



**APEGGA**

The Association of  
Professional Engineers, Geologists  
and Geophysicists of Alberta

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# **GEOPHYSICS**

## **SYLLABUS OF EXAMINATIONS**

### **2000 Edition**

#### **Introduction**

The regulations associated with the EGGP act require that a candidate have at least two years of post-secondary education in one or more of geology, physics, or mathematics before attempting any of the examinations in this syllabus. Each examination discussed in this syllabus covers a body of material that might normally be taught in a one-semester course at a Canadian University, but different university programs cover this material in different ways. Students could encounter parts of the material specified for an exam in different courses.

#### **FUNDAMENTAL EXAMINATIONS (*All 7 compulsory*)**

These examinations cover subjects normally taken in the first two years of a university course in physical sciences or engineering. They do not usually have university level pre-requisites.

#### **MATHEMATICS**

##### **00-GP-F1    Introductory Calculus**

Functions and graphs, differentiation and integration of simple functions, analytical geometry.

##### ***Prime Text***

*Single Variable Calculus*. James Stewart, February 2000, Brooks/Cole Publishing Company, ISBN: 0-534-37923-0

##### ***Supplementary Text***

*Schaum's Outline of Beginning Calculus*. Elliot Mendelson, February 1985, McGraw-Hill Companies, The, ISBN: 0-07-041465-3

##### **00-GP-F2    Linear Algebra**

Vector and matrix algebra, determinants, linear systems of equations, vector spaces, eigenvalues and eigenvectors. Applications.

##### ***Prime Text***

*Linear Algebra and its Applications*. Lay, David C., 1994, Addison-Wesley Publishing Co., ISBN 0-201-52031-1

##### ***Supplementary Text***

*Introduction to Linear Algebra*. Strang, Gilbert, 1993, Wellesley-Cambridge Press, ISBN 0-9614088-5-5

## PHYSICS

### **00-GP-F3     Introductory Physics I**

Fundamental concepts, definitions and physical laws. Vectors, kinematics and statics. Newton's laws, force, work and energy, conservation laws.

#### ***Prime Text***

*Physics for Scientist & Engineers, Vol. 3.* Raymond A. Serway, Robert J. Beicher, August 1999, Saunders College Publishing, ISBN: 0-03-026947-4

#### ***Supplementary Text***

*University Physics: Extended Edition.* Hugh D. Young, December 1999, Addison-Wesley Longman, Incorporated, ISBN: 0-201-60336-5

### **00-GP-F4     Introductory Physics II**

Applications of Newton's laws. Particle dynamics. Rotational Mechanics, Work and energy with variable forces. Fluid mechanics, kinetic and wave theory. First law of thermodynamics.

#### ***Prime Text***

*Physics for Scientist & Engineers, Vol. 3.* Raymond A. Serway, Robert J. Beicher, August 1999, Saunders College Publishing, ISBN: 0-03-026947-4

*University Physics: Extended Edition.* Hugh D. Young, December 1999, Addison-Wesley Longman, Incorporated, ISBN: 0-201-60336-5

## CHEMISTRY

### **00-GP-F5     General Chemistry I**

Atomic and molecular structure, stoichiometry in chemical reactions. Chemical bonding. Structures and reactions of organic and inorganic compounds. Materials science.

#### ***Prime Text***

*Chemistry,* Steven S. Zumdahl, December 1996, Houghton Mifflin Company (Trade Division), ISBN: 0-669-41794-7

#### ***Supplementary Text***

*Chemistry for Science & Engineering.* Breck W. Brown McCowan, October 1982, McGraw-Hill Companies, The, ISBN: 0-07-092372-8

### **00-GP-F6     General Chemistry II**

Gas laws. Kinetics and chemical equilibrium, acids and bases. Oxidation-reduction processes and electrochemistry. Elementary thermodynamics.

#### ***Prime Text***

*Chemistry.* Steven S. Zumdahl, December 1996, Houghton Mifflin Company (Trade Division), ISBN: 0-669-41794-7

***Supplementary Text***

*Chemistry for Science & Engineering*. Breck W. Brown McCowan, October 1982, McGraw-Hill Companies, The, ISBN: 0-07-092372-8

**00-GP-F7     Computing Science**

Application of programming techniques using a high level language for the manipulation of large data sets and the solution of problems in mathematics and physics.

***Prime Text***

*Introduction to Fortran 90 for Engineers and Scientists*. Larry Nyhoff and Sanford Leestma, Prentice-Hall (1996) 411 pages, ISBN 0135052157, paperback.

