FACULTY OF SCIENCE

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Dean

Abrahams, M., B.Sc.(Hons.) *Western*, M.Sc. *Queen's*, Ph.D. *Simon Fraser*; Professor of Biology; Joint appointment with the Department of Ocean Sciences

Associate Dean (Administration and Undergraduate)

Foster, A., B.Sc. *Dalhousie*, M.Math *Waterloo*, Ph.D. *Dalhousie*; Motivational Teaching Award, 2001; Associate Professor of Mathematics and Statistics

Associate Dean (Research)

Zedel, L., B.Sc., M.Sc. *Victoria*, Ph.D. *University of British Columbia*; Petro-Canada Young Innovator Award, 2001; Associate Professor of Physics and Physical Oceanography

Senior Administrative Officer

Rideout, J., B.Comm.(Co-op)(Hons.) *Memorial*

Department of Biochemistry

www.mun.ca/biochem

Head

Berry, M.D., B.Sc.(Hons.) *Sunderland*, Ph.D. *Saskatchewan*; Professor

Professor Emeritus

Keough, K.M.W., B.Sc.(Hons.), M.Sc., Ph.D. *Toronto*

Professors

Bertolo, R.F.P., B.A.Sc.(Hons.) *McMaster*, M.Sc., Ph.D. *Guelph*
Booth, V.K., B.Sc.(Hons.) *Victoria*, M.Sc. *Waterloo*, Ph.D. *Toronto*; Canada Research Chair in Proteomics; Deputy Head (Undergraduate); Cross appointment with Department of Physics and Physical Oceanography
Brosnan, J.T., B.Sc.(Hons.), M.Sc., D.Sc. *National University of Ireland*, D.Phil. *Oxford*; University Research Professor, Awarded 1990; Recipient of the John Lewis Paton Distinguished University Professorship, 2014-2015; Cross appointment with Faculty of Medicine
Brosnan, M.E., B.A.(Hons.), M.Sc., Ph.D. *Toronto*; Cross appointment with Faculty of Medicine
Cheema, S.K., B.Sc. *Punjab*, M.Sc. *Punjab Agricultural*, Ph.D. *Post Graduate Institute of Medical Education and Research*; Deputy Head (Graduate Studies); Cross appointment with Faculty of Medicine
Davis, P.J., B.Sc., Ph.D. *Memorial*
Heeley, D.H., B.Sc.(Hons.), Ph.D. *Birmingham*
Herzberg, G.R., B.S., Ph.D. *Maine*
McGowan, R.A., B.Sc.(Hons.) *Brock,* Ph.D. *SUNY, Buffalo*; Joint appointment with Department of Biology
Mulligan, M.E., B.Sc.(Hons.) *National University of Ireland*, Ph.D. *Harvard*; Recipient of the President's Award for Distinguished Teaching, 1999
Robinson, J.J., B.Sc.(Hons.) *University College Dublin*, M.Sc. *Trinity College Dublin*, Ph.D. *Alberta*
Shahidi, F., B.Sc. *Shiraz*, Ph.D. *McGill*, University Research Professor, Awarded 1998; Cross appointment with Departments of Biology and Ocean Sciences
Volkoff, H., B.Sc. *Pierre and Marie Curie University*, M.Sc. *University of Aix-Marseille III,* Ph.D. *Clemson University*; Joint appointment with Department of Biology

Associate Professors

Brown, R.J., B.Sc.(Hons.), Ph.D. *Ottawa*
Brunton, J.A., B.A.Sc. *Guelph*, Ph.D. *McMaster*
Christian, S.L., B.Sc.(Hons.) *Alberta*, Ph.D. *University of British Columbia*; Cross appointment with Faculty of Medicine
Nag, K., B.Sc.(Hons.), M.Sc. (Part I) *Calcutta*, M.Sc., Ph.D. *Memorial*
Randell, E.W., B.Sc.(Hons.), Ph.D. *Memorial*; Cross appointment from Faculty of Medicine

Assistant Professor

Mailloux, R.J., B.Sc., Ph.D *Laurentian*

Adjunct Professors

Banoub, J., B.Sc.(Hons.) *Alexandria*, Ph.D. *Montreal*
Bromley-Brits, K., B.Sc.(Hons.) *Memorial*, Ph.D. *University of British Columbia*
Dave, D., B.Eng. *Gujarat University*, M.Eng. *S.V. Patel University*, Ph.D. *Indian Institute of Technology*

Communal Research and Instrumentation Grouping Supervisor

Skinner, C.T.

Senior Technician, Student Laboratory

Codner, H.M.

Department of Biology

www.mun.ca/biology

Head

Marino, P., B.A. *Vermont*, M.Sc. *Northern Arizona*, Ph.D. *Alberta*

Professores Emeriti

Burton, D., B.Sc. *Wales*, P.G.C.E., Ph.D. *London*
Burton, M., B.Sc., Ph.D. *London*
Haedrich, R.L., A.B., A.M., Ph.D. *Harvard*; University Research Professor, Awarded 1999
Khan, R.A., B.S.A., M.Sc., Ph.D. *Toronto*
Patel, T.R., B.Sc., M.S. *Baroda*, M.A., Ph.D. *Texas*

Honorary Research Professors

Collins, M.A.J., B.Sc., Cert. Ed., M.Sc. *Southampton*, B.Ed., M.Ed. *Memorial*, Ph.D. *Keele*; Recipient of the President's Award for Distinguished Teaching, 1996-1997)
Dickinson, A., B.Sc. *University of London*, B.Ed., M.Sc. *Memorial*, M.A. *University of Leeds*, M.Phil., Ph.D. *Cambridge*
Green, J.M., B.Sc. *Michigan*, M.Sc. *Miami*, Ph.D. *University of British Columbia*

Academic Director of Memorial University of Newfoundland Botanical Garden

Goodyear, N., B.Sc.(Hons.) *McGill*, M.Sc., Ph.D. *Guelph*

Professors

Abrahams, M., B.Sc.(Hons.) *Western*, M.Sc. *Queen's*, Ph.D. *Simon Fraser*; Dean of Science
Carr, S.M., B.Sc. *California Polytechnic*, C.Phil., Ph.D. *University of California, Berkeley*; Cross appointment to Faculty of Medicine
Edinger, E., B.A. *California*, M.Sc., Ph.D. *McMaster*; Joint appointment with Department of Geography
Hermanutz, L., B.Sc. *Guelph*, M.Sc. *Windsor*, Ph.D. *Western Ontario*; Cross appointment with Botanical Garden
Igamberdiev, A.U., Dr.Sci. *Russian Acad. Sciences*, Ph.D., M.S. *Voronezh*
Innes, D.J., B.Sc.(Hons.) *University of British Columbia*, M.Sc. *Dalhousie*, Ph.D. *S.U.N.Y. Stony Brook*
Jones, I.L. B.Sc. *Carleton*, M.Sc. *Toronto*, Ph.D. *Queen's*
McGowan, R.A., B.Sc.(Hons.) *Brock,* Ph.D. SUNY/AB; Joint appointment with Department of Biochemistry
Miller, E.H., B.Sc. *Alberta*, M.Sc. *Canterbury*, Ph.D. *Dalhousie*
Snelgrove, P., B.Sc.(Hons.) *Memorial*, M.Sc. *McGill*, Ph.D. *Woods Hole*; Joint appointment with Ocean Sciences Centre
Staveley, B.E., B.Sc., M.Sc. *Guelph*, Ph.D. *Alberta*
Volkoff, H., B.Sc. *Pierre et Marie Curie University*, M.Sc. *University of Aix-Marseille III*, Ph.D. *Clemson University*; Joint appointment with Department of Biochemistry

Associate Professors

Bignell, D., B.Sc.(Hons.) *Manitoba*, Ph.D. *Alberta*
Chapman, T.W., B.Sc.(Hons.), M.Sc. *Guelph*, Ph.D. *Simon Fraser*
Dufour, S., B.Sc.(Hons.), M.Sc. *Universite de Moncton*, Ph.D. *University California San Diego*
Lang, A.S., B.Sc.(Hons.) *Brock*, Ph.D. *University of British Columbia*
Marshall, H.D., B.Sc.(Hons.) *Memorial*, Ph.D. *Toronto*
Murrin, F., B.Sc.(Hons.) *Memorial*, M.Sc. *Acadia*, Ph.D. *Queen's*
Peña-Castillo, L., B.Sc. *ITESM-Veracruz, Mexico*, M.Sc. *Alberta*, Ph.D. *Otto-von-Guericke, Magdeburg*; Joint appointment with Department of Computer Science
Purchase, C.F., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Toronto*
Tahlan, K., B.Sc. *Kurukshetra University*, Ph.D. *Alberta*
Wiersma, Y.F., B.Sc.(Hons.), B.Ed. *Toronto*, M.Sc., Ph.D. *Guelph*

Assistant Professors

Hurford, A., B.Sc. *Fairfield*, M.Sc. *Alberta*, Ph.D. *Queen's*
Leroux, S.J., B.A., M.Sc. *Alberta*, Ph.D. *McGill*
Roncal, J., B.Sc. *Universidad Peruana Cayetano Heredia, Lima, Peru*, Ph.D. *Florida International University*
Vander Wal, E., HBSc., M.Sc. *Lakehead University,* Ph.D. *University of Saskatchewan*

Adjunct Professors

Brattey, J., B.Sc.(Hons.) *Glasgow*, Ph.D. *Liverpool*
Bykova, N.V., B.Sc., M.Sc., Ph.D. *Voronezh State Univ. Russia*
Debnath, S., B.Sc.Ag.(Hons.), M.Sc.Ag. *Bangladesh Agric. Univ.*, Ph.D. *India Agric. Res. Inst*.
Dixon, P.L., B.Sc. *Memorial*, M.Sc. *Guelph*, Ph.D. *Edinburgh*
Gilkinson, K., B.Sc. *Ottawa*, M.Sc., Ph.D. *Memorial*
Gregory, R.S., B.Sc.(Hons.) *Acadia*, M.Sc. *Trent*, Ph.D. *University of British Columbia*
Hamoutene, D., B.Sc. *Houari Boumediene Univ. & Marine Sciences & Coastal Management Institute (ISMAL)*, M.Sc., Ph.D. *Aix-Marseille II Univ.*
Hicks, B., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Edinburgh*
Hillier, K., B.Sc.(Hons), Ph.D. *Memorial*
Jewell, L., B.Sc.(Hons.), M.Sc. *Ottawa*, Ph.D. *Guelph*
Lewis, K., B.Sc. *University of California, Davis*, M.Sc., Ph.D. *Memorial*
McKenzie, D., B.S.A., M.Sc. *University of Manitoba,* Ph.D. *Texas A & M University*
Robertson, G.J., B.Sc. *Queens*, Ph.D. *Simon Fraser*
Stenson, G.B., B.Sc. *Alberta*, Ph.D. *University of British Columbia*
Whitney, H.G., B.Sc. *McGill*, M.Sc. *Saskatchewan*, Ph.D. *Montréal*

Cross Appointments

Cadigan, N., B.Sc.(Hons), M.Sc. *Memorial*, Ph.D. *University of Waterloo*; Cross appointment from Fisheries and Marine Institute
Clement, M., B.Sc.(Hons.) *Moncton*, M.Sc. *University of New Brunswick*; Ph.D. *Guelph*; Cross appointment from Fisheries and Marine Institute
Fleming, I.A., B.Sc. *Queen's*, M.Sc. *Simon Fraser*, Ph.D. *Toronto*; Cross appointment from Ocean Sciences Centre
Gagnon, P., B.Sc., Ph.D. *Laval University*; Cross appointment from Ocean Sciences Centre
Gamperl, A.K., B.Sc.(Hons.), M.Sc. *Guelph*, Ph.D. *Dalhousie*; Cross appointment from Ocean Sciences Centre
McGaw, I.J., B.Sc.(Hons.), Ph.D., *Wales-Bangor*; Cross appointment from Ocean Sciences Centre
Mercier, A., B.Sc. *Université de Sherbrooke*, M.Sc., Ph.D. *Université du Québec á Rimouski*; Cross appointment from Ocean Sciences Centre
Montevecchi, W., B.Sc. *Northeastern*, M.Sc. *Tulane*, Ph.D. *Rutgers*; Cross appointment from Department of Psychology
Parrish, C.C., B.Sc. *Wales*, Ph.D. *Dalhousie*; Recipient of the President's Award for Outstanding Research, 1995-1996; University Research Professor, Awarded 2013; Cross appointments with the Department of Chemistry and from the Oceans Sciences Centre
Rise, M.L., B.Sc. *Whitworth College*, M.Sc. *Boston College*, Ph.D. *Victoria*; Cross appointment from Ocean Sciences Centre
Robert, D., B.Sc., Ph.D. *Universite Laval*; Cross appointment from Fisheries and Marine Institute
Rowe, S, B.Sc.(Hons.), M.Sc., *Memorial*, Ph.D. *Dalhousie*; Cross appointment from Fisheries and Marine Institute
Schneider, D.C., B.Sc. *Duke*, Ph.D. *SUNY, Stony Brook*; Associate Dean (Research); Professor; Cross appointment from Ocean Sciences Centre; Cross appointment with Department of Psychology; Recipient of the President's Award for Outstanding Graduate Student Supervision, 2012-2013
Shahidi, F., B.Sc. *Shiraz*, Ph.D. *McGill*; Cross appointment from Department of Biochemistry
Storey, A.E., B.Sc.(Hons.), M.A. *Manitoba*, Ph.D. *Rutgers*; Cross appointment from Department of Psychology
Wilson, D., B.Sc.(Hons.), M.Sc. *Manitoba*, Ph.D. *Macquarie University*; Cross appointment from Department of Psychology
Wroblewski, J.S., B.Sc. *Illinois*, M.Sc., Ph.D. *Florida State*; Professor (Research); Cross appointment from Ocean Sciences Centre

Administrative Officer

Kenny, A.J., B.A. *Memorial*

Supervisor of Laboratories

Darby-King, A.

