Rudkavi, A.J. and Collander, R.A.(1976) *Analysis of Groundwater Flow*. Edward Arnold.

EAS E 323	**Environmental Geochemistry**	**Dr. M. Jayaprakash**

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 petrogeneis – 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 :

1. Mason, B. and Moore, B. (1982) *Principles of Geochemistry*. John Wiley & Sons, New York.
2. Hawkes, H.A. and Webb, J.S. (1962) *Geochemistry in Mineral Exploration*. Harper & Row, New York.
3. Levinson, H.A. (1976) *Introduction to Exploration Geochemistry*.
4. Ginzburg, I.I. and Sokoloff, V.P. (1960) *Principles of Geochemical Prospecting*.
5. Krauskopf, K.B. (1967) *Introduction to Geochemistry*. McGraw-Hill Publishers, New York.
6. Fairbridge, R.W. (1972) *Encyclopedia of Geochemistry and Environmental Science*. John Wiley.

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 classificationand 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, Echinoides, 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 **:**

1. M.D. Brasier (1980). Microfossils. George Allen & Unwin, London, 193p.
2. G. Bignot (1985). Elements of Micropaleontology. Graham & Trotman, London, 212p.
3. E.N.K. Clarkson (1986). Invertebrate paleontology and evolution. George Allen & Unwin.
4. R.C. Moore, Lalicker & Fisher (1952). Invertebrate fossil. McGraw Hill Book Co., San Francisco.
5. D.M. Raup & Stanley (1985). Principles of paleontology. CBS Publ. & Distributors,

New Delhi.

6. C.A. Arnold (1947). An Introduction to paleontology. McGraw Hill Book Co., San Francisco.

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

8. Prothero, D.R. – Bibliography 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 1: Fundamentals of remote sensing: History of remote sensing technology – Remote sensing system – Electromagnetic radiation – Spectral properties of terrestrial objects – Analysis of spectral reflectance curves – Types of satellites – Image acquisition – Multi-spectral scanners – Remote sensing resolution – Introduction to thermal remote sensing – Introduction to microwave remote sensing and new satellite sensors – Remote sensing in landform and land use mapping, structural mapping, coastal and ocean studies – Global and Indian space missions.

Unit 2: Aerial photography: Introduction – Vertical and oblique photographs – Photoscale – Image displacement due to relief – Parallax in aerial photographs – Aerial photographic procedures – Camera and flight requirement – Flight planning – Filters – Compensation – Stereoscopy – Photomosaics. Photographical studies – Photo recognition elements and keys – Interpretation of lithology, structures and landforms from aerial photographs.

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 **:**

1. Asrar, G. (1989) *Theory and Applications of Optical Remote Sensing*. John Wiley & Sons, New York.
2. Curran, P.J. (1984) *Principles of Remote Sensing*. Longman Group Ltd.
3. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2007) *Remote Sensing and Image Interpretation.* Wiley India, 763.
4. Paul R. Wolf. (1986) *Elements of Photogrammetry*, McGraw-Hill Book company. 628.
5. Victor C. Miller and Calvin F. Miller (1961) *Photogeology*, McGraw-Hill Book company, 248.
6. Sabins, F.F. (1998) *Remote Sensing Principles and Interpretation*. W.H.Freeman & Co.
7. Agarwal, C.S. and P.K. Garg (2000) *Textbook on Remote Sensing In natural resources monitopring and management,* Wheeler Publishing, 196.
8. Mather, P.M. (1999) *Computer Processing of Remotely Sensed Images: An Introduction*. John Wiley & Sons, New York.
9. Burrough, P.A. and McDonnell, R.A. (1998) *Principles of Geographical Information Systems*, Oxford University Press.
10. Lo, C.P. and Albert K. W. Yeung (2007) *Concepts and Techniques of Geographic Information Systems,* Prentice-Hall of India Pvt. Ltd., 492.
11. Chandra, A.M. and Ghosh, S.K. (2009) Remote Sensing and Geographical Information system, Narosa Publishing House, 298.

II SEMESTER

EAS C 323	**Continuous Evaluation of the Project**	**All Faculty**

EAS C 324	**Dissertation**	**All Faculty**

EAS C 325	**Viva-voce**	**All Faculty**