**CORE SUBJECTS (*Eleven examinations which consist of the 6 compulsory examinations in Section A and any 5 examinations from Section B*)**

With the exception of the geology courses, most core subjects require one or more fundamentals as prerequisites. They may appear after the first year of a Canadian University Course in science or engineering, but are more likely to be taken after the second year.

**SECTION A - 6 compulsory exams**

**MATHEMATICS**

**00-GP-C1     Differential Equations**

First and second order linear differential equations with applications. Series solutions about regular points and singular points.

***Prime Text***

*Single Variable Calculus*. James Stewart, February 2000, Brooks/Cole Publishing Company, ISBN: 0-534-37923-0

***Supplementary Text***

*Elementary Differential Equations*. Earl D. Rainville, Phillip E. Bedient, Richard Bedient, October 1996, Prentice Hall, ISBN: 0-13-508011-8

**00-GP-C2     Intermediate Calculus**

Differential and integral calculus to multiple integrals, with applications. Trigonometric, exponential and logarithmic functions and their inverses. Numerical integration, Taylor Series. Partial differentiation.

***Prime Text***

*Calculus: A Complete Course*. Robert A. Adams, January 1999, Addison-Wesley Longman, Incorporated, ISBN: 0-201-39607-6

***Supplementary Text***

*Calculus with Analytic Geometry*. John B. Fraleigh, July 1999, Addison-Wesley Longman, Incorporated, ISBN: 0-201-50363-8 (Chapters 1-11, 16)

## PHYSICS

### **00-GP-C3 Electricity and Magnetism**

Electrostatics, DC circuits, electric field, electric potential, Gauss's law, electromagnetic induction, capacitance. AC circuits. Electrical and magnetic properties of materials.

#### ***Prime Text***

*University Physics: Extended Edition.* Hugh D. Young, December 1999, Addison-Wesley Longman, Incorporated, ISBN: 0-201-60336-5

#### ***Supplementary Text***

*Physics for Scientist & Engineers, Vol. 3.* Raymond A. Serway, Robert J. Beicher, August 1999, Saunders College Publishing, ISBN: 0-03-026947-4

### **00-GP-C4 Vibrations, Waves and Optics**

Harmonic damped and forced oscillators. Geometrical optics, interference, waves, diffractions. Wave - equation.

#### ***Prime Text***

*Physics for Scientist & Engineers, (3<sup>rd</sup> edition).* Raymond A. Serway, Robert J. Beicher, August 1999, Saunders College Publishing, ISBN: 0-03-026947-4

#### ***Supplementary Text***

*Vibrations & Waves, French, November 1990.* Chapman & Hall Imprint: Chapman & Hall, ISBN: 0-412-38460-4

## GEOLOGY AND GEOPHYSICS

### **00-GP-C5 Physical Geology**

Composition and internal structure of the Earth. Surface and internal processes. Continents, oceans, rocks and minerals. Global tectonics and mountain building.

#### ***Prime Text***

*Understanding Earth.* Frank Press, July 1997, W. H. Freeman & Company, ISBN: 0-7167-3487-7

### **00-GP-C6 Physics of the Earth**

Figure of the earth, gravity, the geoid, geomagnetism, paleomagnetism, heat flow, radioactivity and geochronology. Earthquake seismology. Solar system, meteorites.

#### ***Prime Text***

*The Solid Earth, An Introduction to Global Geophysics.* Fowler, C.M.R., Cambridge University Press, 1990. ISBN 0521385903

#### ***Supplementary Text***

*Global Tectonics.* Philip Kearey, Frederick John Vine, August 1996, Blackwell Science, Incorporated, ISBN: 0-86542-924-3

*Fundamentals of Geophysics*. William Lowrie, October 1997, Cambridge University Press, ISBN: 0-521-46728-4

**SECTION B - Any 5 examinations from this section**

**MATHEMATICS**

**00-GP-C7 Probability and Statistics**

Concepts of probability, events and populations, probability theorems, concept of a random variable, continuous and discrete random variables, probability distributions, moments, skewness, kurtosis, estimation of moments, joint distributions, probability. Distribution of functions of a random variable, sampling and statistical estimation theory, hypotheses testing, simple regression analysis, introduction to the design of experiments.

***Prime Text***

*Introductory Statistics*. Jay Devore, Roxy L. Peck Contributor: Marshall (Editor), January 1994, West Publishing Company, College & School Division, ISBN: 0-314-02766-1

***Supplementary Text***

*Probability & Statistics for Engineers*. Irwin Miller, John E. Freund, Richard A. Johnson, December 1993, Prentice Hall, ISBN: 0-13-721408-1

**00-GP-C8 Integral Transform Methods and their Application**

Fourier and Laplace transforms and their applications in the physical sciences.