Department of Chemistry

www.mun.ca/chem

Head

Fridgen, T.D., B.Sc.(Hons.) *Trent*, B.Ed., Ph.D. *Queen's*, Pofessor

Professores Emeriti

Gogan, N.J., B.Sc.(Hons.), Ph.D. *National University of Ireland, Dublin*, F.C.I.C.
Lucas, C.R., B.Sc., M.Sc. *Acadia*, D.Phil. *Oxon*, F.C.I.C.
Machin, W.D., B.Sc. *Carleton*, Ph.D. *Rensselaer*
Thompson, L.K., B.Sc., Ph.D. *Manchester*, F.C.I.C.; University Research Professor, Awarded 1995

Honorary Research Professors

Georghiou, P.E., B.Sc.(Hons.) *Witwatersrand*, Ph.D. *McGill*, F.C.I.C.
Helleur, R.J., B.Sc. *Concordia*, M.Sc. *McGill*, Ph.D. *Queen's*; Safety Coordinator

Professors

Bodwell, G.J., B.Sc., M.Sc. *Victoria*, Dr.rer.nat. *Tech. Univ. Braunschweig*; Deputy Head (Graduate Studies and Research); Recipient of the President's Award for Outstanding Research, 1998-1999; Winner of the 2011 Distinguished Scholar Medal; University Research Professor, Awarded 2013
Bottaro, C.S., B.Sc.(Hons.) *St. Mary's*, Ph.D. *Dalhousie*
Kerton, F.M., B.Sc.(Hons.) *Univ of Kent*, D.Phil. *Univ of Sussex*; Recipient of the 2016 Distinguished Scholar Medal
Merschrod, E., A.B. *Bryn Mawr Coll.,* M.S., Ph.D. *Cornell*
Mezey, P.G., M.Sc., M.Sc., Ph.D. *Budapest*, D. Sc. *Saskatchewan*
Pansare, S.V., B.Sc., M.Sc., *Univ. Pune (India),* Ph.D. *Alberta*
Pickup, P.G., B.A., D.Phil. *Oxon*; University Research Professor, Awarded 2005
Poirier, R.A., B.Sc., M.Sc. *Laurentian*, Ph.D. *Toronto*, F.C.I.C.; Recipient of the President's Award for Outstanding Research, 1986-1987; University Research Professor, Awarded 2012
Zhao, Y., B.S., M.S. *Dalian*, Ph.D. *Alberta*

Associate Professors

Flinn, C.G., B.Sc., M.Sc., Ph.D. *Dalhousie*; Deputy Head (Undergraduate Studies)
Kozak, C.M., B.Sc.(Hons.) *McMaster*, Ph.D. *UBC*
Thompson, D.W., B.Sc.(Hons.), M.Sc. *Queen's*, Ph.D. *York*

Assistant Professors

Katz, M.J., B.Sc., Ph.D. *Simon Fraser University*
Rowley, C.N., B.Sc.(Hons) *Carleton*, Ph.D. *Ottawa*; Recipient of the President's Award for Outstanding Research, 2016-2017
Young, C.J.L., B.Sc.(Hons.), Ph.D. *Toronto*

Assistant Professors (term)

Hattenhauer, K.M., B.Sc. *Winnipeg*, Ph.D. *Manitoba*; First Year Coordinator
Warburton, P., B.Sc. (Hons.), M.Sc., Ph.D. *University of Saskatchewan*

Cross Appointments

Alisaraie, L., B.Sc. *Sharif University of Technology*, M.Sc. *Chemistry & Chemical Engineering Research Centre of Iran*, Dr.rer.nat. *Paderborn*; Cross appointment from School of Pharmacy
Parrish, C.C., B.Sc. *Wales,* Ph.D *Dalhousie;* Recipient of the President's Award for Outstanding Research 1995-1996; Professor (Research); University Research Professor, Awarded 2013; Cross appointment with the Department of Biology and from the Ocean Sciences Centre
Poduska, K., B.A. *Carleton College*, Ph.D. *Cornell*; Cross appointment from Department of Physics and Physical Oceanography

Adjunct Professors

Banoub, J.H., B.Sc.(Hons.) *University of Alexandria, Egypt*, Ph.D. *University of Montreal*
De Silva, A., B.Sc. *Carleton*, M.Sc. *McGill*. Ph.D. *Toronto*
MacQuarrie, S., B.Sc. *Mount Allison*, Ph.D. *Virginia Polytechnic Institute and State University*
Pearson, J., B.Sc. *Cape Breton*, Ph.D *Dalhousie*
Schneider, C., B.Sc.(Hons), M.Sc. *Universite de Nancy I (France)*, Ph.D. *Keele University*

Undergraduate Laboratory Supervisor

Vanasse, N.

Department of Computer Science

www.mun.ca/computerscience

Head

Gong, M., B.Eng. *H.E.U.*, M.Sc. *Tsinghua*, Ph.D. *Alberta*; Professor

Professors

Banzhaf, W., Dipl. Phys. *Ludwig-Maximilian,* Munich, Dr.rer.nat *Fidericiana,* Karlsruhe; University Research Professor, Awarded 2010 (on leave)
Bartha, M., M.Sc., Ph.D. *József Attila University, Hungary*
Lu, S., B.Eng. *Peking*, M.Sc., Ph.D. *Waterloo*
Miminis, G., Dipl. Greek Center of Productivity, B.Sc. *Univ. of Ioannina (Greece)*, M.Sc., Ph.D. *McGill*
Tang, J., M.Sc. *Iowa*, Ph.D. *Penn. State*
Vidyasankar, K., M.Tech. *I.I.T. Kanpur*, Ph.D. *Waterloo*
Wang, C.A., B.A. *Peking*, M.Sc., Ph.D. *Alberta*
Wareham, H.T., B.Sc.(Hons.), B.A., M.Sc. *Memorial*, Ph.D. *Victoria*
Zuberek, W., M.Sc., Ph.D., D.Sc. *Warsaw Tech*.

Associate Professors

Brown, E., B.Sc.(Hons.), *Memorial*, M.Sc., Ph.D. *Toronto*, LL.B. *Victoria*
Bungay, S., B.Sc., M.Sc. *Memorial*, Ph.D. *Guelph*
Byrne, R., B.Sc.(Hons.), B.Eng. *Memorial*, M.Sc., Ph.D. *Victoria*
Chen, Y.P., B.Sc. *Beijing*, Ph.D. *Simon Fraser*
Deb, A., M.Tech. *Calcutta*, Ph.D. *Iowa*
Fiech, A., Dipl. Inf. *Dortmund*, Ph.D. *Kansas State*
Kolokolova, A., B.Sc.(Hons.) *Arizona*, M.Sc., Ph.D. *Toronto*
Mata-Montero, M., B.Sc. *Costa Rica*, M.Sc. *Illinois*, Ph.D. *Victoria*
Peña-Castillo, L., B.Sc. *ITESM, Veracruz, Mexico*, M.Sc. *Alberta*, Ph.D. *Otto-von-Guericke, Magdeburg*; Joint appointment with Department of Biology
Shieh, J., B.Sc. *Beijing*, M.Sc., Ph.D. *Simon Fraser*
Vardy, A., B.Eng. *Memorial*, M.Sc. *Sussex*, Ph.D. *Carleton*; Joint appointment with Electrical and Computer Engineering, Faculty of Engineering and Applied Science

Assistant Professors

Churchill, D., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Alberta*
Hu, T., B.Sc., M.Sc. *Wuhan*, Ph.D. *Memorial*

Adjunct Professor

van Rooij, I., M.S.c. *Radboud University Nijmegen*, Ph.D. *Victoria*

Lecturers

Batten, D.L., B.Sc.(Hons.) *Memorial*, M.Sc. *Queen's*
Gupta, R., B.A. *Agra Univ.*, B.A. *Memorial*, M.S. *Georgia Tech.*

Cross Appointments

Carr, S.M., B.Sc. *California Polytechnic*, C.Phil, Ph.D. *University of California*; Cross appointment from Department of Biology
Devillers, R., B.Sc.(Eq.) *Lyon 1*, M.Sc. *UQAM*, M.Sc. *Laval*, Ph.D. *Laval/Marne la Vallée*; Cross appointment from Department of Geography
Evermann, J., Dipl.Wirt.Inf. *Muenster*, Ph.D. *University of British Columbia*; Cross appointment from Faculty of Business Administration
Farrell, G., M.D. *Memorial*; Cross appointment from Discipline of Family Medicine, Faculty of Medicine
Meruvia-Pastor, O., B.Eng. *ITESM, Monterrey*, M.Sc. *Alberta*, Dr. Eng. *Otto-von-Guericke, Magdeburg*; Cross appointment from Faculty of Science
Norvell, T.S., B.Sc.(Hons.) *Dalhousie*, M.Sc., Ph.D. *Toronto*; Cross appointment from Faculty of Engineering and Applied Science
Parsons, J., B.Comm.(Hons.) *Memorial*, Ph.D. *University of British Columbia*; Cross appointment from Faculty of Business Administration
Peters, D.K., B.Eng. *Memorial*, M.Eng., Ph.D. *McMaster*, P.Eng.; Cross appointment from Faculty of Engineering and Applied Science
Pike, D., B.Math. *Waterloo*, MAM, Ph.D. *Auburn*, FTICA; Cross appointment from Department of Mathematics and Statistics
Samet, S., M.Sc., Ph.D. *Ottawa*; Cross appointment from Faculty of Medicine
Shalaby, N.A.I., M.A. *York*, Ph.D. *McMaster*; Cross appointment from Department of Mathematics and Statistics
Usefi, H., B.Sc. *AmirKabir*, M.Sc. *IASBS*, Ph.D. *Western Ontario*; Cross appointment from Department of Mathematics and Statistics

Systems Manager

Rayment, M., B.Sc. *Memorial*, MS *M.I.U.*

Systems Personnel

Casey, A., B.Sc *Memorial*
Draskóy, A., B.Sc., B.A. *Memorial*
Flynn, R.
Greening, L., B.Sc. *Memorial*
Price, P., B.Sc. *Memorial*
Wissink, M., B.Sc. *University of New Brunswick*

Laboratory Instructor

Johnstone, S., B.Sc. *Memorial*

Instructional Assistants

Anthony, S., B.Sc. *Memorial*
Milley, C., B.Sc. *Memorial*
Verbree-Barnes, I., B.Sc. *Memorial*

Department of Earth Sciences

www.mun.ca/earthsciences

Head

Hanchar, J.M., B.S. *Memphis*, M.S. *Vanderbilt*, Ph.D. *Rensselar Polytechnic Institute*, P.Geo.

Professores Emeriti

Hall, J., B.A. *Oxon*, DIC *London*, Ph.D. *Glasgow*, F.G.C., P.Geo.; University Research Professor, Awarded 2003
Hiscott, R.N., B.Sc.(Hons.) *Brock*, Ph.D. *McMaster*, P.Geo.
Hodych, J.P., M.A., Ph.D. *Toronto*
Longerich, H., B.Sc. *Millikin*, Ph.D. *Indiana*
Rochester, M.G., B.A., M.A. *Toronto*, Ph.D. *Utah*, F.R.S.C.; University Research Professor, Awarded 1986

Honorary Research Professor

Rivers, C.J.S., B.Sc. *Belfast*, Ph.D. *Ottawa*

Professors

Aksu, A.E., B.Sc. *Ege*, M.Sc., Ph.D. *Dalhousie*; University Research Professor, Awarded 2009
Azmy, K., B.Sc.(Hons.) *Ain Shams*, M.Sc. *Windsor*, Ph.D. *Ottawa*
Burden, E.T., B.Sc.(Hons.), M.Sc. *Toronto*, Ph.D. *Calgary*, P.Geo.
Dunning, G.R., B.Sc.(Hons.), M.Sc. *Carleton*, Ph.D. *Memorial*; Recipient of the President's Award for Outstanding Research, 1994-1995
Indares, A., B.Sc. *Grenoble*, M.Sc., Ph.D. *Montreal*
Jenner, G.A., B.Sc.(Hons.), M.Sc. *Western Ontario*, Ph.D. *Tasmania*, P.Geo.
Johansen, T., BaSc., M.Sc., Ph.D. *Oslo*; Canada Research Chair in Reservoir Engineering; Cross appointment with Faculty of Engineering and Applied Science
Kachanoski, G., B.Sc.(Hons.), M.Sc. *University of Saskatchewan*, Ph.D. *University of California (Davis);* President and Vice-Chancellor
McIlroy, D., B.Sc.(Hons.) *Manchester*, D.Phil. *Oxford*
Piercey, S.J., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *University of British Columbia*, P.Geo; Recipient of the President's Award for Outstanding Research, 2015
Slawinski, M.A., B.Sc., M.Sc., Ph.D. *Calgary*
Wilton, D.H.C., B.Sc. *Memorial*, M.Sc. *University of British Columbia*, Ph.D. *Memorial*, P.Geo.
Ziegler, S., B.Sc.(Hons.) *Massachusetts*, Ph.D. *Texas*

Associate Professors

Calon, T.J., M.Sc., Ph.D. *Leiden*
Cheng, T., B.E. *Tsinghua University*, M.C.E., Ph.D. *Delaware*
Farquharson, C.G., B.Sc.(Hons.) *Edinburgh*, Ph.D. *University of British Columbia*
Hurich, C., B.Sc., M.Sc., Ph.D. *Wyoming*
Layne, G.D., B.Sc.(Hons.), Ph.D. *Toronto*, P.Geo.
Leitch, A.M., B.Sc.(Hons.), Ph.D. *Australian National*
Malcolm, A.E. B.Sc.(Hons.) *University of British Columbia*, Ph.D. *Colorado School of Mines*; NSERC-Chevron Industrial Research Chair in Reservoir Characterization
Mason, R.A., B.Sc.(Hons.) *London*, Ph.D. *Aberdeen*
Morrill, P. B.Sc.(Hons.), Ph.D. *Toronto*

Assistant Professors

Beranek, L.P., B.S. *Wisconsin-Eau Claire*, M.S. *Idaho State*, Ph.D. *University of British Columbia*
Jamieson, J.W., B.Sc.(Hons.) *Alberta*, M.Sc. *Maryland*, Ph.D. *Ottawa*; Canada Research Chair in Marine Geology
Welford, J.K., B.Sc.(Hons.) *McGill*, M.Sc., Ph.D. *British Columbia*; P.Geo.

Adjunct Professor

Taylor, R., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Unversity of Amsterdam*

Manager of Academic Programs

Miskell, M., B.Sc.(Hons.) *Memorial*

Research Computing Specialist
Smith, D., B.A., B.Sc.(Hons.) *Memorial*

Laboratory Coordinator and Instructor
Hicks, R., M.Sc. *Dalhousie*

Department of Mathematics and Statistics

www.mun.ca/math

Head
Radford, C., B.Sc., Ph.D. *Sydney*

Professores Emeriti
Booth, P.I., B.Sc., M.Sc., Ph.D., *Hull*; Winner of the Dean of Science Distinguished Scholar Medal, 1996
Brunner, H., M.A., Ph.D., E.T.H. *Zurich*; University Research Professor, Awarded 1994; Canadian Mathematical Society's David Borwein Distinguished Career Award, Awarded 2008
Goodaire, E.G., B.Sc., Toronto, Ph.D., University of British Columbia
Heath, P.R., B.Sc., Ph.D. *Hull*, DBS *Durham*, MTS *Queen's*
Shawyer, B.L.R., B.Sc., Ph.D. *St. Andrews*

Mathematics

Professors
Bahturin, Y., D.Sc., Ph.D. *Moscow*; University Research Professor, Awarded 2002
Booth, I., B.Sc. *Memorial,* M.Sc., Ph.D. *Waterloo*; Cross appointment to Department of Physics and Physical Oceanography
Haynes, R.D., B.Sc. *Memorial*, M.Sc., Ph.D. *Simon Fraser*
Kocabiyik, S., B.Sc., M.Sc. *Middle East Tech.*, Ph.D. *Western Ontario*; Petro-Canada Young Innovators Award, 2000
MacLachlan, S., B.Sc.(Hons.) *University of British Columbia*, Ph. D. *Colorada at Boulder*
Merkli, M., Diploma in Theoretical Physics, *EPF Lausanne*, Ph.D. *Toronto*; Recipient of the President's Award for Outstanding Research 2010-2011
Ou, C.H., B.A. *Peking*, Ph.D. *Hong Kong*
Pike, D., B.Math. *Waterloo*, MAM, Ph.D., *Auburn*, FTICA; Cross appointment to Department of Computer Science
Shalaby, N.A.I., M.A. *York*, Ph.D. *McMaster*; Cross appointed to Department of Computer Science
Summers, D., B.Sc., Ph.D. *London*, F.I.M.A. (U.K.), FRSC; University Research Professor, Awarded 2000
Xiao, J., M.Sc. *Hunan*, Ph.D. *Peking*; University Research Professor, Awarded 2011
Yuan, Y., B.Sc. *Wuhan*, M.Sc. *Central South Univ. of Tech.*, Ph.D. *Western Ontario*; UFA 2004
Zhao, X., B.S., M.S. *Northwest*, Ph.D. *Academia Sinica*; University Research Professor, Awarded 2008
Zhou, Y., B.Sc. *Hunan Normal*, M.Sc. *Beijing Normal*, Ph.D. *University of British Columbia*

