

ENGINEERS AND GEOSCIENTISTS BRITISH COLUMBIA
2018 GEOLOGICAL ENGINEERING SYLLABUS
 For Self-Evaluation

Name: George Rockwell User ID: _____

For directions, refer to the [Instructions for Completing Syllabus and Course Descriptions](#). Please save as a PDF document and upload via your applicant portal.

Exam Number	Exam Name	Applicant's Self-Evaluation – Course Equivalent Code	Page Number Reference	For Office Use Only Notes
Basic Studies (6 Required)				
04-BS-1	Mathematics	Mathematics 211		Full Credit- <u>No Credit</u> Comments The APEGA course equivalents would require you to take three courses just for this.
04-BS-2	Probability and Statistics	Statistics 327		<u>Full Credit</u> -No Credit Comments On APEGA course equivalents list.
04-BS-3	Statics and Dynamics	Engineering 202		Full Credit <u>No Credit</u> Comments Good on statics (APEGA course equivalent).
04-BS-6	Mechanics of Materials	Engineering 317		<u>Full Credit</u> <u>No Credit</u> Comments On APEGA course equivalents list.

04-BS-7	Mechanics of Fluids	Engineering Chemistry 331		<u>Full Credit</u>	No Credit
				Comments On APEGA course equivalents list.	
04-BS-14	Geology			<u>Full Credit</u>	No Credit
				Comments They can't deny our candidate this one.	
Basic Studies (2 Required)					
04-BS-5	Advanced Mathematics			Full Credit	No Credit
				Comments	
04-BS-10	Thermodynamics	Engineering Thermodynamics 311		<u>Full Credit</u>	No Credit
				Comments On APEGA course equivalents list.	
04-BS-11	Properties of Materials			Full Credit	No Credit
				Comments	
04-BS-12	Organic Chemistry			Full Credit	No Credit
				Comments	
04-BS-15	Engineering Graphics and Design Process			Full Credit	No Credit
				Comments	

Group A (7 required)

18-Geol-A1	Mineralogy & Petrology	Geology 313 Geology 333		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list.	
18-Geol-A2	Hydrogeology	Geology 401		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list.	
18-Geol-A3	Sedimentation & Stratigraphy	Geology 381		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list.	
18-Geol-A4	Structural Geology	Geology 343 Geology 445		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list. Just needed one but applicant has both	
18-Geol-A5	Rock Mechanics	Geology 571		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list.	
18-Geol-A6	Soil Mechanics			<u>Full Credit</u>	<u>No Credit</u>
				Comments Our applicant never got around to this topic so a nice add to their toolbox.	
18-Geol-A7	Applied Geophysics	Geophysics 351		<u>Full Credit</u>	<u>No Credit</u>
				Comments On APEGA course equivalents list.	

Group B (3 Required)

18-Geol-B1	Contaminant Hydrogeology			Full Credit	No Credit
				Comments	
18-Geol-B2	Terrain Analysis			Full Credit	No Credit
				Comments	
18-Geol-B3	Site Investigation	Geology 441		Full Credit	No Credit
				Comments On APEGA course equivalents list.	
18-Geol-B4	Geomorphology & Pleistocene Geology	Geology 353		Full Credit	No Credit
				Comments On APEGA course equivalents list.	
18-Geol-B5	Environmental Geology			Full Credit	No Credit
				Comments	

18-Geol-B6	Resource Geology <u>ONE</u> of 18-Geol-B6-1 – Petroleum Deposits or 18-Geol-B6-2 – Coal Deposits or 18-Geol-B6-3 – Metallic & Industrial Mineral Deposits	Geology 577		<u>Full Credit</u>	<u>No Credit</u> Comments On APEGA course equivalents list for 18- GEOL-B6-1.
18-Geol-B7	Petroleum Development			Full Credit	No Credit Comments
18-Geol-B8	Resource Economics & Valuation			Full Credit	No Credit Comments
18-Geol-B9	Exploration & Mining Geology			Full Credit	No Credit Comments