***Prime Text***

*Fast Fourier Transform & Applications*. E. Oran Brigham, March 1988, Prentice Hall, ISBN: 0-13-307505-2

***Supplementary Text***

*Boundary Value Problems*. David L. Powers, January 1999, Academic Press, Incorporated, ISBN: 0-12-563734-9

**00-GP-C9 Complex Variable Calculus**

Analytic functions, poles, residues, contour integration and its applications, and conformal mapping.

***Prime Text***

*Advanced Calculus for Applications*. Francis B. Hildebrand, February 1976, Prentice Hall, ISBN: 0-13-011189-9 (Chapters 10, 11)

***Supplementary Text***

*Complex Variables & Applications*. Ruel V. Churchill, James W. Brown, August 1989, McGraw-Hill Companies, The, ISBN: 0-07-010905-2

**00-GP-C10 Database Management, or Computer Graphics, or Computational Physics**

## **Database Management**

Concepts and structures for design and implementation. Data models, data normalization, data description languages, query facilities, data integrity and reliability, concurrency. File organization, including sequential, indexed and direct access, multiple key, indexed files and hashing. File processing, including records, files and compaction. Sorting, merging and updating files. Algorithms for inverted lists, multilist, indexed sequential and hierarchical structures.

### ***Prime Text***

*Database Systems Concept.* Henry F Korth, January 1991, McGraw-Hill Companies, The, ISBN: 0-07-044754-3

## **Computer Graphics**

Graphics hardware, including architecture and circuits. Vector and raster graphics systems. Input and output devices. Techniques for describing images, including point, vector and raster approaches. Image transformations, including scaling, translation, rotation, clipping and windowing. Graphics software and data structures.

### ***Prime Text***

*Computer Graphics in C: Principles & Practices.* James D Foley, July 1995, Addison-Wesley Longman, Incorporated, ISBN: 0-201-84840-6

## **Computational Physics**

Basic methods in computational physics including numerical algorithms applied to problems in nonlinear mechanics (chaotic dynamics, iterative maps, etc.), wave motion, electrodynamics, statistical physics, and quantum mechanics, parallel computing methods, writing programs and running simulation algorithms.

### ***Prime Text:***

*An Introduction to Computer Simulation Methods: Applications to Physical Systems.* Harvey Gould, Jan Tobochnik, August 1995, Addison-Wesley Longman, Incorporated, ISBN: 0-614-07737-0

## **PHYSICS**

### **00-GP-C11 Thermodynamics**

Thermodynamic states of simple systems; the fundamental relation of thermodynamics; the first and second laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; energy of state; compressibility charts and steam tables; calculation of property changes; enthalpy; Helmholtz and Gibbs function; the Maxwell equations; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, the Clapeyron equation Gibbs phase rule; gas-vapor mixtures, psychrometrics.

### ***Prime Text***

*Heat & Thermodynamics: An Intermediate Textbook.* Mark W Zemansky, Richard Dittman, November 1996, McGraw-Hill Companies, The, ISBN: 0-07-017059-2

### **00-GP-C12 Continuum Mechanics**

Stress and strain in continuous media; elasticity. Mechanics of fluid flow in two and three dimensions. Thermodynamics and mechanics of compressible and viscous flows. Turbulence and convection.

#### ***Prime Text***

*Mechanics of Deformable Media.* A B Bhatia, R N Singh, 1986, I O P Publishing, ISBN: 0-85274-500-1 (Chapters 1-8)

### **00-GP-C13 Optics and Lasers**

Review of waves and EM theory, the electromagnetic spectrum, interaction of light with matter and optical materials, Geometrical optics and aberrations, polarization, electro-optic modulators, diffraction, diffraction gratings, spot size and resolution of imaging systems, Fourier optics and image processing, laser fundamentals and examples of laser systems.

#### ***Prime Text:***

*Optics.* Eugene Hecht. July 1997, Addison-Wesley Longman, Incorporated, ISBN: 0-201-83887-7

#### ***Supplementary Text***

*Laser Fundamentals.* William T Silfvast, May 1996, Cambridge University Press, ISBN: 0-521-55617-1

### **00-GP-C14 Electromagnetic Theory**

Time varying electromagnetic fields up to Maxwell's Equations including topics such as induced fields. Gradient, divergence, curl. Boundary value problems in electrostatics and magnetostatics. Dielectric and magnetic properties of materials.

#### ***Prime Text***

*Classical Electromagnetic Radiation.* Jerry B Marion, November 1994, Harcourt College Publishers, ISBN: 0-03-097277-9

## **GEOLOGY AND GEOPHYSICS**

### **00-GP-C15 Historical Geology**

Methods of interpretation of the history of the Earth. Structural geology and application of plate tectonics. Global change. Paleontology, origin and evolution of life. Resource geology, principles of stratigraphy. Relative and radiometric age dating.