Associate Professors
Alam, J., B.Sc., M. Sc. *Chittagong*, M.Sc., *Alberta*, Ph.D., *McMaster*
Baird, T.J., B.Sc. *Queen's*, Ph.D. *Toronto*
Dyer, T.D., B.Sc.(Hon.) *Memorial*, M.Sc., Ph.D. *Simon Fraser*; Recipient of the President's Award for Distinguished Teaching, 2016
Foster, A., B.Sc., Ph.D. *Dalhousie*, M.Math *Waterloo*; Associate Dean (Administration and Undergraduate)
Kondratieva, M., M.Sc. *Moscow Inst. of Electronics & Math*, Ph.D. *Tomsk State*; Joint appointment with Faculty of Education
Kotchetov, M., M.Sc. *Moscow State (Lomonosov)*, Ph.D. *Memorial*, Cand. Sc. *Moscow State*
Mantyka, S., B.A., M.B.A. *Sask.*, M.Math., Ph.D. *Waterloo*
Suvak, J.A., B.S. *St. Martin's College*, M.S., Ph.D. *Arizona*
Usefi, H., B.Sc. *AmirKabir*, M.Sc. *IASBS*, Ph.D. *Western Ontario*; Cross appointed with Department of Computer Science
Ye, D., B.Sc. *Shandong*, M.Sc. *Zhejiang*, Ph.D. *Case Western Reserve*

Assistant Professors
Bhilo, A., M.Sc., Ph.D. *University Vienna*
Cox, G., B.Sc.(Hons.) *Victoria*, M.A., Ph.D. *Duke*
Hurford, A., B.Sc. *Fairfield*, M.Sc. *Alberta*, Ph.D. *Queen's*; Joint appointment with Department of Biology
Kunduri, H., B.Sc.(Hons.) *Toronto*, M.Math., Ph.D. *Cambridge*
Martinez-Pedroza, E., Dipl. Math. *Los Andes*, M.Sc., Ph.D. *Oklahoma*
Sommerhäuser, Y., Diploma, Ph.D. *Ludwig-Maximilians-Universität Munich*

Visiting Assistant Professor
Sullivan, S.P., B.Sc., Ph.D. *Memorial*

Cross Appointments
Finnis, J., B.Sc. *Guelph*, Ph.D. *Colorado*; Cross appointed from Department of Geography
Howell, J., B.Sc., M.Sc. *Memorial*, Ph.D. *Victoria*; Cross appointed from Grenfell College

Adjunct Professors
Burgess, A., B.A.(Hons.), M.Sc. *Memorial*, Ph.D. *Ottawa*
Ginosar, Y., D.Sc. *Technion, Haifa, Israel*
Morgan, D., B.Sc., M.Sc. *Memorial*, Ph.D. *Alberta*
Tang, R., B.S.c., M.Sc., Ph.D. *Wuhan*

Laboratory Instructor
O'Rielly, G., B.Sc. *Memorial*

Statistics

Professors
Fan, Z., B.Sc., M.Sc. *Shandong*, Ph.D. *Gottingen*
Loredo-Osti, J.C., B.Sc., M.Sc. *Universidad Autonoma*, Ph.D. *Dalhousie*, Graduate Officer

Associate Professors
Oyet, A., B.Sc., M.Sc. *Fed. U. of Tech.*, Ph.D. *Alberta*
Variyath, A., B.Sc., *Calicut*, M.Sc. *Kerala Agricultural*, Post Graduate Diploma *Indian Statistical Institute*, Ph.D. *Waterloo*
Wang, H., B.Sc. *Beijing Normal*, Ph.D. *Regina*

Assistant Professors
Abarin, T., B.Sc., M.Sc. *Shiraz*, Ph.D. *Manitoba*
Cigsar, C., B.Sc., M.Sc. *Middle East Technical University*, Ph.D. *Waterloo*
Yilmaz, Y., B.Sc., M.Sc.(Statistics) *Middle East Technical University*, Ph.D. *Waterloo*; Joint and Cross appointments with Genetics and Medicine

Cross Appointments
Cadigan, N., B.Sc., MAS *Memorial*, Ph.D. *Waterloo*; Cross appointment from Marine Institute
Gadag, V., B.Sc., M.Sc. *Karnatak*, M.Phil., Ph.D. *Poona*; Professor of Biostatistics, Cross appointment from Department of Health Statistics and Health Information Systems
Yi, Y., B.Sc., *Hunan Normal*, M.Sc., *Changsha College*, M.Sc., Ph.D. *Manitoba*; Assistant Professor of Biostatistics; Cross appointment from Division of Community Health and Humanities

Department of Ocean Sciences

www.mun.ca/osc

Head
Fletcher, G.L., B.Sc. *University of British Columbia,* Ph.D. *California*; Professor Emeritus

Professors
Abrahams, M., B.Sc. *Western*, M.Sc. *Queen's*, Ph.D. *Simon Fraser*; Dean of Science
Driedzic, W.R., B.Sc. *York*, M.Sc. *Toronto*, Ph.D. *University of British Columbia*; Tier I Canada Research Chair in Marine Bioscience; Cross appointment with Department of Biology
Fleming, I.A., B.Sc. *Queen's,* M.Sc. *Simon Fraser Univ.*, Ph.D. *Univ. of Toronto*; Cross appointment with Department of Biology
Gamperl, A.K., B.Sc., M.Sc. *Guelph*, Ph.D. *Dalhousie*; Cross appointment with Department of Biology; Graduate Officer
Mercier, A., B.Sc. *Sherbrooke*, M.Sc., Ph.D. *Québec á Rimouski*; Cross appointment with Department of Biology; Academic Program Officer and Deputy Head
Parrish, C.C., B.Sc. *Wales,* Ph.D *Dalhousie;* Recipient of the President's Award for Outstanding Research 1995-1996; Professor (Research); University Research Professor, Awarded 2013; Cross appointment with Department of Biology
Rise, M., M.Sc. *Boston College*, Ph.D. *Victoria*; Tier II Canada Research Chair in Marine Biotechnology; Cross appointment with Department of Biology
Rivkin, R.B., B.Sc., M.Sc. *City College, New York*, Ph.D. *Rhode Island*; University Research Professor, Awarded 2007-2012
Schneider, D.C., B.Sc. *Duke*, Ph.D. *SUNY, Stony Brook*; Cross appointment with Department of Biology; Recipient of the President's Award for Outstanding Graduate Student

Supervision, 2012-2013
Snelgrove, P.V.R., B.Sc. *Memorial*, M.Sc. *McGill*, Ph.D. *Massachusetts/Woods Hole*; Joint appointment with Department of Biology; University Research Professor, Awarded 2015
Wroblewski, J.S., B.Sc. *Illinois*, M.Sc., Ph.D. *Florida State*; Cross appointment with Department of Biology

Associate Professors
Gagnon, P., B.Sc., Ph.D. *Laval*; Cross appointment with Department of Biology
McGaw, I., B.Sc., Ph.D. *Wales-Bangor*; Cross appointment with Department of Biology

Assistant Professor
Santander, J.A., B.Sc. *Universidad Católica del Norte, Chile*, M.Sc. *Pontificia Universidad Católica de Valpariso, Chile*, Ph.D. *Arizona State University, Arizona*

Adjunct Professors
Bradbury, I., Ph.D. *Dalhousie*; Research Scientist, Department of Fisheries and Oceans
Cote, D., M.Sc. *Wilfrid Laurier*, Ph.D. *Waterloo*; Terra Nova National Park
Dixon, B., B.Sc. *Wilfrid Laurier*, M.Sc. *Guelph*, Ph.D. *Waterloo*
Eaves, A.A., B.Sc., M.Sc. *University of Victoria*, Ph.D. *University of Alberta*
Farrell, T., Ph.D. *University of British Columbia*; Research Scientist, University of British Columbia. Vancouver
Hale, M., B.Sc., Ph.D. *Flinders*; Senior Lecturer, University of Portsmouth
Lawton, P., B.Sc. *University of Bradford*, Ph.D. *University of Whales*
McKenzie, C., B.Sc., Ph.D. *Texas A&M*; Research Scientist, Department of Fisheries and Oceans
Morris, C., Ph.D. *Memorial*; Research Scientist. Department of Fisheries & Oceans
Pepin, P., B.Sc. *McGill*, Ph.D. *Dalhousie*; Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans

Cross Appointed Faculty
Favaro, B., B.Sc., Ph.D. *Simon Fraser*; Research Scientist, Marine Institute
Purchase, C., B.Sc., M.Sc. *Memorial*, Ph.D. *Toronto*
Rowe, S., B.Sc., M.Sc. *Memorial*, Ph.D. *Dalhousie*
Shahidi, F., B.Sc. *Shiraz*, Ph.D. *McGill*, University Research Professor, Awarded 1998; Professor, Department of Biochemistry

Post-Doctoral Fellows
Le Corre, N., Ph.D. *Laval*, M.Sc. *Bordeaux University*, B.Sc. *Bretagne Occidental University, France*
Solares, A.C., M.Sc, Ph.D. *Universitat de Barcelona*
Wringe, B., Ph.D. *Memorial*, B.Sc., M.Sc. *Guelph*
Zanuzzo, F., Ph.D., M.Sc., B.Sc. *São St. Paulo State University, Brazil*

Research Assistant
Shears, M., B.Sc. *University of New Brunswick*, Ph.D. *Memorial*

Research Marketing Manager
Nichols, D., B.Sc. *Memorial*

Department of Physics and Physical Oceanography

www.mun.ca/physics

Head
Lagowski, J.B., B.Sc. *Manitoba*, M.Sc., Ph.D. *Toronto*; Professor

Professores Emeriti
Cho, C.W., B.Sc. *Seoul*, M.A., Ph.D. *Toronto*
Clouter, M.J., M.Sc. *Memorial*, Ph.D. *Toronto*; University Research Professor, Awarded 2000
Gien, T.T., Lic. és Sc. *Saigon*, M.Sc., Ph.D. *Ohio*; University Research Professor, Awarded 2001
Rochester, M.G., M.A. *Toronto*, Ph.D. *Utah*, FRSC; University Research Professor, Awarded 1986; Cross appointment from Department of Earth Sciences

Honorary Research Professors
Lewis, J.C., B.Sc., M.Sc. *Carelton*, Ph.D. *Toronto*
Whitehead, J.P., B.Sc. *St. Andrew's*, Ph.D. *Alberta*

Professors
Afanassiev, I., Ph.D. *P.P. Shirshov Institute of Oceanology, Russian Acad.*, M.Sc. *Moscow Physical-Technical University*
Andrews, G.T., B.Sc., M.Sc., Ph.D. *Memorial*
Chen, Q., B.Sc. *Shanghai Jiao Tong University China*, M.Sc., Ph.D. *Shanghai Institute of Optics and Fine Mechanics, China*
Curnoe, S.H., B.Sc. *Toronto*, Ph.D. *University of British Columbia* (NSERC UFA); Recipient of the President's Award for Outstanding Research, 2005-2006
de Young, B., B.Sc., M.Sc. *Memorial*, Ph.D. *University of British Columbia*; Appointed to Robert A. Bartlett Professorship in Oceanography; Recipient of the President's Award for Outstanding Research, 1997-1998
Morrow, M.R., B.Sc. *McMaster*, M.Sc., Ph.D. *University of British Columbia*
Plumer, M., B.Sc. *St. Francis Xavier*, M.Sc. *Dalhousie*, Ph.D *Toronto*
Poduska, K., B.A. *Carleton College,* M.S., Ph.D. *Cornell*; Cross appointment with Department of Chemistry
Quirion, G., B.Sc., M.Sc., Ph.D. *Sherbrooke*
Yethiraj, A., B.Sc. *Bombay (St. Xavier's College)*, M.Sc. *Houston*, Ph.D. *Simon Fraser*; Recipient of the President's Award for Outstanding Research 2008-2009
Zedel, L., B.Sc., M.Sc. *Victoria*, Ph.D. *University of British Columbia*; Petro-Canada Young Innovators Award, Awarded 2001

Associate Professors
Beaulieu, L., B.Sc. *University of Ottawa*, M.Sc., Ph.D. *Dalhousie*; Petro Canada Young Innovators Award, Awarded 2008
Demirov, E., M.Sc., Ph.D. *University of St. Petersburg, Russia*
Munroe, J.R., B.Math.(Hons.), M.Math *Waterloo*, Ph.D. *Alberta*
Saika-Voivod, I., B.Sc.(Hons.), Ph.D. *University of Western Ontario*
Tarasov, L., B.Sc. *Guelph*, M.Sc., Ph.D. *Toronto*; CRC Glacial Dynamics Modelling

Assistant Professors
Evstigneev, M., B.Sc., Ph.D. *York*
LeBlanc, J., M.Sc., Ph.D. *Guelph*
Wallin, S., M.Sc., Ph.D. *Lund University*

Adjunct Professors
Barkanova, S., B.Sc., M.Sc. *University of Latvia*, Ph.D. *University of Manitoba*
Han, G., B.S., M.S., Ph.D. *Hohai University*
Poole, P., B.Sc. *St. Francis Xavier University*, M.A., Ph.D. *Boston University*

Cross Appointments
Aleksejevs, A., B.Phys.(Hons.), M.Phys. *Latvia*, Ph.D. *Manitoba*
Booth, I., B.Sc.(Hons.) *Memorial*, M.Sc., Ph.D. *University of Waterloo*; Cross appointment from Department of Mathematics and Statistics
Booth, V., B.Sc. *Victoria*, M.Sc. *Waterloo*, Ph.D. *Toronto*; Cross appointment from Department of Biochemistry

Administrative Officer
Crant, A.