18-Geol-10	Geophysical Exploration Methods <u>ONE</u> of 18-Geol-B10-1 – Gravity & Magnetic Fields or 18-Geol-B10-2 – Electrical Methods or 18-Geol-B10-3 – Exploration Seismology			Full Credit	No Credit
Comments					
Complementary Studies (All Required)					
11-CS-1	Engineering Economics			Full Credit	<u>No Credit</u>
Comments Filthy money! You won't likely find this in your science degree.					
11-CS-2	Engineering in Society – Health and Safety			Full Credit	No Credit
Comments					
11-CS-3	Sustainability, Engineering and the Environment	Geography 254		Full Credit	No Credit
Comments Geography 254 covers much of the same ground. Maybe you get credit.					
11-CS-4	Engineering Management			Full Credit	No Credit
Comments					

INTRODUCTION

The Canadian Engineering Qualifications Board of Engineers Canada issues the Examination Syllabus that includes a continually increasing number of engineering disciplines.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Geological Engineering examinations consists of ten, three-hour examination papers. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidates' discipline may be assigned at the discretion of the constituent association.

Before writing the discipline examinations, candidates must have passed, or have been exempted from, the Basic Studies Examinations.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be supplied by the constituent association.

GEOLOGICAL ENGINEERING EXAMINATIONS GROUP A

COMPULSORY EXAMINATIONS (SEVEN REQUIRED)

18-Geol-A1 Mineralogy and Petrology

Introduction to crystallography and crystal chemistry. Physical and chemical properties of minerals in hand specimens. Identification of minerals and rocks with the petrographic microscope. Field and laboratory classification of igneous and metamorphic rocks. The nature of magmas and processes of magmatic differentiation. Metamorphic facies concepts. Interpretation of mineral assemblages of igneous and metamorphic rocks in the light of the phase rule and phase relations of relevant mineral assemblages. Textural and physical properties of rocks relevant to engineering problems.

18-Geol-A2 Hydrogeology

Hydrologic cycle: precipitation, evaporation, transpiration, deep and shallow groundwater circulation. Physics of flow through porous media. Hydraulic conductivity and groundwater storage. Occurrence, transmissivity and storage characteristics of surficial and bedrock aquifers. Groundwater exploration methods: geophysics, remote sensing, mapping, borehole investigations. Groundwater flow patterns: recharge, discharge, flow net construction and analysis. Aquifer development and management. Control of pore pressures and groundwater flow in geotechnical engineering.

18-Geol-A3 Sedimentation and Stratigraphy

Classification of sedimentary rocks, processes of weathering, erosion, sedimentation and diagenesis. Formation of carbonate, clastic and chemical precipitate rocks. Principles of stratigraphic and paleontological correlation; sedimentary facies: geological and practical significance. Distribution of major Precambrian and Phanerozoic systems. Facies associations; modern and ancient sedimentary

environments. The engineering properties and behaviour of sedimentary rocks and the use of stratigraphic principles in the solution of engineering problems.

18-Geol-A4 Structural Geology

Stress and strain. Brittle and ductile rock deformation behaviour. Fabric analysis of deformed rocks. Structural features of stable and mobile parts of the crust. Fold and fault development. Mountain building and orogenies. Theories in geotectonics. Methods of structural analysis. Field mapping and graphical data processing; maps, cross-sections, block diagrams, structure contour maps, stereographic projections, equal area nets, and strain indicators. Kinematic and dynamic interpretation. The application of structural geology to the solution of engineering problems.

18-Geol-A5 Rock Mechanics

Engineering properties and classification of intact rocks. Rock mass properties and classification. Laboratory and in-situ testing of rock. In-situ stresses and stress measurement techniques. Stability analysis of rock slopes and excavations. Rock excavation techniques. Design of excavations, slopes, tunnels and shafts. Rock reinforcement and support. Groundwater considerations in rock engineering.