#### ***Prime Text***

*The Earth Through Time.* Harold L Levin, July 1998, Saunders College Publishing, ISBN: 0-03-023751-3

#### ***Supplementary Text***

*Evolution of the Earth.* Robert H Dott Jr., Donald R Prothero, January 1994, McGraw-Hill Companies, The, ISBN: 0-07-017803-8

### **00-GP-C16 Crystallography and Mineralogy**

Morphological crystallography. Crystal systems, rotation and inversion axes, crystal classes, Miller indices, axial ratios and stereonets. Determinative and descriptive mineralogy. Optical crystallography.

#### ***Prime Text***

*Crystallography: An Introduction for Earth Science (and Other Solid State) Students.* E J Whittaker, January 1981, Pergamon Press Reprint, ISBN: 0-08-023805-X

#### ***Supplementary Text***

*Introduction to Optical Mineralogy.* William D Nesse, February 1991, Oxford University Press, Incorporated, ISBN: 0-19-506024-5

### **00-GP-C17 Sedimentation and Stratigraphy**

Sedimentary processes, environments and facies. Properties and classification of sedimentary rocks. Stratigraphic nomenclature and the stratigraphic column. Stratigraphic relationships and interpretations.

#### ***Prime Text***

*Principles of Sedimentology & Stratigraphy.* Sam Boggs Jr, November 1994, Prentice Hall Imprint: Macmillan College, ISBN: 0-02-311792-3

### **00-GP-C18 Structural Geology**

Orientation, measurement, representation and geometric analysis of planar and linear geologic structures such as faults and folds; relation of faults to stress. Geologic maps and cross-sections. Descriptive geometry, stereographic and equal area projections. Mechanical principles involved in the deformation of rocks.

#### ***Prime Text***

*Structural Geology: An Introduction to Geometrical Techniques.* Donal M Ragan, January 1985, John Wiley & Sons, Incorporated, ISBN: 0-471-08043-8

### **00-GP-C19 Introduction to Applied Geophysics**

Reflection and refraction seismology, gravity and magnetics, and electrical and electromagnetic methods applied to exploration and environmental problems.

#### ***Prime Text***

*Introduction to Geophysical Exploration.* Philip Kearey, M Brooks, April 1991, Blackwell Science, Incorporated, ISBN: 0-632-02923-4

#### ***Supplementary Text***

*An Introduction to Applied & Environmental Geophysics.* John M Reynolds, August 1997, John Wiley & Sons, Incorporated, ISBN: 0-471-95555-8



**MAJOR OPTIONS** (*Seven examinations are required with at least 4 examinations from Section A and at least 2 from Section B*)

The major options define the geophysics content of the academic qualifications of a professional geophysicist. The subject matter here should be at the level of third or fourth year in science or engineering programs in most Canadian Universities. Major Options all require Fundamentals and or core subjects as prerequisites. In some cases these options may be taught as graduate courses in some Canadian Universities.

**SECTION A - At least 4 examinations from this section**

**00-GP-M1 Quantitative Seismology**

Theory of body and surface wave propagation, techniques in exploration seismology. Earthquake source mechanisms. Seismic attenuation.

***Prime Text***

*Exploration Seismology*. L P Geldart Robert E Sheriff, August 1995, Cambridge University Press, ISBN: 0-521-46826-4

***Supplementary Text***

*Reflection Seismology: A Tool for Energy Resource Exploration*. Kenneth H Waters, March 1992, Krieger Publishing Company, ISBN: 0-89464-712-1

**00-GP-M2 Digital Signal Processing**

Basics of geophysical data processing, convolution, correlation, z-transforms, basic spatial, time and frequency domain analysis.

***Prime Text***

*Seismic Data Processing*. Ozdogan Yilmaz, 1987, Society of Exploration Geophysicists, ISBN: 0-931830-40-0 (Chapters 1-3).

***Supplementary Text***

*Exploration Seismology*. L P Geldart, Robert E Sheriff, August 1995, Cambridge University Press, ISBN: 0-521-46826-4

**00-GP-M3 Principles of Applied Seismic Methods**

Introduction to refraction and reflection seismic methods applied to the exploration for resources and their use in engineering studies. Elasticity theory, seismic instrumentation, velocity surveys, near-surface corrections.