Academic Program Officer
Goulding, R., B.Sc. *Prince Edward Island*, M.Sc. *Western Ontario*, Ph.D. *University of New Brunswick*

Laboratory Co-ordinator
Deacon, C.G., Ph.D. *Birmingham*, M.B.A. *Memorial*

Department of Psychology

www.mun.ca/psychology

Head
Neath, I., B.A. *Rice University*, M.S., Ph.D. *Yale*; Professor

Professor Emeritus
Harley, C.W., B.S. *San Francisco State*, M.S., Ph.D. *Oregon*; Cross appointment with Faculty of Medicine

Honorary Research Professors
Anderson, R.E., B.A. *Wisconsin*, Ph.D. *California*
Penney, C.G., B.Sc.(Hons.) *McGill*, M.A., Ph.D. *Toronto*

Professors
Adams, R.J., B.A. *Concordia*, Ph.D. *McMaster*; Cross appointment with Faculty of Medicine
Button, C.M., B.Sc., M.Sc. *Memorial*, Ph.D. *Rhode Island*

Courage, M.L., B.A. *Memorial*, M.Sc. *Alberta*, Ph.D *Memorial*; Cross appointment with Faculty of Medicine; University Research Professor, Awarded 2010
Fowler, K.F., B.Sc.(Hons.), Ph.D. *Memorial*
Martin, G.M., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Australian National University*
Montevecchi, W.A., B.A. *Northeastern*, M.Sc. *Tulane*, Ph.D. *Rutgers*; Cross appointments to Ocean Sciences Centre and Department of Biology; University Research Professor, Awarded 2005
Peterson, C., B.S. *Washington*, Ph.D. *Minnesota*; University Research Professor, Awarded 2006
Skinner, D.M., B.Sc.(Hons.) *Memorial*, Ph.D. *Toronto*
Snook, B., B.A. *Memorial*, M.Sc., Ph.D. *Liverpool*; Recipient of the President's Award for Outstanding Graduate Supervision, 2016-2017
Storey, A.E., B.Sc., M.A. *Manitoba*, Ph.D. *Rutgers*
Surprenant, A.M., B.A. *New York*, M.S., Ph.D. *Yale*; Dean of the School of Graduate Studies

Associate Professors

Blundell, J.J., B.Sc.(Hons.) *Dalhousie*, M.Sc., Ph.D. *Memorial*; Cross appointment with the Faculty of Medicine
Carter-Major, J.C., B.A.(Hons.), M.A. *Carleton University*, D.Phil. *University of Oxford*; R.Psych.
Drover, J.R., B.Sc.(Hons.), M.Sc., Ph.D. *Memorial*; Cross appointment with Faculty of Medicine
Gosselin, J., B.A.(Hons.) *Ottawa*, Ph.D. *Montréal*
Hallett, D., B.A.(Hons.), M.A., Ph.D. *University of British Columbia*
Thorpe, C., B.Sc.(Hons.) *Memorial*, M.A., Ph.D. *University of British Columbia*
Walsh, C.J., B.Sc.(Hons.), Ph.D. *Memorial*, M.A. *Toronto*

Assistant Professors

Bambico, F.R., B.A. *University of the Philippines*, M.Sc. *IMPRS Tübingen*, Ph.D. *McGill*
Day, M., B.Sc.(Hons.) *Dalhousie*, Ph.D. *Waterloo*
Fawcett, J.M., B.Sc.(Hons.), Ph.D. *Dalhousie*
Garland, S., B.A.(Hons.), M.Sc., Ph.D. *Calgary*; Cross appointment with Faculty of Medicine
Hadden, K., B.A.(Hons.) *York*, M.A., Ph.D. *Saskatchewan*; Cross appointment to Student Wellness and Counselling Centre
Harris, N., B.A.(Hons.) *St. Mary's*, Ph.D. *Lakehead*
Hebert, M., B.Sc.(Hons.) *St. Francis Xavier*, M.S., Ph.D *Georgia*
Hourihan, K.L., B.Sc.(Hons.) *Dalhousie*, M.A., Ph.D. *Waterloo*
Mercer, M., B.Sc.(Hons.), M.Sc., Ph.D. *Memorial*
Walling, S.G., B.Sc. *Calgary*, Ph.D. *Memorial*; Co-ordinator, First Year
Wilson, D., B.Sc.(Hons.), M.Sc. *Manitoba*, Ph.D. *Macquarie*

Adjunct Professors

Garthe, S., B.Sc. *Hamburg*, M.Sc., Ph.D. *Kiel*
Hedd, A., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *University of Tasmania*
Hubbard, J., B.A.(Hons.) *Western Ontario*, M.A., Ph.D. *York*
Koen-Alonso, M., Ph.D. *Buenos Aires*
Perry, E., B.A.(Hons.) *Guelph*, M.Sc., Ph.D. *Memorial*
Vernescu, R.M., B.A. *York*, M.Sc., Ph.D. *Memorial*

Cross Appointments

Carnahan, H., B.P.Ed., M.Sc. *McMaster*, Ph.D. *Waterloo*; Cross appointment from Faculty of Medicine
Ellenbogen, S., B.A. *Concordia*, M.Sc., *Montreal*, Ph.D. *McGill*; Cross appointment from Faculty of Humanities and Social Sciences
Harris, G.E., B.A.(Hons.) *Saint Mary's*, M.Sc. *Calgary*, Ph.D. *Alberta*; Cross appointment from Faculty of Education
Heath, O., B.A. *McGill*, M.Sc., Ph.D. *Memorial*; Cross appointment from Student Wellness and Counselling Centre
Hesson, J., B.A.(Hons.), M.Sc., *Memorial*, Ph.D *Victoria*; Cross appointment from Faculty of Education

Professional Associates

DiDonato, R., B.A. *Rutgers State*, M.S.A. *Hahnemann*, Ph.D. *Memorial*
Drover, K., B.A.(Hons.) *Memorial*, M.A. *Argosy*
Edison, S., B.Sc.(Hons.), M.Sc. *Memorial*, Ph.D. *Guelph*
Neary, M., B.Sc.(Hons.) *Memorial*, M.Ed., Ph.D. *McGill*
Thomas, B., Ph.D. Pharmacy *Colorado*

Administrative Staff Specialist

Young, S., B.B.A. *Lakehead*, M.B.A. *Memorial*

Laboratory Instructors

Brown, A., B.A.(Hons.), M.Sc. *Memorial*
Milway, S., B.A. *Concordia*

Instructional Assistant

Gaborko, L., B.Sc. *Trent*

Research Computing Specialist

Earle, A., B.Sc. *Memorial*

Science 1150/1151

Assistant Professor

Meruvia-Pastor, O., B.Eng. *ITESM Monterrey*, M.Sc. *Alberta*, Dr. Eng. *Otto-von-Guericke Magdeburg*

Laboratory Instructor

Huelin, S., B.Sc., M.Sc., B.Ed. *Memorial*

Academic Staff Members in Co-operative Education

MacKenzie, T., B.Sc. *Memorial*, M.SW. *Carleton*
Newhook, R., B.A., M.Ed. *Memorial*

1 The Memorial University of Newfoundland Code

The attention of all members of the University community is drawn to the section of the University Calendar titled **The Memorial University of Newfoundland Code**, which articulates the University's commitment to maintaining the highest standards of academic integrity.

2 Student Code of Conduct

Memorial University of Newfoundland expects that students will conduct themselves in compliance with University Regulations and Policies, Departmental Policies, and Federal, Provincial and Municipal laws, as well as codes of ethics that govern students who are members of regulated professions. The *Student Code of Conduct* outlines the behaviors which the University considers to be non-academic misconduct offences, and the range of remedies and/or penalties which may be imposed. Academic misconduct is outlined in ***UNIVERSITY REGULATIONS* - Academic Misconduct** in the University Calendar.

For more information about the *Student Code of Conduct*, see www.mun.ca/student/sscm/conduct/.

3 Faculty Description

The Faculty of Science encompasses nine academic departments: Biochemistry, Biology, Chemistry, Computer Science, Earth Sciences, Mathematics and Statistics, Ocean Sciences, Physics and Physical Oceanography, and Psychology. Departments offer programs leading to general and honours degrees. A number of specialized and joint programs are also offered, as well as Bachelor of Science degree programs delivered by the Departments of Geography and Economics. Selected students can complete the first two years of Acadia University's Bachelor of Science in Nutrition (Dietetics option) at Memorial University of Newfoundland. In addition to educational programs, research is a most important aspect of the Faculty of Science. As such, the Faculty is in a position to generate new knowledge by the pursuit of high quality research and to foster economic development through cooperative research and technology transfer with the private sector. The Faculty of Science is the scientific training ground for all undergraduates at the University. Memorial University of Newfoundland's science graduates are in demand by science-based industries throughout the country. Our Faculty excels in research and in its commitment to effective teaching and delivery of quality educational programs.

Additional information regarding the Faculty of Science is available at www.mun.ca/science.

Information regarding the Centre for Earth Resources Research (CERR) and the Ocean Sciences Centre (OSC) is available under **General Information, Centre for Earth Resources Research (CERR)**, and **General Information, Ocean Sciences Centre**, respectively.

4 Bachelor of Science in Nutrition (Dietetics Option), Memorandum of Understanding (MOU) between Memorial University of Newfoundland and Acadia University

Program Coordinator: B. Walters, Department of Biochemistry

4.1 General Information

Under the terms of a Memorandum of Understanding (MOU) between Memorial University of Newfoundland and Acadia University, selected students are able to complete the first two years of Acadia University's Bachelor of Science in Nutrition (Dietetics option) at Memorial University of Newfoundland and complete the final two years of the program at Acadia University. Selection for this program is competitive and is limited to ten qualified students each year. Upon successful completion of all degree requirements students will graduate with the degree of Bachelor of Science in Nutrition (Dietetics option) from Acadia University.

For detailed information about the Memorial University of Newfoundland component of the program, and for information about the selection process and deadlines, contact the Office of the Dean of Science by e-mail at science@mun.ca or by telephone at (709) 864-8153 or (709) 864-8154.

For detailed information about the Acadia University program, contact Acadia University in writing to the School of Nutrition and Dietetics, Acadia University, P.O. Box 68, 12 University Avenue, Wolfville, Nova Scotia, Canada B4P 2R6, or by telephone at (902) 585-1366, or by e-mail at nutr@acadiau.ca, or through the website at nutrition.acadiau.ca/.

4.2 Admission Regulations

1. Students who are interested in pursuing this program must first complete 30 credit hours from the prescribed courses from the **Memorial University of Newfoundland Courses** list below.
2. In the Winter semester, normally at the end of a student's first year at Memorial University of Newfoundland, a selection competition will be held. Only those students who are selected will be eligible to continue into the second year of the program at Memorial University of Newfoundland.
3. The selection process will be jointly administered by Memorial University of Newfoundland and by Acadia University.
4. Academic achievement will be a significant criterion used for selection and students may be asked to attend an interview.
5. The letter of acceptance will give the selected applicant 14 days from the date of the letter in which to confirm acceptance of their place in the program.
6. To continue on to Acadia University, the selected students must successfully complete the 17 courses, 51 credit hours from the **Memorial University of Newfoundland Courses** and the 3 courses, 9 credit hours from the **Acadia University Courses** lists below required by the MOU with a minimum 60% overall average. A grade of 60% (Acadia University equivalent grade of C-) is required in each of the three individual Nutrition courses taken through Open Acadia at www.openacadia.ca, the distance education unit of Acadia University.

4.3 Continuance Regulations

Students who successfully complete the first two years of the program at Memorial University of Newfoundland as described below will transfer to Acadia University where the final two years will be completed.

4.3.1 Memorial University of Newfoundland Courses

Under the terms of the MOU, the following 17 courses, 51 credit hours at Memorial University of Newfoundland must be completed with a minimum 60% overall average before being admitted to the third year of Acadia University's program:

1. Biology 1001
2. Chemistry 1010, 1011 (or Chemistry 1200, 1001)
3. Chemistry 2440
4. English 1090 or the former English 1080, 1110 (or equivalent)
5. Mathematics 1090 and 1000 (or Mathematics 1000 and one elective)
6. Pharmacy 2002, 2003, and 2004 or Biochemistry 2101 (only students who are selected for this program will be permitted to register for these Pharmacy courses)
7. Psychology 1000, 1001
8. Statistics 2500, 2501
9. Two Humanities and Social Sciences electives

4.3.2 Acadia University Courses

To continue to the third year of Acadia University's program, the selected students must successfully complete 20 courses, 60 credit hours comprised of the 17 courses, 51 credit hours from the **Memorial University of Newfoundland Courses** list above and the 3 courses, 9 credit hours from the **Acadia University Courses** list below. This is required by the MOU and students must obtain a minimum 60% overall average. A grade of 60% (Acadia University equivalent grade of C-) is required in each of the three individual Nutrition courses taken through Open Acadia at www.openacadia.ca, the distance education unit of Acadia University.

Nutrition 1313
Nutrition 1323
Nutrition 2323

4.3.3 Internship

In order to be eligible to apply for internship placements administered by the Acadia Dietetic Internship Program, students must obtain a grade of at least B- (70-72) in the two courses Nutrition 2503 and 2513. This requirement does not apply for other non-Acadia internships for which all students are eligible to apply.

4.3.4 Programs Tables

The following tables present a schedule for completing the course requirements at Memorial University of Newfoundland.

For Students Who Complete Mathematics 1090 in Their First Semester

Term	Suggested Courses
Fall Semester 1	Biology 1001 Chemistry 1010 or 1200 English 1090 or the former English 1080 Mathematics 1090 Psychology 1000
Winter Semester 2	Chemistry 1011 or 1001 English 1110 (or equivalent) Mathematics 1000 NUTR 2323 through Acadia Online at www.openacadia.ca Psychology 1001
Fall Semester 3	Humanities and Social Sciences Elective Chemistry 2440 NUTR 1313 through Acadia Online at www.openacadia.ca Pharmacy 2002 Statistics 2500
Winter Semester 4	Humanities and Social Sciences Elective NUTR 1323 through Acadia Online at www.openacadia.ca Pharmacy 2004 (or Biochemistry 2101) Pharmacy 2003 Statistics 2501

For Students Who Complete Mathematics 1000 in Their First Semester

Term	Suggested Courses
Fall Semester 1	Biology 1001 Chemistry 1010 English 1090 or the former English 1080 Mathematics 1000 Psychology 1000
Winter Semester 2	Chemistry 1011 English 1110 (or equivalent) NUTR 2323 through Acadia Online at www.openacadia.ca Psychology 1001 Statistics 2500
Fall Semester 3	Humanities and Social Sciences Elective Chemistry 2440 NUTR 1313 through Acadia Online at www.openacadia.ca Pharmacy 2002 Statistics 2501
Winter Semester 4	Humanities and Social Sciences Elective Elective NUTR 1323 through Acadia Online at www.openacadia.ca Pharmacy 2004 (or Biochemistry 2101) Pharmacy 2003

Notes: *1. Statistics 2501 is offered on campus in the Fall semester and normally is offered only by distance education in the Winter semester.*
2. While students are strongly encouraged to complete Nutrition 2323 in the first year, they can substitute an Humanities and Social Sciences elective for Nutrition 2323 in the first year but must then complete Nutrition 2323 in the second year.
3. All three Open Acadia courses must be completed prior to starting courses at Acadia.

5 Joint Degrees of Bachelor of Science and Bachelor of Arts

Students who wish to simultaneously pursue a Bachelor of Science program and a Bachelor of Arts program may do so by completing a minimum of 135 credit hours in courses, rather than the minimum of 150 credit hours required under ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Residence Requirements - Second Degree**.

Students who complete the Joint Degrees of Bachelor of Science and Bachelor of Arts are not required to complete a minor. Students may complete the requirements for a minor, or an additional (third) major, in accordance with ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Degree and Departmental Regulations - Further Credentials**.

Credit hours earned in Computer Science, Economics, Geography, Mathematics and Statistics, and Psychology may be eligible to simultaneously satisfy a requirement for credit hours in the Faculty of Science and a requirement for credit hours in the Faculty of Humanities and Social Sciences.

Careful planning of courses is crucial to ensure timely completion of the Joint Degrees of Bachelor of Science and Bachelor of Arts. Students enrolled in this program, or who plan to enroll in this program, are strongly encouraged to consult regularly with appropriate academic advisors in both the Faculty of Science and the Faculty of Humanities and Social Sciences. It may not be possible to complete the requirements for the Joint Degrees in the normal time if the decision to embark on the program is delayed.

Students who have enrolled in the Joint Degrees of Bachelor of Science and Bachelor of Arts must satisfy all program requirements before they may be granted either the degree of Bachelor of Science and Bachelor of Arts, and must graduate with both degrees at the same convocation.