18-Geol-A6 Soil Mechanics

Rock weathering and development of soils. Engineering classification of soils. Soil physical properties: porosity, density, capillarity, permeability. Shear strength, consolidation and settlement. Normally and over consolidated soils. In-situ stresses in soil masses. Lateral earth pressures. Mechanics, stability and analysis of soil slopes. Pore water pressure, seepage pressure, groundwater considerations in soil engineering.

18-Geol-A7 Applied Geophysics

Basic principles, interpretation, and limitations of geophysical methods applied to the exploration for coal, oil and natural gas, minerals, groundwater, and for geotechnical studies of the surface and subsurface. Introduction to electrical, electromagnetic, and magnetotelluric surveys; magnetic and gravity surveys; seismic reflection and refraction surveys; radiometric methods. Introduction to geophysical well logging techniques. Case histories of applications to engineering problems.

GROUP B**ELECTIVE EXAMINATIONS (THREE REQUIRED)****18-Geol-B1 Contaminant Hydrogeology**

Groundwater geochemistry, isotopes in groundwater. Movement of dissolved species. Diffusion and dispersion regimes. Classification of contaminants. Organic contaminants, introduction to multiphase flow, LNAPLs and DNAPLs. Assessment, control and remediation of contaminants. Waste management. Deep well disposal.

18-Geol-B2 Terrain Analysis

Elements of photogrammetry. Interpretation of aerial photos – recognition elements (tone, pattern, texture, size and shape, occupance). Identification of structures and terrain features. Glacial, fluvial, coastal, and permafrost landforms – identification and engineering characteristics. LANDSAT imagery. Operation, characteristics, and uses of thermal infrared and RADAR remote sensing.

18-Geol-B3 Site Investigation

Uses and sources of geological and geotechnical information. Methods of site investigation: trial pits, boreholes, sampling, laboratory and in-situ testing, geophysical methods. In-situ instrumentation and post construction monitoring: measurement of stress, deformation and settlement, pore pressures, permeability, groundwater contamination. Design of site investigations and monitoring schemes.

18-Geol-B4 Geomorphology and Pleistocene Geology

Basic geomorphological concepts: formation and composition of landforms, geomorphologic cycles. Weathering and soils. Mass wasting. Fluvial processes and landforms. Coastal processes and landforms. Glacial geomorphology and landforms. Frozen-ground phenomena. Karst geomorphology. Physical geology of Canada. Quaternary geology of selected areas of Canada. Influence of geomorphology on human activity.

18-Geol-B5 Environmental Geology

Geological hazards, volcanoes, landslides, earthquakes, subsidence, floods, erosion. Preparation of hazard maps. Return period concepts and risk assessment. Environmental considerations for landfills, deep cavern and deep well disposal of wastes. Mining reclamation. Acid rock drainage. Control of sediment and dissolved contaminants. Preservation and restoration of soils, landscaping and contour restoration, revegetation and erosion control. Preparation of environmental impact statements. Laws and procedures pertaining to environmental assessments.

18-Geol-B6 Resource Geology

Select **ONE** from:

18-Geol-B6-1 Petroleum Deposits

Physical properties, geochemistry, origin, migration, accumulation, and history of oil and natural gas, and their associated waters. Geological conditions of oil and gas entrapment. Structural and

stratigraphic factors controlling the distribution of reservoir rocks, porosity, permeability and fluid saturations. Environmental problems associated with the development of hydrocarbons.

18-Geol-B6-2 Coal Deposits

Coal depositional environments and their significance. Nature, origin, diagenesis, metamorphism, and classification of organic sediments. Rank, physical, and petrological properties of coal. Glacial and tectonic deformation effects on rank and seam dimensions. Trace element geochemistry of coal. Stratigraphic and geographic occurrence of Canadian (and world) coals. Properties of environmental and mining significance.