***Prime Text***

*Exploration Seismology*. L P Geldart, Robert E Sheriff, August 1995, Cambridge University Press, ISBN: 0-521-46826-4

***Supplementary Text***

*Fundamentals of Geophysics*. William Lowrie, October 1997, Cambridge University Press, ISBN: 0-521-46728-4

*Modern Global Seismology*. Thorne Lay, Terry C Wallace, May 1995, Academic Press, Incorporated, ISBN: 0-12-732870-X

*Introduction to Geophysical Exploration*. Keary, P. and Brooks, M. (2nd edition) Blackwell Scientific Publishing, 1991. ISBN 0632029234

**00-GP-M4 Principles of Applied Electrical and Electromagnetic Methods**

Electromagnetic, resistivity, induced polarization, and self-potential methods applied to problems in the search for metallic mineral deposits. Theory and application of Maxwell's equations. Direct and indirect methods of inversion.

***Prime Text***

*Applied Geophysics*. W M Telford, L P Geldart, Robert E Sheriff, October 1990, Cambridge University Press, ISBN: 0-521-33938-3

***Supplementary Text***

*Principles of Applied Geophysics*. D S Parasnis, December 1997, Chapman & Hall, ISBN: 0-412-64080-5.

**00-GP-M5 Principles of Applied Gravity and Magnetic Methods**

The nature of the magnetic and gravity fields of the Earth. Density, porosity, magnetic susceptibility. Gravity meters and magnetometers. Potential theory. Theory and applications of gravity and magnetic methods of geophysical exploration.

***Prime Text***

*Applied Geophysics*. W M Telford, L P Geldart, Robert E Sheriff, October 1990, Cambridge University Press, ISBN: 0-521-33938-3

***Supplementary Text***

*Principles of Applied Geophysics*. D S Parasnis, December 1997, Chapman & Hall, ISBN: 0-412-64080-5

**00-GP-M6 Advanced Global Geophysics or Global Geology**

**Global Geophysics**

Theory and research applications in gravitation, rotation and figure of the Earth, seismology and Earth structure, free oscillations of the Earth, seismic risk, geomagnetism and the core, paleomagnetism and continental drift. Thermal energy at plate boundaries and hot-spots. Mantle convection.

***Prime Text***

*Fundamentals of Geophysics*. William Lowrie, October 1997, Cambridge University Press, ISBN: 0-521-46728-4.

***Supplementary Text***

*The Solid Earth: An Introduction to Global Geophysics*. C M Fowler, June 1990, Cambridge University Press, ISBN: 0-521-38590-3

**Global Geology**

Global aspects of plate tectonics and regional geology through time. Application of fundamental stratigraphic and structural principles. Contributions of geophysics, geochemistry, experimental and theoretical petrology to the modern plate tectonic model. Analysis and of major structural provinces as they relate to plate interactions.

***Prime Text:***

*"Global Tectonics"*, by Kearey, P., and Vine, E.J., Blackwell Scientific, Publishing, 1990, ISBN 0632024240

***Supplementary Text***

*"The Evolving Continents"*, by Windley, B.F., (3rd ed.), J. Wiley and Sons (Toronto), 1995.

*"Plate Tectonics and Geomagnetic Reversals"*, by A. Cox, Freeman, 1973.

**00-GP-M7 Petroleum Geology**

Origin and distribution of petroleum. Geochemistry and maturation of organic matter; microbial and thermal degradation of hydrocarbons, conventional and unconventional source and reservoir rocks. Principles of primary and secondary migration. Diagenesis of carbonate and clastic reservoir rocks, with reference to seals and traps.

***Prime Text***

*Petroleum Geology*. F K North, December 1985, Routledge, ISBN: 0-04-553004-1

**00-GP-M8 Metallic Mineral deposits**

Processes of ore formation and concentration in association with all the major geological processes. Stratigraphic and structural control of ore deposits. Examples of the occurrence of the economically more important types of deposits in Canada and the world. Study of ores in polished and thin section. The application of chemical principles to the understanding of ore deposits; solution chemistry, phase equilibria, isotope geochemistry. Exploration for, and evaluation of metallic mineral deposits.

***Prime Text***

*Ore Microscopy & Ore Petrography*. James R Craig, David Vaughan, August 1994, John Wiley & Sons, Incorporated, ISBN: 0-471-55175-9

**00-GP-M9 Hydrogeology**

The occurrence of groundwater; rock properties that affect groundwater, quality of groundwater; geology of groundwater basins; procedures for surface and subsurface investigations. Hydrology of groundwater flow, derivation of Darcy's law from fundamental concepts of fluid mechanics, and its generalization to spatially varied flows. Permeability parameters and validity of Darcy's law in terms of Reynold's number.