1. The minimum of 135 credit hours for the Joint Degrees of Bachelor of Science and Bachelor of Arts shall include:
    a. a Major program chosen from those majors offered by departments within the Faculty of Science with the exception of majors offered by the Department of Economics and the Department of Geography;
    b. a Major program chosen from those majors offered by departments within the Faculty of Humanities and Social Sciences and the interdisciplinary Arts majors, with the exception of majors offered by the Department of Computer Science, the Department of Mathematics and Statistics, and the Department of Psychology;
    c. the **Core Requirements** for the Faculty of Humanities and Social Sciences (including the **Breadth of Knowledge Requirement**, the **Critical Reading and Writing (CRW) Requirement,** the **Language Study (LS) Requirement**, and the **Quantitative Reasoning (QR) Requirement**), for which the Quantitative Reasoning Requirement shall be satisfied by 6 credit hours in Mathematics courses;
    d. 6 credit hours in courses from each of two Sciences other than Mathematics;
    e. a total of at least 78 credit hours in courses offered by departments within the Faculty of Science, and a total of at least 78 credit hours offered by departments within the Faculty of Humanities and Social Sciences; and
    f. no more than 6 credit hours in courses offered by a Faculty or School other than the Faculty of Science or the Faculty of Humanities and Social Sciences.

    While the Joint Degrees of Bachelor of Science and Bachelor of Arts is available to all Major programs offered by the Faculty of Science and the Faculty of Humanities and Social Sciences, students pursuing a major outside of Computer Science, Economics, Geography, Psychology, Pure Mathematics or Statistics should pay special attention to course planning and selection to ensure that this requirement is met within the required 135 credit hours.
2. Admission to the Major programs shall be governed by **Faculty of Science - Degree Regulations - Admission to the Department of Subject of Major** and **Faculty of Humanities and Social Sciences - Admission to the Bachelor of Arts General Degree Programs**.
3. Where an admission requirement or program regulation for the Major program from the Faculty of Science includes English 1090 (or the former English 1080) and English 1110 (or equivalent), such requirements may instead be satisfied by the completion of 3 credit hours in any 1000-level **Critical Reading and Writing (CRW)** course offered by the Department of English, and an additional 3 credit hours in any Faculty of Humanities and Social Sciences course whose title begins with "Critical Reading and Writing" chosen from those listed under **Core Requirements - Critical Reading and Writing (CRW) Requirement for the Bachelor of Arts**.
4. Students who have already completed a bachelor's degree are not eligible to complete the Joint Degrees of Bachelor of Science and Bachelor of Arts, but may separately complete a Bachelor of Science or a Bachelor of Arts in accordance with ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Residence Requirements - Second Degree**.

6 Joint Programs

Course descriptions are found at the end of the Faculty of Science section under **Course Descriptions**.

The following joint honours, majors and option programs are offered by Departments in the Faculty of Science, and the regulations for each program are joint Departmental Regulations. For convenience of reference the joint programs are listed below in alphabetical sequence: Joint Honours, Joint Majors, and Joint Options.

A joint degree program, the Bachelor of Arts and Bachelor of Science, can be found under the Faculty of Science at **Joint Degrees of Bachelor of Science and Bachelor of Arts** and under the Faculty of Humanities and Social Sciences at **Joint Degrees of Bachelor of Arts and Bachelor of Science**.

6.1 Joint Honours

A student who wishes to be admitted to any of the Honours programs must submit an "Application for Admission to Honours Program Faculties of Humanities and Social Sciences or Science". This Application is available online from the Office of the Registrar at www.mun.ca/regoff/Application_Honours_Program.pdf.

6.1.1 Applied Mathematics and Chemistry Joint Honours (B.Sc. Only)

The following courses are required:

1. English 1090 or the former English 1080 and English 1110 (or equivalent).
2. A computing course. Computer Science 1510 is recommended.
3. Biochemistry 2101.
4. Physics 1050 (or 1020) and 1051 (or 1021).
5. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 3000, 3001, 3132, 3161, 3202, 3210, 4160.
6. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210 or 3211, 3303.

7. Six additional credit hours chosen from courses numbered 3000 or higher that are offered by the Department of Chemistry.
8. An Honours Dissertation (Mathematics 419A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
9. A sufficient number of elective courses to bring the degree up to a total of 120 credit hours.

6.1.2 Applied Mathematics and Physics Joint Honours

The following courses are required:

1. English 1090 or the former English 1080 and English 1110 (or equivalent).
2. A computing course. Computer Science 1510 is recommended.
3. Six credit hours in a science other than Mathematics or Physics (if Computer Science is chosen then Computer Science 1510 may be counted as three of these hours).
4. Mathematics 1000, 1001, 2000, 2050, 2051, 2260, 3000, 3001, 3132, 3202, 3210.
5. At least one of Mathematics 2130 or Mathematics 2320.
6. Physics 1050 (or 1020), 1051, 2053, 2055, 2750 (or 2056), 2820, 3220, 3230, 3400, 3500, 3750.
7. Three additional credit hours chosen from courses numbered 3000 or higher that are offered by the Department of Physics and Physical Oceanography.
8. Mathematics 3161 and Mathematics 4160, or Physics 3820 and Physics 4820.
9. Physics 490A/B or Mathematics 419A/B.
10. Twelve additional credit hours chosen from courses numbered 4000 or higher that are offered by the Department of Mathematics and Statistics or the Department of Physics and Physical Oceanography. At least 3 credit hours must be selected in each of Applied Mathematics and Physics.
11. A sufficient number of elective courses to bring the degree to a total of 120 credit hours.

The topic for the Honours project or thesis, Mathematics 419A/B or Physics 490A/B must be chosen with the prior approval of both departments.

6.1.3 Biochemistry and Cell Biology Joint Honours

1. Biology 1001, 1002, Chemistry 1050, 1051 (or 1200 and 1001), English 1090 or the former English 1080 and 1110 (or equivalent), Mathematics 1000, 1001, Physics 1020 or 1050, Physics 1021 or 1051, Statistics 2550;
2. Biochemistry 2101, 3105, 3106, Chemistry 2301, 2400, 2401;
3. Either Biochemistry 3107 and 3108 or Medicine 310A/B;
4. An additional 12 credit hours to be selected from Biochemistry 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4210 or 4211, 4230-4249;
5. Biology 2060, 2250, 2600, 2900, 3530, 4241, plus one of Biology 3401, 3402, 4245 or 4404;
6. 12 credit hours from the following: Biology 3050, 3052 (or Biochemistry 3052), 3401, 3402, 3500, 3620, 3950, 3951, 4010, 4040, 4050, 4200 (or Biochemistry 4105), 4245, 4250, 4251, 4255, 4404, 4550, 4605, 4607;
7. Biochemistry 499A/B or Biology 499A/B; and
8. Electives to make up 120 credit hours.

Note: *Students may count only one of the two courses, Biochemistry 4105 or Biology 4200, for credit in this program.*

Seventy-five credit hours in Biology, Biochemistry and Chemistry courses beyond the first-year level from those listed in the program shall contribute to those in which a grade of "B" or an average of 75 or higher is required. Medicine 310A/B counts as Biochemistry for these 75 credit hours.

6.1.4 Biochemistry and Chemistry Joint Honours

The following courses are required:

1. Chemistry 1050 and 1051 (or Chemistry 1010, 1011 and the former 1031) (or Chemistry 1200 and 1001), Mathematics 1000 and 1001, Physics 1050 (or 1020) and 1051 (or 1021), 6 credit hours in first year English courses. Biology 1001 and 1002 are highly recommended;
2. Mathematics 2000;
3. Chemistry 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410;
4. Nine further credit hours in Chemistry courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher;
5. Biochemistry 2100, 2101, 3105, 3106, and either 3107, 3108, or Medicine 310A/B;
6. 12 credit hours chosen from Biochemistry 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4210, 4211, 4230-4249;
7. Either Chemistry 490A/B or Biochemistry 499A/B; and
8. A sufficient number of elective courses to bring the degree to a total of 120 credit hours.

Note: *Students should check prerequisites for 4000 level courses before making decisions about their 3000 level courses and seek academic advice if necessary.*

6.1.5 Biochemistry and Physics Joint Honours

The following courses are required:

1. English 1090 or the former English 1080 and 1110 (or equivalent), Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031) (or 1200 and 1001), Mathematics 1000 and 1001, Physics 1050 (or 1020) and 1051;
2. Chemistry 2400, 2401;
3. Chemistry 2301 or Physics 2053
4. Mathematics 2000, 2050, 2260, either Mathematics 3202 or Physics 3810;
5. Biochemistry 2100, 2101, 3105, 3106;

6. Either Biochemistry 3107 and 3108 or Medicine 310A/B;
7. An additional 12 credit hours to be selected from Biochemistry 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4210 or 4211; 4230-4249;
8. Physics 2055, 2750 or 2056, 2820, 3220, 3400, 3500, 3750, 3820, 3900, plus one 4000 level Physics course;
9. Either Physics 490A/B or Biochemistry 499A/B; and
10. Other courses to complete the prescribed minimum of 120 credit hours in courses for the Joint Honours degree.

6.1.6 Biochemistry and Psychology (Behavioural Neuroscience) Joint Honours

Note: *Students completing this program cannot receive credit for Psychology 2920.*

The following courses (or equivalent) are required to complete the 120 credit hours in courses required for the degree:

1. Chemistry 1050 and 1051 (or 1200 and 1001), Biology 1001 and 1002, Mathematics 1000 and 1001, Physics 1050, (or 1020), 1051 (or 1021), English 1090 or the former English 1080 and 1110.
2. Biochemistry 2100, 2101, 3105, 3106, 3107, 3108, Medicine 310A/B, either 4210 or 4211, 9 credit hours chosen from Biochemistry 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4230-4249, Chemistry 4701.
3. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800, 3820, 3900, one further courses in Psychology chosen from the following: 3050, 3100, 3350, 3450, 3620, 3650, 3750; any research experience course and one of Psychology 4250, 4251, 4850 or 4851; or, any selected topics course and one of Psychology 4270 or 4870.
4. Either Biochemistry 499A/B or Psychology 499A/B.
5. Chemistry 2301, 2400, 2401.

Notes:
1. *In accordance with Clause 6.a. of the Regulations for the Honours Degree of Bachelor of Science, Honours candidates must obtain a grade of "B" or better, or an average of 75% or higher in all the required courses listed in Clauses 2., 3. and 4. above, except those at the 1000 level.*
2. *Students in first year intending to follow this program should note the regulations for admission to Major programs in Psychology and that the deadline for submission of a completed application form to the Department of Psychology is June 1 for the Fall semester.*

6.1.7 Biochemistry (Nutrition) and Psychology (Behavioural Neuroscience) Joint Honours

Note: *Students completing this program cannot receive credit for Psychology 2920.*

The following courses (or equivalent) are required:

1. Chemistry 1010 and 1011 (or 1050, 1051) (or 1200 and 1001), Biology 1001 and 1002, Mathematics 1000, Physics 1020 or 1050, and 1021 (or 1051), English 1090 or the former English 1080 and 1110.
2. Biochemistry 2100, 2101, 2600, 3106, 3203, 4002, 4300, 4301, 4502, Medicine 310A/B; one course chosen from: Biochemistry 3105, 3107, 3108, 3202, 3402, 3600, 4101, 4103, 4104, 4105, 4200, 4201, 4210, 4211, 4230-4249, Biology 3050, Chemistry 4701.
3. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800, 3820, 3900, one further course in Psychology chosen from the following: 3050, 3100, 3350, 3450, 3620, 3650, 3750; any research experience course and one of Psychology 4250, 4251, 4850 or 4851; or, any selected topics course and one of Psychology 4270 or 4870.
4. Either Biochemistry 499A/B or Psychology 499A/B.
5. Chemistry 2400, 2401 or Chemistry 2440.
6. Other courses to complete at least the prescribed minimum of 120 credit hours in courses for the Joint Honours Degree.

Notes:
1. *In accordance with Clause 6.a. of the Regulations for the Honours Degree of Bachelor of Science, Honours candidates must obtain a grade of "B" or better, or an average of 75% or higher in all the required courses listed in Clauses 2., 3., and 4. above, except those at the 1000 level.*
2. *Students in first year intending to follow this program should note the regulations as outlined for admission to Major programs in Psychology and that the deadline for submission of a completed application form to the Department of Psychology is June 1 for the Fall semester.*

6.1.8 Biology and Earth Sciences Joint Honours

The following courses, including prerequisites where applicable, will be required:

1. English 1090 or the former English 1080 and 1110 (or equivalent), Mathematics 1000 and 1001, Biology 1001 and 1002, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1200 and 1001), Physics 1020 and 1021 (or 1050 and 1051).
2. Chemistry 2440, Biochemistry 2101, Biochemistry 3106, one of Statistics 2550 or 2560.
3. Biology 2060, 2250, 2600, 2900, one of 3401, 3402, 4245 or 4404; plus Biology 3710, 3711, and 4505. In addition, further Biology courses at the 2000, 3000, or 4000 level must be selected by the student in consultation with the supervisor to make up a minimum of 42 credit hours in Biology not including Biology 499A or 499B.
4. Earth Sciences 2030, 2031, 2502, 2905; plus a minimum of 24 credit hours in other Earth Science courses from 2000 to 4000 level, at least 3 credit hours of which must be at 4000 level. Earth Sciences 2150, 2914, 2915, 2916, 2917, 2918, 4310, and 4950 cannot be used to fulfill this requirement. Career-related streams outlined in the departmental Student Handbook should be used as a guide to course selection so as to achieve a concentration in one facet of Earth Sciences.
5. An Honours dissertation (Biology 499A/B or Earth Sciences 499A/B). The topic of the Honours dissertation must be chosen with the approval of both Department Heads. A faculty member of either Department may act as supervisor.
6. Other courses to complete the prescribed minimum of 135 credit hours in courses for the Honours degree, with at least 84 credit hours in courses in Biology and Earth Sciences combined.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

6.1.9 Biology and Psychology Joint Honours

Note: *Students completing this program cannot receive credit for Psychology 2920.*

The following forty courses (or equivalent) are required:

1. Biology 1001, 1002, 2060, 2250, 2600, 2900; one of 3401, 3402, 4245, 4404; four Biology electives at the 2000, 3000 or 4000 level not including Biology 499A or 499B.
2. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800; 3900, 4910; one of the following: 3050, 3100, 3350, 3450, 3620, 3650; one further 4000 level Psychology research experience course.
3. Biology or Psychology 3750, 4701, 499A/B.
4. English 1090 or the former English 1080 and 1110; Mathematics 1000; Chemistry 1010 and 1011 (or 1050 and 1051), and 2440;

Physics 1020 (or 1050) and 1021 (or 1051); Biochemistry 2101 and 3106.

5. Other courses, if necessary, to complete at least 120 credit hours of courses.

6.1.10 Biology and Psychology (Behavioural Neuroscience) Joint Honours

Note: *Students completing this program cannot receive credit for Psychology 2920.*

The following forty courses (or equivalent) are required:

1. Biology 1001, 1002, 2060, 2250, 2600, 2900; one of 3401, 3402, 4245, 4404; five Biology electives at the 2000, 3000 or 4000 level not including Biology 499A or 499B.
2. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800, 3820, 3900; one further course in Psychology chosen from the following: 3050, 3100, 3350, 3450, 3620, 3650, 3750; any research experience course and one of Psychology 4250, 4251, 4850 or 4851; or, any selected topics course and one of Psychology 4270 or 4870.
3. Biology or Psychology 499A/B.
4. Biochemistry 2101, 3106.
5. English 1090 or the former English 1080 and 1110; Mathematics 1000 and 1001; Physics 1020 (or 1050) and 1021 (or 1051); Chemistry 1010 and 1011 (or 1050 and 1051), and 2440 (or 2400 and 2401).
6. Other courses, if necessary, to complete at least 120 credit hours of courses.