18-Geol-B6-3 Metallic and Industrial Mineral Deposits

Nature, mode of occurrence and processes of formation of metallic and industrial minerals including minerals deposited from magmas, high-temperature vapours and aqueous solutions; formed by evaporation or precipitation in surface waters; formed by mechanical accumulation or accumulated by residual weathering. Processes of element/mineral migration and concentration. Stratigraphic and structural controls on occurrence. Solution geochemistry and isotopic characteristics of ore bearing fluids and ore deposits. Illustrative case histories for important deposits of sulphides, oxides, native elements, silicates, and ionic salts.

18-Geol-B7 Petroleum Development

Drilling equipment, controls and techniques. Circulation systems and well completions. Drilling problems associated with overpressure, underpressure, permafrost, evaporites, sour-gas, loss of circulation. Reservoir fluid phase behaviour. Material balance equations. Porosity and permeability characteristics of reservoirs. Steady and transient flow of oil, water and gas through porous media. Well stimulation. Capillary pressure and multiphase flow. Segregated and diffuse flow regimes. Oil and gas well testing and analysis. Natural drive mechanisms. Secondary and tertiary oil recovery. Introduction to history matching and numerical simulators. Conventional and geostatistical methods of oil and gas reserve estimation.

18-Geol-B8 Resource Economics & Valuation

Growth of mining and petroleum industries. Estimation of future demands. Significance of the resource sector in the Canadian economy. Prices, exchanges and futures markets. Types and grades of concentrates, smelter charges and returns. Properties, specifications and markets for industrial rocks and minerals. Relative value of hydrocarbon fractions. Evaluation of mining and oil prospects; mining and oil law, taxes and tariffs, labour, transportation, technical factors, property acquisition and claims, development methods, production estimates. Evaluation of geological engineering and commercial aspects of developed properties. Feasibility reports. Costs: access; transportation; mining; milling; well-development, well stimulation; primary, secondary and tertiary recovery. Capital costs, amortization and depreciation, rate-of-return on investment calculations.

18-Geol-B9 Exploration & Mining Geology

Planning and execution of exploration programs. Sampling methods. Legal aspects of exploration in Canada. Principles of geochemistry in mineral exploration. Field analytical techniques. Primary and secondary dispersion patterns, weathering, soil formation. Anomalies in residual and transported overburden, stream waters, stream sediments, vegetation. Factors affecting relative mobility of

elements. Background values, threshold values, orientation surveys. Application, planning and interpretation of geophysical surveys. Planning surface drilling programs. Logging, sampling, analysis and interpretation of drill core data. Mineralogical study of ore and recommendations for beneficiation. Introduction to mining methods, equipment selection, layout, environmental logistics during life of mine and at closure, and integration of these with a clear understanding of their compatibility with the geological and geotechnical parameters of the site materials. Mapping and sampling underground. Planning subsurface drilling programs. Structural interpretation and analysis of underground drilling. Quality control aspects of mining and milling. Conventional and geostatistical methods of ore-deposit reserve estimation.

18-Geol-B10 Geophysical Exploration Methods

Select ONE from:

18-Geol-B10-1 Gravity and Magnetic Fields

Theory and quantitative interpretation of the gravity and magnetic fields in geophysical exploration. Interpretation of regional gravity and magnetic maps. Identification of local anomalies. Data acquisition and data reduction for gravimeters and magnetometers. Design and conduct of field surveys. Potential field, Fourier, forward modeling and inversion methods in data interpretation and analysis.

18-Geol-B10-2 Electrical Methods

Theory and quantitative interpretation of electrical, electromagnetic and magnetotelluric data in geophysical exploration. Electrical properties of rocks. Self-potential, induced polarization, electromagnetic induction and magnetotelluric methods. Operation of field instrumentation, data reduction. Design and conduct of field surveys. Potential field, forward modeling and inversion methods for data interpretation.

18-Geol-B10-3 Exploration Seismology

Theory of elasticity and elastic properties of rock. Wave propagation in elastic media. Interaction of waves with boundaries. Body-wave seismology. Surface waves. Earthquake source studies. Artificial energy sources. Refraction and reflection methods. Theory of operation and selection of seismometers. Design and conduct of field refraction and reflection surveys. Fundamentals of digital processing: static corrections, velocity analysis and corrections, Fourier analysis and filtering, stacking, migration. Interpretation of refraction and reflection seismograms.