***Prime Text***

*Applied Hydrogeology*. Charles W Fetter Jr, October 1993, Prentice Hall Imprint: Macmillan College, ISBN: 0-02-336490-4

***Supplementary Text***

*Groundwater*. R Allan Freeze, John A Cherry, February 1979, Prentice Hall, ISBN: 0-13-365312-9

**00-GP-M10 Physical Properties of Rocks/Engineering Geology**

Physical properties of minerals and rocks. Measurement methods and their relationship to geophysical surveys and interpretation. Engineering site surveys and exploration, geological aspects of a given site with regard to the engineering design of foundations, hydraulic structures and the stability of natural or man-made slopes and open cuts.

***Prime Text***

*Introduction to the Physics of Rocks*. Gueguen and Palciauskas, May 27, 1994, Princeton University Press; ISBN: 0691034524

**00-GP-M11 Well log analysis**

Petrophysics and modern well-logging methods. Theory and applications of measurements of physical properties of the formation near the well bore, types of well logging devices, interpretation and use of information in petroleum and natural gas engineering.

***Prime Text***

*Well Logging for Earth Scientists*. D V Ellis, November 1987, Prentice Hall, ISBN: 0-444-01180-3

***Supplementary Text***

*Well Logging for Physical Properties*. Joseph R Hearst (Editor) Philip H Nelson (Editor) F L Paillet (Editor), February 2000, John Wiley & Sons, Incorporated, ISBN: 0-471-96305-4

**00-GP-M12 Partial Differential Equations**

Orthogonal sets of functions. Numerical solution of partial differential equations. Classification of second order linear equations. Hyperbolic and parabolic equations, methods of descent.

***Prime Text***

*Partial Differential Equations of Applied Mathematics, Vol. 1*, Contributor: Erich Zauderer (Editor), July 1998, John Wiley & Sons, Incorporated, ISBN: 0-471-31516-8

***Supplementary Text***

*Boundary Value Problems*. David L Powers, January 1999, Academic Press, Incorporated, ISBN: 0-12-563734-9

**00-GP-M13 Solid State Physics**

Crystal structure. Classification of solids and their bonding. Elastic, electric and magnetic properties of solids. Lattice structure, Fermi surfaces.

***Prime Text***

*Introduction to Solid State Physics*. Kittel, August 1995, John Wiley & Sons, Incorporated, ISBN: 0-471-14286-7

***Supplementary Text***

*Elementary Solid State Physics*. M Ali Omar, December 1993, Addison-Wesley Longman, Incorporated, ISBN: 0-201-60733-6

**SECTION B - At least 2 examinations from this section**

**00-GP-M14 Geostatistics**

Same as 2000-Glgy-26

Analysis of quantitative geological data using digital computers, simple and multivariate statistical models (multiple regression, factor analysis and discriminant functions). Application of these methods to real and hypothetical geological situations.

***Prime Text***

*Numerical Geology. Rock, N.M.S. Lecture Notes in Earth Sciences, vol. 18*. Springer-Verlag, 1988. ISBN 0387500707

***Supplementary Text***

*Statistics and Data Analysis in Geology*. Davis, J.C. (2nd edition) John Wiley and Sons, 1986. (550 pp). ISBN 0471080799

**00-GP-M15 Advanced Signal Processing**

Advanced methods of data analysis in exploration and production geophysics including advanced filtering, migration, inversion and tomography.

***Prime Text***

*Seismic Data Processing*. Les Hatton, M Worthington J Makin, May 1986, Blackwell Science, Incorporated, ISBN: 0-632-01374-5

***Supplementary Text***

*Geophysical Data Analysis: Discrete Inverse Theory*. William Menke, August 1989, Academic Press, Incorporated, ISBN: 0-12-490921-3

*Geophysical Inverse Theory*. Robert L Parker, April 1994, Princeton University Press, ISBN: 0-691-03634-9.

*Inverse Problem Theory: Methods for Data Fitting & Model Parameter Estimation*. A Tarantola, April 1987, Elsevier Science, ISBN: 0-444-42765-1

**00-GP-M16 Advanced Seismic Methods**

Acquisition design of three-dimensional (3-D) seismic surveys; processing and interpretation of 3-D seismic data volumes. Multi-component seismic methods.

***Prime Text***

*Interpretation of Three-Dimensional Seismic Data.* Alistair R Brown, November 1999, American Association of Petroleum Geologists, ISBN: 0-89181-352-7

***Supplementary Text***

*Multi-component Seismology in Petroleum Exploration.* Robert H Tatham, M D McCormack, 1991, Society of Exploration Geophysicists, ISBN: 1-56080-051-8

**00-GP-M17 Advanced Seismic Interpretation**

Principles of seismic stratigraphy, and seismic sequence analysis, and structural interpretation of reflection seismic data, Depth conversion Methods.