Note: *In accordance with Clause 6.a. of the Regulations for the Honours Degree of Bachelor of Science, Honours candidates must obtain a grade of "B" or better, OR average of 75% or higher in all the required courses listed in Clauses 1, 2, 3, and 4 above, except those at the 1000 level.*

6.1.11 Biology and Statistics Joint Honours (B.Sc. Only)

See **Regulations for the Honours Degree of Bachelor of Science**. Students shall complete the following requirements:

1. Mathematics 1000 and 1001, Biology 1001 and 1002, English 1090 or the former English 1080 and 1110, Chemistry 1010 and 1011 (or 1050 and 1051), Physics 1020 and 1021, or equivalent;
2. Mathematics 2000, 2050, 2051, Statistics 2500, 2501, or 2560, 3520, 3521, 4530, and 4581;
3. 9 further credit hours in Statistics courses (excluding those with second digit 0) including at least 6 credit hours in courses at the 4000 level or higher but not including Statistics 459A/B;
4. Chemistry 2440 (or 2400 and 2401), Biochemistry 2101 and 3106;
5. Biology 2060, 2250, 2600, 2900, one of 3401, 3402, 4245, or 4404. In addition, further Biology courses at the 2000, 3000 or 4000 level must be selected by the student in consultation with the supervisor to make up a minimum of 42 credit hours in Biology but not including Biology 499A or 499B;
6. Either Biology 499A/B or Statistics 459A/B; and
7. A computing course. Computer Science 1510 is recommended.

6.1.12 Chemistry and Earth Sciences Joint Honours

The following courses, including prerequisites, where applicable, will be required:

1. English 1090 or the former English 1080 and 1110 (or equivalents), Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1010, 1011 and the former 1031) or their equivalents, Physics 1050 (or 1020) and 1051 (or 1021).
2. Earth Sciences 2030, 2031, 2401, 2502, 2702, 2905, 3420, 3600; plus 6 additional credit hours in 3000-level Earth Sciences courses, and 9 additional credit hours in 4000-level Earth Sciences courses.
3. Chemistry 2100, 2210, 2301, 2302, 2400, 2401 and 3110; and at least 6 additional credit hours in 3000-level and 6 credit hours in 4000-level Chemistry courses.
4. Mathematics 2000 and 2050.
5. Biology 2120 and Biochemistry 2101.
6. An Honours Dissertation (Earth Sciences 499A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
7. Other courses to complete the prescribed minimum of 120 credit hours.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

6.1.13 Chemistry and Physics Joint Honours

The following courses are prescribed:

1. Mathematics 1000, 1001, 2000, 2050, 3202, and 2260.
2. Physics 1050 (or 1020) and 1051, 2055, 2750 or 2056, 2820, 3220, 3500, 3750, 3820, 3900, 4820, 3 additional credit hours in a Physics course numbered 3000 or higher and 6 additional credit hours in Physics courses numbered 4000 or higher.
3. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, and 6 additional credit hours in Chemistry courses numbered 3000 or higher.
4. Biochemistry 2101.
5. 5. An Honours Dissertation (Chemistry 490A/B or Physics 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
6. A sufficient number of elective courses to bring the degree total to 120 credit hours.
7. English 1090 or the former English 1080 and English 1110 (or equivalent).

6.1.14 Computer Science and Geography Joint Honours (B.Sc. Only)

See **Regulations for the Honours Degree of Bachelor of Science**.

1. **Computer Science Requirements**

   Forty-eight credit hours in Computer Science courses are required for the Joint Honours:

   a. 1000, 1001,1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 4751.

   b. Six additional credit hours in courses at the 4000 level not including 4780.

   c. Twelve additional credit hours in courses at the 3000 level or beyond.

2. **Geography Requirements**

   Forty-eight credit hours in Geography courses are required for the Joint Honours: 1050, 2001, 2102, 2195, 2226, 2302, 2425, 3202, 3222, 3226, 3250, 3260, 3303, 4202, 4250, 4261, and the former 4291.

3. **Additional Requirements**

   a. Mathematics 1000, 1001, 2000, and 2050.

   b. An Honours Dissertation (either Computer Science 4780 or Geography 4999). The topic for dissertation must be chosen with the prior approval of the Heads of both Departments.

6.1.15 Computer Science and Physics Joint Honours

The following courses are prescribed:

1. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031) (or 1200 and 1001).
2. a. Computer Science 1000, 1001,1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 3731.

   b. Nine additional credit hours in Computer Science courses numbered 3000 or higher, including at least 3 credit hours in courses at the 4000 level.
3. a. Physics 1050 (or 1020) and 1051.

   b. Physics 2053, 2055, 2750, 2820, 3220, 3400, 3500, 3750, 3800, and 3820.

   c. Three additional credit hours in Physics at the 4000 level.
4. Physics 490A and Physics 490B or Computer Science 4780. and 3 additional credit hours in Computer Science at the 4000 level.
5. a. Mathematics 1000 and 1001.

   b. Mathematics 2000, 2050, 2260, and 3202.
6. English 1090 or the former English 1080 and 1110 (or equivalent).
7. Two electives to bring the total credit hours to 120. Computer Science 2500 and Statistics 2550 are recommended.

6.1.16 Computer Science and Pure Mathematics Joint Honours (B.Sc. Only)

See **Regulations for the Honours Degree of Bachelor of Science**. Students shall complete the following:

At least 51 credit hours in Computer Science courses are required including the following:

1. Computer Science 1000, 1001, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.
2. Excluding 4780, 24 additional credit hours from courses numbered 3000 or higher, at least 9 credit hours of which must be in courses at the 4000 level.

The following courses in Mathematics and Statistics are required:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 2320, 3000, 3001, 3202, 3210, 3320, 3340, Statistics 2550.
2. Either Mathematics 4000 or 4001.
3. Excluding the former Mathematics 3330, the former 4399, and 439A/B, 15 additional credit hours in courses offered by the Department of Mathematics and Statistics numbered 3000 or higher including at least 9 credit hours from courses numbered 4000 or higher and at least 9 credit hours in Pure Mathematics courses.
4. An Honours Dissertation in one of the departments, with the topic chosen in consultation with both departments.

Note: *There is an Undergraduate Advisor in each Department. These advisors should be consulted on all academic matters.*

6.1.17 Computer Science and Statistics Joint Honours (B.Sc. Only)

See **Regulations for the Honours Degree of Bachelor of Science**.The following courses are required:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2320, 3340, Statistics 1510 or 2500 or 2550, 2501 or 2560, 3410, 3411, 3520, 3521, 3540, 4530, 4590.
2. Eighteen further credit hours in Statistics courses including at least 12 credit hours in courses numbered 4000 or higher, but not including Statistics 4581 and 459A/B.
3. Computer Science 1000, 1001, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 4734.
4. Twenty-one additional credit hours in Computer Science courses at the 3000 level or higher, not including 4780.
5. Either Computer Science 4780 or Statistics 459A/B.

6.1.18 Earth Sciences and Geography Joint Honours (B.Sc. Only)

The following courses will be required. A few prerequisites are not met by this list of courses, and students are advised to obtain advice from instructors in such cases to be sure that they are prepared for course material. Both departmental Heads can advise students on a workable sequencing of courses to complete the degree in a timely manner, and students should view a student handbook that describes thematic streams within the program and offers specific guidance about course selection.

1. English 1090 or the former English 1080 or equivalent, English 1110 or equivalent, Geography 1050, Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 (or equivalent) and 1051 (or equivalent), Physics 1050 and 1051, or Physics 1020 and 1021.
2. Geography 2001 or 2302, and Geography 2102, 2195, 2226, 2425 and 3226, Earth Sciences 2401 or 2502, and Earth Sciences 2030, 2031, 2702 and 2905.

3. Mathematics 2000 or Statistics 2550 or Geography 3222, Biology 1001 and 1002, or Biology 2120 or Physics 2055.
4. Either Earth Sciences 499A and 499B, or Geography 4990 and Geography 4999.
5. At least an additional 40 credit hours from Earth Sciences and Geography, with a minimum of 16 credit hours from Earth Sciences and 18 credit hours from Geography; and a minimum of 9 credit hours at the 4000-level in each discipline. Earth Sciences 2150, 2914, 2915, 2916, 2917, 2918, 4310, and 4950 cannot be used to fulfill this requirement. Geography 2105, 2290, 2405, 2460 and 2495 cannot be used to fulfill this requirement.
6. Additional credit hours selected to conform to the **Regulations for the Honours Degree of Bachelor of Science** so as to achieve a total of 120 credit hours.

Notes:
1. *The topic of the Honours dissertation must be chosen with the approval of both Departments. A faculty member of either Department may act as supervisor.*
2. *Any change in the program of study must have the prior approval of the Heads of both Departments concerned.*
3. *The number of specified courses means that English 1110 will be taken normally in the second or third year of the program.*
4. *Students who do not satisfy the **Regulations for the Honours Degree of Bachelor of Science - Academic Standing**, but who successfully complete all the courses, with the exception of the Honours dissertation, and who satisfy all other requirements for the Bachelor of Science, will be eligible to receive a Bachelor of Science with a joint major in Geography and Earth Science.*

6.1.19 Earth Sciences and Physics Joint Honours

This program was formerly in the Earth Sciences section of the calendar as an Honours B.Sc. Degree in Geophysics. The following courses will be required:

1. English 1090 or the former English 1080 and 1110 (or equivalent), Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1200 and 1001), Physics 1050 (or 1020) and 1051.
2. Earth Sciences 2030, 2401, 2502, 2702, 2905, 3170, 3172, 3420, 3905, 4171, 4173, 4179.
3. Physics 2055, 2750 or 2056, 2820, 3220, 3230, 3500, 3820, 4820; plus 9 other credit hours in Physics courses at 3000 level or higher.
4. Mathematics 2000, 2050, 2260, and 3202.
5. Either Earth Sciences 499A/B or Physics 490A/B.
6. Other courses to complete at least a minimum of 120 credit hours.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

6.1.20 Geophysics and Physical Oceanography Joint Honours

The program requires the following courses:

1. English 1090 or the former English 1080 and 1110 (or equivalent), Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Physics 1050 (or 1020) and 1051.
2. Earth Sciences 2905, 3170, 3172, 4105, 4171, 4173, 4179 and 10 credit hours at the 2000 level or higher with at least 3 credit hours at the 3000 level.
3. Physics 2053, 2055, 2820, 3220, 3300, 3500, 3820, 4205, 4300, 4330, 4820 plus one of Physics 3600, 3150, 3400, 3550 or 3900.
4. Mathematics 2000, 2050, 2051, 2260, and 3202.
5. Either Earth Sciences 499A and 499B or Physics 490A and 490B.
6. Other courses to complete the prescribed minimum of 120 credit hours.

6.1.21 Pure Mathematics and Statistics Joint Honours

See **Regulations for the Honours Degree of Bachelor of Science**. The following courses are required:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 2320, 3000, 3001, 3202, 3210, 4000, Statistics 1510 or 2500 or 2550, 2501 or 2560, 3410, 3411, 3520, 3521, 4402, 4410, 4530;
2. A computing course early in the program is required. Computer Science 1510 is highly recommended;
3. either Mathematics 439A/B or Statistics 459A/B;
4. one of: Mathematics 3331 or 3340;
5. Eighteen further credit hours in Pure Mathematics and/or Statistics courses numbered 3000 or higher, excluding the former Mathematics 3330, of which at least 12 credit hours must be from courses numbered 4000 or higher excluding Statistics 4581.

6.2 Joint Majors

6.2.1 Applied Mathematics and Computer Science Joint Major (B.Sc. Only)

The following courses are required

1. Computer Science 1000, 1001, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, plus 18 further credit hours in Computer Science courses numbered 3000 or higher.
2. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 2320, 3000, 3100, 3132, 3161, 3202, 4160, 4190, plus one of Mathematics 3210, 4131, 4132, 4162.

In addition, Statistics 2550 is highly recommended.

6.2.2 Applied Mathematics and Economics Joint Major (B.Sc. Only)

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 3000, 3100, 3202, 4132, Statistics 2550.
2. Either Mathematics 3132 and 4131 or 3161 and 4160.
3. A computing course early in the program is required. Computer Science 1510 is highly recommended.
4. Economics: 1010 (or the former 2010), 1020 (or the former 2020), 2550, 3000, 3001, 3010, 4550, 4551.
5. Eighteen further credit hours chosen from among the various Economics courses in consultation with the Head of the Department or delegate, including at least 9 credit hours at the 4000 level.

6.2.3 Applied Mathematics and Physics Joint Major (B.Sc. Only)

Required course for this degree are:

1. English 1090 or the former English 1080 and English 1110 (or equivalent).
2. A computing course. Computer Science 1510 is recommended.
3. Six credit hours in science other than Mathematics or Physics (if Computer Science is chosen then Computer Science 1510 may be counted as 3 of these hours).
4. Mathematics 1000, 1001, 2000, 2050, 2051, 2260, 3000, 3001, 3132, 3202.
5. At least one of Mathematics 2130 or Mathematics 2320.
6. Physics 1050 (or 1020), 1051, 2053, 2055, 2750 (or 2056), 2820, 3220, 3400, 3500, 3750.
7. Mathematics 3161 or Physics 3820.
8. At least 15 additional credit hours chosen from Applied Mathematics and Physics courses numbered 3000 or above. At least 3 hours are required from Applied Mathematics and 6 hours are required from Physics.
9. A writing course. Any one of Mathematics 2130, Physics 3900, Mathematics 419A/B, or Physics 490A/B is acceptable.

The last requirement does not have to be met independently of the other regulations. For example, it can be satisfied either by choosing Mathematics 2130 from clause 5. above or choosing Physics 3900 as a 3000+ elective in clause 8. above.

6.2.4 Computer Science and Economics Joint Major (B.Sc. Only)

1. **Computer Science Requirements**

   Forty-two credit hours in Computer Science courses are required: 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2500, 3731, 3753 plus 6 further credit hours in Computer Science courses numbered 3000 or higher.

2. **Economics requirements**

   A total of 42 credit hours in Economics courses are required: 1010 (or the former 2010), 1020 (or the former 2020), 2550, 3000, 3001, 3010, and 6 credit hours from either 3550 and 3551, or 4550 and 4551 are obligatory.

   The remaining 18 credit hours shall be chosen from among the various Economics courses in consultation with the Head of the Department or delegate, and will include at least 9 credit hours in courses at the 4000 level.

3. **Additional Requirements:** Mathematics 1000, 1001, 2000, 2050, and Statistics 2550.

6.2.5 Computer Science and Geography Joint Major (B.Sc. Only)

1. **Computer Science Requirements**

   Thirty-nine credit hours in Computer Science courses are required: 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2500, 4751 plus 6 further credit hours in Computer Science courses numbered 3000 or higher.

2. **Geography Requirements**

   Thirty-nine credit hours in Geography courses are required: 1050, 2001, 2102, 2195, 2302, 2425, 3202, 3222, 3250, 3260, 4202, 4250, 4261.

3. **Additional Requirements**: Mathematics 1000, 1001, 2000, 2050, and Statistics 2550.

6.2.6 Computer Science and Physics Joint Major

1. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031).
2. Thirty-nine credit hours in Computer Science are required for the Joint Major: 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 3731 plus 9 further credit hours in Computer Science courses numbered 3000 or higher, including at least 3 credit hours at the 4000 level.
3. Physics 1050 (or 1020) and 1051 plus at least 30 additional credit hours in Physics including 2053, 2055, 2750, 2820, 3220, 3400, 3500, 3750, 3800.
4. a. Mathematics 1000 and 1001.
   b. Mathematics 2000, 2050, 2260, 3202.
   c. Additional electives to bring the credit hours to 120. Computer Science 2500 and Statistics 2550 are recommended.