NOTE: Please feel free to use the most recent edition of textbooks referenced in this list
NOTA : Utilisez l'édition la plus récente des manuels cités dans cette liste.

18-Geol-A1 Mineralogy and Petrology

Raymond, L.A., Petrology, The study of igneous, sedimentary, and metamorphic rocks. 2nd Ed., McGraw Hill, 2002.

Perkins, D. and K. Henke, Minerals in Thin Section. 2nd Ed. Prentice Hall, 2004.

MacKenzie, W.S. and A.E. Adams, A Color Atlas of Rocks and Minerals in thin Section. J. Wiley, 1994.

Nesse, William D., Introduction to Optical Mineralogy. Oxford University Press, 2003.

Philpotts, Anthony R., Petrography of Igneous and Metamorphic Rocks. Prentice Hall, 2003.

Klein, C., Dutrow, B., The Manual of Mineral Science (after James D. Dana), 23rd Ed., John Wiley and Sons, New York, 20082.

Blatt, H. and R.J. Tracy, Petrology: Igneous, Sedimentary and Metamorphic. 2nd Ed., W.H. Freeman and Co., 1996.

Prinz, Martin, George E. Harlow, and Joseph Peters, eds. Simon and Schuster's Guide to rocks and minerals, Simon & Schuster, 1978.

18-Geol-A2 Hydrogeology

Freeze, R. Allan, and John A. Cherry, Groundwater, 604 pp. (1979). Online at:
<http://hydrogeologistswithoutborders.org/wordpress/textbook-project/>

Schwartz, F.W., and H. Zhang, Fundamentals of Ground Water, Wiley, 2003.

Domenico, P.A., and F.W. Schwartz, Physical and Chemical Hydrogeology. 2nd Ed., Wiley, 1998.

18-Geol-A3 Sedimentation and Stratigraphy

Boggs, S., Principles of Sedimentology and Stratigraphy. 3rd Ed., Prentice Hall, New York, 2001.

18-Geol-A4 Structural Geology

Fossen, Haakon, Structural geology, Cambridge University Press, 2016.

van der Pluijm, Ben A., and Stephen Marshak, Earth Structure: An Introduction to Structural Geology and Tectonics. New York, W.W. Norton, 2004.

Davis, G.H., and S.J. Reynolds, Structural Geology of Rocks and Regions. 2nd Ed., New York, John Wiley and Sons, Inc., 1996.

18-Geol-A5 Rock Mechanics

Hoek, Evert and John Bray, Rock Slope Engineering. London: Institution of Mining and Metallurgy, 1981.

Hoek, Evert and Edwin T. Brown, Underground Excavations in Rock. London: Institution of Mining and Metallurgy, 1982.

18-Geol-A6 Soil Mechanics

Coduto, D.P., Component: Geotechnical Engineering: Principles and Practices. Prentice Hall, NJ, 1999.

Lambe, T.W., Soil Testing for Engineers. BiTech Publishers, Vancouver, 1991.

18-Geol-A7 Applied Geophysics

Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, 1997. Reynolds, J.M., An Introduction to Applied and Environmental Geophysics. Wiley, 1997.

Kearey, P., M. Brooks and I. Hill, An Introduction to Geophysical Exploration. 3rd Ed., Blackwell Science, 2002.

18-Geol-B1 Contaminant Hydrogeology

Fetter, C.W., Contaminant Hydrogeology. 2nd Ed., MacMillan Publishing Co., New York, 1999.

Bedient, Philip B., Hanadi S. Rifai, and Charles J. Newell, Ground Water Contamination: Transport and Remediation, 2nd edition. Upper Saddle River, NJ: Prentice Hall, 1999. <https://www.amazon.ca/Ground-Water-Contamination-Transport-Remediation/dp/0130138401>.