***Prime Text***

*Interpretation of Three-Dimensional Seismic Data.* Alistair R Brown, November 1999, American Association of Petroleum Geologists, ISBN: 0-89181-352-7

***Supplementary Text***

*Seismic Stratigraphy.* Robert E Sheriff, 1980, Human Resources Development Corporation, ISBN: 0-934634-08-4

**00-GP-M18 Advanced Electrical and Electromagnetic Methods and Interpretation**

Advanced topics in electromagnetic, resistivity, induced polarization and self-potential methods. Advanced problems starting at Maxwell's Equations.

***Prime Text***

*Applied Geophysics.* W M Telford, L P Geldart, Robert E Sheriff, October 1990, Cambridge University Press, ISBN: 0-521-33938-3

***Supplementary Text***

*Electrical Methods in Geophysical Prospecting.* G V Keller, F C Frischknecht, 1966, Pergamon Press Reprint, ISBN: 0-08-011525-X

**00-GP-M19 Advanced Gravity and Magnetic Methods**

Advanced applications of gravity and magnetic methods of geophysical exploration. Filtering, upward and downward continuation techniques. Reduction to the pole. Modeling and inversion methods.

***Prime Text***

*Applied Geophysics.* Telford, W.M., Geldart, L.P., and Sheriff, R.E., Cambridge University Press, 1990. ISBN 0521326931

***Supplementary Text***

*Principles of Applied Geophysics.* Parasnis, D.S.

### **00-GP-M20 Reservoir Engineering**

Rock properties, rock-fluid interactions, flow through porous media, and material balance.

#### ***Prime Text***

*Applied Petroleum Reservoir Engineering*. Ronald E Terry, M F Hawkins, Benjamin C Craft, January 1991, Prentice Hall, ISBN: 0-13-039884-5 (pp. 1-53, 56-68, 210-272)

#### ***Supplementary Text***

*Fundamentals of Reservoir Engineering*. L P Dake, August 1979, Elsevier Science, ISBN: 0-444-41830-X

### **00-GP-M21 Geophysical Field Methods**

Field surveys and data collection techniques for seismic, gravity, magnetic, electromagnetic, electrical and radiometric methods. Surveys for elevation and position location. Field analysis of geophysical data. Instrumentation.

(There is no textbook for this course. No exam will be set by APEGGA but the candidate can qualify here with the geophysical field course included in most Canadian geophysics curricula.)

### **00-GP-M22 Isotope Geophysics**

Theory and systematics of radioactive decay, geochronology using K-Ar, Rb-Sr, U-Pb, Pb-Pb, Fission-track, C-14, U-series disequilibrium and Sm-Nd systems.

#### ***Prime Text***

*Principles of Isotope Geology*. Gunter Faure, September 1986, John Wiley & Sons, Incorporated, ISBN: 0-471-86412-9

### **00-GP-M23 Fluid Dynamics**

Flow of viscous and non-viscous fluids, dimensional methods in turbulence.

#### ***Prime Text***

*Fundamentals of Fluid Mechanics*. Philip M Gerhart, Richard J Gross, January 1985, Addison-Wesley Longman, Incorporated, ISBN: 0-201-11411-9

#### ***Supplementary Text***

*Mechanics of Deformable Media*. A B Bhatia, R N Singh, 1986, I O P Publishing, ISBN: 0-85274-500-1

### **00-GP-M24 Computer Controlled Instrumentation**

Data communications, including signals, modulation and reception. Performance of optimum and sub-optimum systems. Data transmission characteristics, including half/full duplex, asynchronous/synchronous, point-to-point/multidrop and character/bit oriented. Error detecting and correcting codes. Character sets and message communications. Local area networks, including bus, ring and tree topologies, protocols and hardware.

#### ***Prime Text***

*Data & Computer Communications*. William Stallings, September 1996, Prentice Hall Imprint: Macmillan College, ISBN: 0-02-415425-3

***Supplementary Text***

*Computer Networks*. Andrew S Tanenbaum, March 1996, Prentice Hall, ISBN: 0-13-349945-6

**00-GP-M25 Igneous Petrology**

Same as 2000-Glgy-3

Mineralogical and chemical classification of igneous rocks. Physics and chemistry of igneous rock formation.

***Prime Text***

*Igneous Petrology*. McBirney, A.R. (2nd edition) Jones and Bartlett, Boston MA. 1993. ISBN 0-86720-175-4

***Alternative Text***

*Igneous Petrology*. Hall, A. (2nd edition) Longman Group Ltd., Essex, England. 1996. ISBN 0-582-23080-2.