6.2.7 Computer Science and Pure Mathematics Joint Major (B.Sc. Only)

In addition to Mathematics 1000, 1001, and Computer Science 1000, 1001, the following courses numbered 2000 or higher are required:

1. Computer Science 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.
2. Eighteen additional credit hours in Computer Science courses numbered 3000 or higher.
3. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 2320, 3000, 3202, 3320, 3340, and Statistics 2550.
4. Nine additional credit hours in courses numbered 3000 or higher offered by the Department of Mathematics and Statistics, excluding the former Mathematics 3330.

6.2.8 Computer Science and Statistics Joint Major (B.Sc. Only)

The following courses are required:

1. Computer Science 1000, 1001, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2500, 4734, plus 15 further credit hours in Computer Science courses numbered 3000 or higher.
2. Statistics 1510 or 2500 or 2550, and 2501 or 2560.
3. Mathematics 1000, 1001, 2000, 2050, 2051, 2320, 3340, Statistics 3410, 3411, 3520, 3521, 3540, 4590.
4. Nine further credit hours in Statistics courses numbered 3000 or higher including at least a 3 credit hour course numbered 4000 or higher excluding Statistics 4581.

6.2.9 Earth Sciences and Physics Joint Major

This program was formerly in the Earth Sciences section of the calendar as a General B.Sc. Degree in Geophysics. The following courses will be required:

1. English 1090 or the former English 1080 and 1110 (or equivalent), Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1200 and 1001), Physics 1050 (or 1020) and 1051.
2. Earth Sciences 2030, 2401, 2502, 2702, 2905, 3170, 3172, 3420, 3905; plus a 3 credit hour course in Earth Sciences 4100 series.
3. at least 30 credit hours in Physics courses at the 2000 level or higher, including Physics 2055, 2056 or 2750, 2820, 3220, 3500.
4. Mathematics 2000, 2050 and 3202.
5. Other courses to complete at least a minimum requirement of 120 credit hours in courses for the General Degree.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

6.2.10 Economics and Pure Mathematics Joint Major (B.Sc. Only)

1. Mathematics 1000, 1001, 2000, 2050, 2130, 2260, 2320, 3000, 3100, 3202, 3320, Statistics 2550 and one 4000 level Mathematics course.
2. A computing course early in the program is required. Computer Science 1510 is highly recommended.
3. Economics: 1010 (or the former 2010), 1020 (or the former 2020), 2550, 3000, 3001, 3010, and 6 credit hours from either 3550 and 3551, or 4550 and 4551.
4. Eighteen further credit hours chosen from among the various Economics courses in consultation with the Head of the Department or delegate, including at least 9 credit hours at the 4000 level.

6.2.11 Economics and Statistics Joint Major (B.Sc. Only)

1. Mathematics 1000, 1001, 2000, 2050, 2051, Statistics 2550, 2560, 3410, 3411, 3520, 3540, 4590.
2. Six further credit hours in Statistics courses numbered 3000 or higher, at least 3 credit hours of which must be numbered 4000 or higher, excluding Statistics 3521 and 4581.
3. Economics: 1010 (or the former 2010), 1020 (or the former 2020), 2550, 3000, 3001, 3010, 4550, 4551.
4. Eighteen further credit hours chosen from among the various Economics courses in consultation with the Head of the Department or delegate, including at least 9 credit hours at the 4000 level.

6.2.12 Economics (Co-operative) and Statistics Joint Major (B.Sc. Only)

The Joint Major in Economics (Co-operative) and Statistics Option is available to full-time Economics and Statistics majors (B. Sc.) only. The program is available under the Economics Co-operative Education Option (ECEO).

The ECEO provides an excellent mutual opportunity for students and employers. Qualified students will obtain rewarding employment experience in fields related to Economics for several months of continuous duration. Students will learn valuable practical skills in an employment situation during their course of study. Furthermore, paid employment will help to defray the cost of their education. The timing of the Work Terms and the structure of the ECEO generally are such that employers stand to gain from the acquired employable skills of economists and statisticians in training. The objectives of the Work Term component of the ECEO are embodied in the Work Term descriptions below. The descriptions serve to guide the student and the employer toward achieving these objectives.

1. **Admission Requirements**
   a. Admission is competitive and selective. Therefore, prospective students are encouraged to consider an alternate degree program in the event that they are not accepted into the Joint Co-operative program.
   b. Applicants should note that it is possible to enter Term 1 only in the Fall semester commencing in September of each academic year. Application forms are available in the Department of Economics and the Department of Mathematics and Statistics. The deadline for applications for admission to Term 1 is March 1.
   c. The primary criterion used in reaching decisions on applications for admission is overall academic achievement. Students with weak overall academic records are unlikely to be admitted.
   d. To be eligible for admission to Term 1 an applicant must have successfully completed a minimum of 30 credit hours with an overall average of at least 65% as follows: All applicants must have completed Economics 1010 (or the former 2010) and 1020 (or the former 2020); at least 6 credit hours in English; Mathematics 1000 and 1001; and 12 credit hours chosen from courses in the Faculties of Humanities and Social Sciences or Science.

      It is recommended that students complete English 1110 Critical Reading and Writing II (Context, Substance, Style) as one of these English courses.
   e. Students may apply for admission to Advanced Standing.
   f. Transfer students from other universities will be placed in that term of the program judged to be appropriate considering equivalent credits, as determined by the Departments.
2. **Program of Study**
   a. Promotion from each of Terms 1 through 6 requires a passing grade in all specified required courses and an overall average of at least 60% in all courses including electives. A student who fails a required course or fails to maintain an overall average of 60% will not be promoted to the next term and will be required to withdraw from the program. The student in question may apply for readmission in a subsequent year after passing the specified required course(s) previously failed, or re-establishing the 60% average.
   b. In addition to the 30 credit hours required for admission, students are required to complete the six academic terms in the ECEO program for a total of 120 credit hours. Students must complete three Work Terms which follow Academic Terms 2, 4, and 5.
   c. Courses shall normally be taken in academic terms or "blocks" in the sequenced course load and order set out in the **Academic Course Program - Economics (Co-operative) and Statistics Joint Major (B.Sc. Only) Table**. Unspecified credits may be used to fulfill elective requirements only.
   d. ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate) - Classification of Students** notwithstanding, students do not require special permission to register for courses while on work terms if the courses are in addition to the prescribed program.

3. **Work Term Placement**

   See Regulations in Economics for the Major in Economics (Co-operative), in the Faculty of Humanities and Social Sciences section of the Calendar.

4. **Registration and Evaluation of Performance**

   See Regulations in Economics for the Major in Economics (Co-operative), in the Faculty of Humanities and Social Sciences section of the Calendar.

Academic Course Program - Economics (Co-operative) and Statistics Joint Major (B.Sc. Only) Table

Term 1 (Fall) Economics 3000 Economics 3550 Statistics 2550 Mathematics 2000 Computer Science 1700	**Term 3 (Fall)** Economics 4550 Mathematics 2051 Statistics 3410 Three further credit hours in Statistics courses Three credit hours in elective courses [see Note 2]	**Term 5 (Fall)** Statistics 3520 Statistics 4590 Six further credit hours in Economics courses Three further credit hours in Statistics courses
Term 2 (Winter) Economics 2550 Economics 3001 Economics 3010 Mathematics 2050 Statistics 2560	**Term 4 (Winter)** Economics 3011 Economics 4120 Economics 4551 Statistics 3411 Statistics 3540	**Work Term III (Winter)** Economics 499W
Work Term I (Spring) Economics 299W	**Work Term II (Spring)** Economics 399W	**Term 6 (Spring)** Three further credit hours in Economics courses Three credit hours in Science courses [see Note 2] Nine credit hours in elective courses [see Note 2]

Notes: *1. Another 1000-level Computer Science course may be substituted for Computer Science 1700 with the Heads' approvals.*
2. Elective courses should be chosen with reference to the Regulations for the General Degree of Bachelor of Science, since courses specified for admission to and completion of the program only partially satisfy these regulations. In particular note that in addition to the 78 credit hours (26 courses) in Science subjects required, at least 3 credit hours in a Science subject other than Mathematics/Statistics, Economics and Computer Science must be completed.

6.2.13 Marine Biology

The Joint Major in Marine Biology is jointly administered by the Department of Ocean Sciences and the Department of Biology. It consists of core courses in oceanography and biology, and additional courses in various Science subjects. More information on recommended courses and time tables can be found in the Handbook of Undergraduate Studies available on both departmental websites.

Students who wish to enroll in the program should seek academic advising well in advance to ensure they have completed the appropriate prerequisites. Entry to required courses may be limited and determined by academic performance. Students are advised to consult with the Department of Ocean Sciences or the Department of Biology at the earliest opportunity. Each student registered in the program will be assigned a faculty advisor who should be consulted on academic issues, including course selection.

1. **Admission Requirements**

   Admission to the program is based on academic standing. To be considered for admission to the program, students must normally have completed 33 credit hours with an overall average of at least 60%. The following courses must normally have been completed:

   a. Biology 1001 and 1002 with an average grade of 65%;
   b. Chemistry 1050 and 1051 (or 1010 and 1011) (or 1200 and 1001);
   c. Earth Sciences 1000;
   d. English 1090 and 1110 (or equivalent);
   e. Mathematics 1000;
   f. Ocean Sciences 1000 with a minimum grade of 65%; and
   g. Physics 1020 and 1021 (or 1050 and 1051.

   Chemistry 1050 and 1051 (or 1010 and 1011) should be taken in the first year, as it is a prerequisite for other required courses in the programs, and delaying chemistry until second year may make it difficult to complete the program in the normal four years.

2. **Program of Study**

   Students pursuing a Joint Major in Marine Biology are required to complete a minimum of 33 credit hours in Biology and 33 credit hours in Ocean Sciences as follows:

   a. English 1090 and 1110 (or equivalent);
   b. Mathematics 1000;
   c. Earth Sciences 1000;
   d. Statistics 2550 (or equivalent);
   e. Physics 1020 and 1021 (or equivalent);
   f. Chemistry 1050 and 1051 (or 1010 and 1011) (or 1200 and 1001), and 2440 (or 2400 and 2401);
   g. Biochemistry 2101 and 3106;
   h. Biology 1001, 1002, 2060, 2122, 2250, 2600, 2900, 3710 (or Ocean Sciences 2000) and 3711;
   i. additional courses required to complete 33 credit hours in Biology, except Biology 2040, 2041, 2120, 3053, and 3820, making sure the program includes an overall minimum of 6 credit hours in Biology at the 3000/4000 level;
   j. Ocean Sciences 1000, 2000 (or Biology 3710), 2001, 2100, 2500; and at least one of Ocean Sciences 2200 or 2300;
   k. additional courses required to complete 33 credit hours in Ocean Sciences, including a minimum of 12 credit hours at the 3000/4000 level; and
   l. other courses as necessary to complete the minimum of 120 credit hours required for the General Degree of Bachelor of

Science.

Notes: *1. Courses cross listed between Biology and Ocean Sciences can only count for one subject or the other.*
2. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.
3. Students currently enrolled in the former Major in Biology (Marine) have the option of continuing the program as listed previously, or switch to the new Joint Major in Marine Biology outlined above.

6.3 Option Programs

6.3.1 Physics and Chemistry Option Programs

Students who follow the Physics/Chemistry Joint Honours Program of courses outlined above either as Honours students or otherwise and who satisfy all relevant course regulations except those on Academic Standing for the Honours Degree of Bachelor of Science shall receive on their University records a notation that they followed the “Physics/Chemistry” Option Programs.

Students who intend to follow a joint degree program are strongly recommended to consult the Head of the Department or delegate at their earliest opportunity to ensure proper planning of their course sequence.

7 Degree Regulations

Students must meet all regulations of the Faculty of Science in addition to those stated in the general regulations. For information concerning fees and charges, admission/readmission to the University, and general academic regulations (undergraduate), refer to ***UNIVERSITY REGULATIONS***.

Upon meeting the qualifications for any of the programs of the Faculty of Science a student must apply by the appropriate deadline date to graduate on the prescribed "Application for Graduation " form. This form may be obtained on-line at the Memorial Self Service at www3.mun.ca/admit/twbkwbis.P_WWWLogin. Additional information is available from the Office of the Registrar.

7.1 Admission to the Department of Subject of Major

Admission to certain major programs within the Faculty is limited and competitive.

Admission to all major programs within the Faculty is upon formal application to the department of the subject of major after completion of the admission requirements.

Unless otherwise indicated by the Departmental Admission Regulations as published in the University Calendar under departmental regulations, students upon formal application by *Change of Academic Program Form*, are normally admitted to the department of major program upon successful completion of 30 credit hours which must include:

1. 6 credit hours in English courses
2. 6 credit hours in Mathematics courses
3. 6 credit hours in courses from each of two Sciences other than Mathematics

Students seeking admission to departments with Departmental Admission Regulations as indicated above must apply for admission on the appropriate Departmental Application for Admission Form upon completion of the specified admission requirements.

7.2 Limited Enrolment Courses

Certain course offerings in the Faculty of Science will be identified as being Limited Enrolment Courses and will be clearly identified as such in the University Timetable. Students who have registered for a Limited Enrolment Course must confirm their registration either (1) by attending at least one of the first three hours of lecture in the course and the first meeting of any laboratory section of the course; or (2) by notifying the department in writing within the first five university working days of the semester. Students who do not confirm their registration may be dropped from the course on the recommendation of the Head of Department.

7.3 Regulations to Govern Supplementary Examinations in the Departments of Biochemistry, Computer Science, and Mathematics and Statistics

1. Supplementary examinations will be allowed in certain of the Biochemistry, Computer Science, and Mathematics and Statistics courses which have written final examinations. In each course, students will be informed as to the possibility of a supplementary examination during the first week of classes. This information will be provided in writing, as part of the evaluation scheme for the course.
2. Supplementary examinations will be similar in length and degree of difficulty as the original final examination.
3. Students who wish to write supplementary examinations must apply in writing to the department within one week of release of grades.
4. A student who has clear or conditional standing may write a supplementary examination in a course if the final grade obtained is 45-49F and if the term mark is at least 50%.
5. In order to pass the course, the student, must pass the supplementary examination. If the student passes the supplementary examination, then a new grade will be calculated using the same weighting scheme as used in the course, but with the result of the supplementary examination replacing that of the original final examination. Any additional course requirements, including a requirement to pass the laboratory component of a course, will continue to apply.
6. If the new course grade is higher than the original, it will replace the original grade on the student's transcript, subject to the condition that the final mark will not exceed the student's term mark. The student's transcript will indicate that the course result was earned as the result of a supplementary examination.
7. Supplementary examinations will be written no later than the first week of the semester immediately following the one in which the course was failed. Normally they will coincide with the writing of deferred examinations. Grades for supplementary examinations will be submitted to the Office of the Registrar within one week following the commencement of classes for that semester.
8. A student may write a supplementary examination for any one registration in a course only once; if the course result following the supplementary examination is a fail then the course must be repeated in order to obtain credit.