Council, National Research, Contaminants in the Subsurface: Source Zone Assessment and Remediation, 2004. <https://www.nap.edu/catalog/11146/contaminants-in-the-subsurface-source-zone-assessment-and-remediation>.

Domenico, P.A., and F.W. Schwartz, Physical and Chemical Hydrogeology. 2nd Ed., Wiley, 1998.

18-Geol-B2 Terrain Analysis

Mollard, J.D. and J.R. Janes, Airphoto Interpretation and the Canadian Landscape. Energy, Mines and Resources Canada, 1984. ISBN 0-660-11591-3

Required Materials for Examination:

– 1 pocket stereoscope + plates from Mollard and Janes (1984) p. 187-399 only.

18-Geol-B3 Site Investigation

Hunt, Roy E., Geotechnical engineering investigation handbook, CRC Press, 2005.

Hunt, Roy E., Geologic hazards: a field guide for geotechnical engineers, CRC Press, 2007. Canadian

Geotechnical Society, Canadian Foundation Engineering Manual. 3rd Ed. Canadian Geotechnical Society, Technical Committee on Foundations, BiTech Publishers Ltd., Richmond, British Columbia, 1992.

Nielsen, David M., (ed.). Practical Handbook of Ground-Water Monitoring. Lewis Publishers Inc., Chelsea, Michigan, 1991.

18-Geol-B4 Geomorphology and Pleistocene Geology

Easterbrook, D.J., Surface Processes and Landforms. 2nd Ed., Prentice-Hall, 1999.

Trenhaile, AS, Geomorphology: A Canadian Perspective. Oxford University Press, 1998. ISBN 0-19-541277-X

Fulton, RJ, (ed.), Quaternary Geology of Canada and Greenland. Geological Survey of Canada, 1989. ISBN 0-660-13114-5 (Any one section of Part I (Sect. 1-5), and Part II: Sect. 11, 12.)

18-Geol-B5 Environmental Geology

Keller, Edward A. (2011) Environmental Geology (9th ed.) Pearson.

Merritts D, Menking K, and DeWet A (2014) Environmental Geology: An Earth Systems Approach (2nd ed.) Macmillan.

18-Geol-B6 Resource Geology

Select ONE from:

18-Geol-B6-1 Petroleum Deposits

Gluyas, J.G. and R.E Swarbrick, Petroleum Geoscience. Blackwell, 2004.

Hunt, J.M., Petroleum Geochemistry and Geology. 2nd Edition, Freeman, New York, 1996.

18-Geol-B6-2 Coal Deposits

Not available at this time.

18-Geol-B6-3 Metallic and Industrial Mineral Deposits

Evans, Anthony M., Ore Geology and Industrial Minerals - An Introduction. 3rd Ed., Blackwell Science, Oxford, UK, 1993.

18-Geol-B7 Petroleum Development

Dake, L.P., The Practice of Reservoir Engineering. Elsevier, 1994.

18-Geol-B8 Resource Economics & Valuation

Gentry, D.W. and T.J. O'Neill, Mine Investment Analysis. Society of Mining Engineers, American Institute of Mining, Metallurgical, and Petroleum Engineers, New York, 1984.

Rudenno, V., The Mining Valuation Handbook. Wrightbooks, Australia, 1998.

18-Geol-B9 Exploration & Mining Geology

Evans, Anthony M., Ore Geology and Industrial Minerals - An Introduction. 3rd Ed., Blackwell Science, Oxford, UK, 1993.

Evans, Anthony M., and William L. Barrett, Introduction to Mineral Exploration. Blackwell Publications, UK, 1995.

Peters, W.C., Exploration and Mining Geology. 2nd Ed., John Wiley & Sons, Inc, 1987.

18-Geol-B10 *Geophysical Exploration Methods*

Select **ONE** from:

18-Geol-B10-1 *Gravity and Magnetic Fields*

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

Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, 1997.

18-Geol-B10-2 *Electrical Methods*

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

Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, 1997.

18-Geol-B10-3 *Exploration Seismology*

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

Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, 1997.