**00-GP-M26 Metamorphic Petrology**

Same as 2000-Glgy-5

Mineralogy and textures of metamorphic rocks. Concepts of metamorphic facies and facies series, and their pressure-temperature-composition interpretation.

***Prime Text***

*An Introduction to Metamorphic Petrology*. Yardley, B W Longman Scientific & Technical, England, 1989. ISBN 0470211962

***Alternative Text***

*Principles of Igneous & Metamorphic Petrology*. Philpotts, A.R., Prentice-Hall, 1990. ISBN 013691361X

***Supplementary Text***

*Metamorphic Petrology - Mineralogical, Field and Tectonic Aspects*. Turner, F.J. (2nd edition) McGraw Hill, 1981. ISBN 089116510X

**00-GP-M27 Advanced Sedimentology**

Same as 2000-Glgy-20

Processes of sedimentation: weathering, transportation, deposition and diagenesis; classification and description of the principal types of detrital and chemical sedimentary rocks.

***Prime Text***

*Fluvial Sedimentology*. Miall, A.D. (editor) Canadian Society of Petroleum Geologists, 1978. ISBN 0920230032

Recognition of Fluvial Deposition Systems & Their Resource Potential. Flores, R.M. and others (editors) Society of Economic Paleontologists & Mineralogists, Short Notes No. 19, 1985. ISBN 9995246007



***Supplementary Text***

*Origin of Sedimentary Rocks*. Blatt, H., Middleton, G.V., and Murray, R.C. (2nd edition) Prentice-Hall, Englewood Cliffs, N.J., 1980. (634 pp).

*Facies Models*. Walker, R.C. (Editor) (3rd edition) Geoscience Canada Reprint Series 1, 1992. ISBN 0919216498

**00-GP-M28 Advanced Structural Geology**

Same as 2000-Glgy-25

Structural features of complexly folded and faulted strata. Simple statistical analysis of structural data. Analysis of strains. Computer-based procedures for determining the geometry of faults and folds. Structural analysis in plutonic and metamorphic rocks.

***Prime Text***

*Analysis of Geological Structures*. Price, N.S. and Cosgrove, J.W. Cambridge University Press, 1990. ISBN 0521319587

*The Techniques of Modern Structural Geology (Vols 1 and 2)* Ramsay, T.J. and Huber M.I. Academic Press, 1983 and 1987. Vol 1 - 1983, Hardcover ISBN 0125769016, Paperback ISBN 0125769210. Vol 2 - 1987, Paperback ISBN 0125769229

**00-GP-M29 Fluid Flow in Porous Media**

Porosity, fluid saturation, permeability, interfacial tension, wettability, capillary pressure, effective and relative permeability, steady and unsteady state fluid flow.

***Prime Text***

*Fundamentals of Reservoir Engineering*. L P Dake, August 1979, Elsevier Science, ISBN: 0-444-41830-X

***Supplementary Text***

*Applied Petroleum Reservoir Engineering*. Ronald E Terry, M F Hawkins, Benjamin C Craft, January 1991, Prentice Hall, ISBN: 0-13-039884-5 (pp. 1-53, 56-68, 210-272)

**00-GP-M30 Geochemistry**

Chemical processes taking place in geologic settings with emphasis on the abundance relationships of the elements in the Earth's crust and the laws governing the migration and distribution of elements of the Earth. Application of geochemistry in the search for mineral deposits.

***Prime Text***

*Principles & Applications of Geochemistry: A Comprehensive Textbook for Geology Students*. Gunter Faure. December 1997, Prentice Hall, ISBN: 0-02-336450-5

**00-GP-M31 Numerical Modeling Methods**

Numerical modeling methods in geophysics, including finite difference and finite element techniques.

***Prime Text***

*Finite Element Analysis*. Burnett, D.S., Addison Wesley, 1987. ISBN 0201108062

**00-GP-M32 Remote Sensing**

Sensor principles and capabilities. Image analysis. Interpretation of geological structure and landforms.

***Prime Text***

*Remote Sensing: Models and Methods for Image Processing*. Schowengerdt, Robert A., July 1997, (2<sup>nd</sup> edition) Academic Press. ISBN: 0126289816

***Supplementary Text***

*Remote Sensing Digital Image Analysis: An Introduction*. Jia, Xiuping, Richards, John A., Gessner, W., (Editor), Ricken D.E., (Editor). June 1999, (3<sup>rd</sup> edition). Springer Verlag; ISBN 3540648607

*Introductory Digital Image Processing: A Remote Sensing Perspective* Jensen, John R., January 2000, Prentice Hall, ISBN: 0-13-489733-1

**Revised: June 2003**