7.4 Regulations for the General Degree of Bachelor of Science

1. For the General Degree of Bachelor of Science a candidate will be required to complete, subject to the following Regulations, 120 credit hours applicable to the degree which shall include:
   a. Six credit hours in English courses
   b. Six credit hours in Mathematics courses
   c. Six credit hours in courses from each of two Sciences other than Mathematics
2. a. Courses shall be chosen so that a candidate shall have completed an approved concentration of courses in one subject to be known as the candidate's Major. For the purposes of these regulations, candidates may complete only one major from departments which offer more than one. In selecting courses in their Major, candidates must comply with the Departmental Regulations approved by the Senate and printed in the Calendar. The Departmental Regulations shall require not fewer than 36 nor more than 45 credit hours in courses from the subject of the Major (including the courses in that subject completed at the first year level). (See also Notes 1. and 2.).
   b. The subject of the candidate's major shall be that declared by the candidate on the appropriate admission form and approved by the department at the time of admission.
   c. The 36 or more credit hours in courses from one subject referred to in a. above, may be chosen from the following subjects, and may include courses in that subject which were completed at first-year level: Biology (see Note 4.), Biochemistry (see Note 6.), Chemistry, Computer Science, Earth Sciences, Economics, Geography, Mathematics (except the former 1150 and 1151) and Statistics, Physics, Psychology.
   d. A candidate may change the subject of the Major during any Regular Registration Period provided he or she has first applied for and received acceptance by the department to which application is being made.
   e. In those Departments which offer programs leading to both a degree of Bachelor of Arts and a degree of Bachelor of Science, students are free to choose the degree program they wish to follow and may change from one to the other; however, they may not obtain both degrees in the same Major subject at this University.
3. Further courses may be chosen from any of the subjects listed in Clause 2. above, or from other courses approved by the Committee on Undergraduate Studies of the Faculty of Science (see Note 5.), provided that, of the 120 credit hours required:
   a. candidate shall have completed at least 78 credit hours in courses from the subjects listed in Clause 2. above, including the Major courses and the courses required for admission; See Notes 3. and 5.
   b. there shall be not fewer than five subjects in which a candidate shall have completed courses. At least four of these subjects shall be chosen from the subjects listed in Clause 2. above. In the case of unspecified transfer credits awarded in a subject area not taught at Memorial University of Newfoundland any number of such transfer credits in the aggregate shall count as one subject area.
   c. not more than 15 unspecified transfer credit hours awarded in a subject area not taught at Memorial University of Newfoundland shall be used to satisfy the requirements of the degree.
4. Before a candidate registers, the Head of the Department of his or her Major, or delegate, shall approve a candidate's program which is in accordance with the above regulations. The Head of the Department or delegate shall advise each candidate of programs suitable for his or her particular needs.
5. To obtain a general degree of Bachelor of Science a candidate shall have:
   a. satisfied the conditions of ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Graduation** - **Application for Graduation - Degrees, Diplomas and Certificates**;
   b. obtained an average of at least 2.0 points per credit hour in the 78 credit hours in Science required for the degree;
   c. obtained an average of at least 2.0 points per credit hour in the minimum number of credit hours in the major subject (or, in the case of joint majors, subjects) required for the major program (or, in the case of joint majors, programs).
6. Where a student satisfies the separate departmental regulations for a major in two or more subjects for which a specific joint program does not exist, such subjects shall be recognized as the major subjects for the general degree of Bachelor of Science.
7. A candidate may complete a minor of at least 24 credit hours in courses from a subject area other than that of the Major chosen from Clause 2. c. above or from minors available in the Faculty of Humanities and Social Sciences, the Faculty of Business Administration, and the School of Music. (It should be noted that because of departmental regulations for the Major, not every candidate may be able to fit a minor into his or her 120 credit hour program).
   a. The subject of the candidate's minor shall be that declared by the candidate on the Change of Academic Program Form which must then be signed by the Head of the Department of the Minor.
   b. A candidate must follow the departmental regulations for the Minor as set forth in the appropriate section of the Calendar.
   c. The Head of the Department of the Minor will advise the candidate on the selection of courses in the Minor.
   d. Students who have taken courses appropriate to their Minor at another university are required to complete at least 6 credit hours in courses from that subject at this University. These courses must be chosen in consultation with the Head of the Department of the Minor program.
   e. A candidate must obtain a grade point average of at least 2.0 in the credit hours prescribed for the minor program.

Notes:
1. *Departmental regulations are not intended to debar students from taking more than the required courses in the subject of their Major.*
2. *Students who have taken courses in the subject of their Major at another university are required to complete at least 12 credit hours in courses from that subject at this University.*
3. *The former Science 2010/2011 may be used to fulfil in part the requirement of 78 credit hours in Science.*
4. *Biology 2120 may not be used for credit by Biology Majors.*
5. *When Science course equivalents have been established by Department Heads for Engineering courses, credit may not be obtained for both the Engineering course and the established equivalent course offered by the Faculty of Science.*
6. *In the case of Biochemistry the courses for the Biochemistry program shall include Chemistry 2400 and 2401.*

7.5 Regulations for the Honours Degree of Bachelor of Science

A program is offered leading to the Honours Degree of Bachelor of Science. An Honours degree offers greater specialization in a given field of knowledge than a General degree, and requires higher than average academic achievement. Possession of this degree will be of great advantage to all students planning more advanced work in their chosen field. In many cases, an Honours degree is a prerequisite for admission to a graduate program.

7.5.1 Admission and Registration

1. A student who wishes to be admitted to any of the Honours programs must submit an "Application for Admission to Honours Program Faculties of Humanities and Social Sciences or Science". This Application is available online from the Office of the Registrar at www.mun.ca/regoff/Application_Honours_Program.pdf. This form shall be submitted to the Department(s) of specialization and to the Registrar not earlier than the beginning of his (her) fifth semester, or the equivalent, at University, and not later than the final date set for the application for a degree. A candidate for an Honours degree must have completed all courses listed under **Admission to the Department of Subject of Major** before declaring his (her) intent to pursue an Honours degree, regardless of whether these courses had been completed at the time of admission to his (her) Department of specialization.

   Note: *An otherwise qualified student who fails to declare the intention to obtain an Honours degree on or before the last day of the period outlined above shall be awarded a General degree even if the student fulfils all other requirements for an Honours degree. The University cannot undertake to notify him (her) that he (she) may be eligible for an Honours degree.*

2. At the beginning of each registration period the Head(s), or delegate(s), of the Department(s) in which a candidate is taking Honours, shall approve a candidate's program. The Head(s) of Department(s), or delegate(s), shall advise each candidate of programs suitable for his or her particular needs.
3. Students who have been awarded a Bachelor of Science (General) degree may convert it to a Bachelor of Science (Honours) degree by declaring their intention and by completing the requirements for the Honours degree as outlined in these regulations.
4. To graduate, a candidate for an Honours degree must have completed all courses listed under **Admission to the Department of Subject of Major** in addition to those courses required by individual departmental regulations.

7.5.2 Course Requirements

1. a. For the Honours Degree of Bachelor of Science with a single subject major a candidate will be required to have completed 120 prescribed credit hours in courses. For the Joint Honours Degree of Bachelor of Science a candidate will be required to have completed either 120 or 135 credit hours as prescribed by the specific program. In either case, those courses must include the courses specified in **Clause 1. of the Regulations for the General Degree of Bachelor of Science**.

   b. Clause 1.a. notwithstanding, certain Departmental regulations preclude the possibility of completing a single subject Honours degree in 120 credit hours and may require the completion of 123, 126 or 129 credit hours in courses. (See Note below). In such cases all courses required to satisfy requirements of the degree will be used to determine **Academic Standing**, 2. below.

      Note: *The requirements for an Honours Degree of Bachelor of Science cannot be completed in 120 credit hours if any of the following three statements is true: (1) the student is a major in Chemistry, or Physics and has completed the former Mathematics 1080; (2) the student is a major in Chemistry or Physics and has completed the former Chemistry 1800; (3) the student is a candidate for the Honours B.Sc degree in Chemistry or Physics and has completed Physics 1021. Such students will only meet the degree requirements after completing 123, 126 or 129 credit hours in courses.*

2. Courses shall be chosen so that a candidate shall have completed:

   Either, (1) at least 60 credit hours from courses in one of the following subjects, including the courses in that subject completed at the first year level: Biology, Biochemistry, Chemistry, Computer Science, Earth Sciences, Economics, Geography, Mathematics and Statistics, Physics and Psychology.

   Notes: *1. For options in the Biochemistry and Nutrition programs the courses shall be those specified in the respective programs.*
   2. For the Behavioural Neuroscience Program, the courses shall be those specified in the program.
   3. For the Environmental Physics Program, the courses shall be those specified in the program.

   or, (2) at least 84 credit hours in courses from two subjects listed in (1.) above, including the courses in these subjects completed at the first year level, with no fewer than 36 credit hours in either subject approved by the Committee on Undergraduate Studies of the Faculty of Science on the recommendation of the respective Heads of Departments.

   or, (3) in special circumstances, a program of at least 90 credit hours in courses from two or more subjects, including the courses in these subjects completed at the first year level, one of which need not be taken from those listed in 1. above, as recommended by the Heads of the Departments concerned and approved by the Committee on Undergraduate Studies of the Faculty of Science.

3. Further courses may be chosen from any of the subjects listed in Clause 2. above, or from other courses recognized for this purpose by the Committee on Undergraduate Studies of the Faculty of Science (see Note 5 of the Bachelor of Science General Degree) provided that, of the 120 or more credit hours required:

   a. a candidate shall have completed at least 90 credit hours in courses from the subjects listed in Clause 2. above, including those completed at the first-year level, and

   b. there shall be no fewer than four subjects in which a candidate shall have completed courses. In the case of unspecified transfer credits awarded in a subject area not taught at Memorial University of Newfoundland, any number of such transfer credits in the aggregate shall count as one subject area.

   c. Not more than 15 unspecified transfer credit hours in courses awarded from a subject area not taught at Memorial University of Newfoundland shall be used to satisfy the requirements of the degree.

7.5.3 Comprehensive Examination and Dissertation

1. In addition to the regular examinations, a candidate in an Honours program shall pass a general comprehensive examination in his (her) Major subject or subjects. Alternatively, a candidate may be required to submit a dissertation, which at the discretion of the Head(s) of the Department(s) of specialization may be followed by an oral examination thereon.
2. If a candidate is required to submit a dissertation, such dissertation must be submitted to the University Library before the degree is conferred. All Honours dissertations in the University Library shall be available for unrestricted consultation by students and faculty except under very exceptional circumstances which must be approved by the head of the academic unit of the student’s program. Copyright remains with the author. A release form, signed by both the student and the head of the academic unit of the student's program, must accompany an essay or a dissertation when it is submitted to the University Library.
3. The deadline for the submission of Honours dissertations shall be no later than three weeks before the end of the final semester of the candidate's program.
4. The Honours dissertation shall be equivalent to either a 3 credit hour course or a 6 credit hour linked course as specified in the course offerings of each Department.

7.5.4 Departmental Regulations

Candidates for Honours Degrees shall also comply with such additional requirements of the appropriate Department(s) as are approved by the Senate and printed in the Calendar.

7.5.5 Residence Requirements

1. To qualify for an Honours Degree in Science, a candidate shall attend a recognized university or an equivalent institution for at least seven semesters as a full-time student. Honours candidates transferring credits to Memorial University of Newfoundland from other universities or equivalent institutions shall either spend a minimum of four of the seven semesters as full-time students at Memorial University of Newfoundland, and take a minimum of 24 credit hours in courses from their Honours discipline or take a minimum of 36 credit hours in courses from their Honours discipline as full-time students at Memorial University of Newfoundland (whichever is to their advantage), provided that the total number of semesters spent as full-time students at this and other recognized universities or equivalent institutions will not be less than seven.
2. To qualify for an Honours Degree in Science and additionally a second degree, a candidate shall attend this University for at least ten semesters as a full-time student, except with the special permission of the Faculty Committee on Undergraduate Studies.

7.5.6 Academic Standing

In order to graduate with an Honours degree, a candidate shall obtain:

1. a grade of "B" or better, OR an average of 75% or higher (whichever is to the candidate's advantage) in the minimum number of courses in the Honours subject (or subjects) prescribed by the Department (or, in the case of joint Honours, Departments) concerned, excluding the 1000-level courses, and
2. an average of at least 2.75 points on the total number of courses required for the degree (see ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate), Grading** for explanation of the point system).

Note: *A student may, with the approval of the Head of the Department and the Committee on Undergraduate Studies, repeat or substitute up to three courses in order to meet the requirements of Clause 1. above. In counting repeats, each attempt at the same course will count as one course towards the maximum. That is, the same course, repeated three times, would place a student at the maximum and no additional repeats or substitutions would be allowed.*

7.5.7 Classification of Degrees

1. If the candidate's general average is 3.25 or better per required course, and his (her) average for the courses in his (her) Honours subject (excluding 1000-level courses) is 3.50 or better, he (she) shall be awarded an Honours degree with First Class standing.
2. If the candidate fulfils the conditions outlined under **Academic Standing** but not of Clause 1. above., he (she) shall be awarded an Honours degree with Second Class standing.
3. No classification will be given to the degree awarded a candidate who has completed (1) fewer than one half of the courses required for the degree at this University, or (2) who has completed fewer than one half of the courses required for the degree at this University since 1959. All candidates for such degrees shall, however, fulfil the conditions outlined under **Academic Standing** on the courses taken at the University since September, 1959, in order to qualify for the degree.
4. A declared candidate for an Honours degree who fails to attain the academic standing specified under **Academic Standing** but fulfills the academic requirements for a General Degree shall be awarded a General Degree, the classification of which shall be determined in accordance with the ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate), Graduation**.

8 Waiver of Regulations for Undergraduate Students

Where circumstances warrant, any prerequisite or prerequisites listed in Departmental Regulations may be waived by the Head of the Department. Any Department Regulations may be waived by the appropriate Committee on Undergraduate Studies upon request of the Head of the Department concerned.

Students wishing waiver of University academic regulations should refer to ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate) - Waiver of Regulations**.

9 Appeal of Decisions

Any student whose request for waiver of Faculty regulations has been denied has the right to appeal. For further information refer to ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate) - Appeal of Decisions**.

10 Program Regulations

10.1 Biochemistry

www.mun.ca/biochem

The following undergraduate programs are available in the Department:

1. Biochemistry and Cell Biology Joint Honours
2. Biochemistry and Chemistry Joint Honours
3. Biochemistry and Physics Joint Honours
4. Biochemistry and Psychology (Behavioural Neuroscience) Joint Honours
5. Biochemistry (Nutrition) and Psychology (Behavioural Neuroscience) Joint Honours
6. Major or Honours in Biochemistry
7. Major or Honours in Nutrition
8. Minor in Biochemistry

Students who wish to enrol in any of these programs should plan their program well in advance so that they will have taken the appropriate prerequisites. Entry to a number of required courses is limited and will be determined by academic performance. Required courses should be taken in the year indicated by the course numbers so as to avoid timetable clashes and missing prerequisites which could prolong the time necessary to complete the program. Students are advised to consult with the Department at the earliest opportunity.

Candidates for the general and honours degrees in the programs above should refer to the Faculty of Science **Degree Regulations** for the **General** and **Honours** degrees of Bachelor of Science.

Candidates for a minor in Biochemistry should refer to the **Regulations for the General Degree of Bachelor of Science**, Clause 7.

Students who intend to pursue graduate studies should take the courses leading to the honours degree.

Biochemistry course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Biochemistry**.

Note: *Supplementary examinations will be allowed in certain Biochemistry courses which have written final examinations. Students should refer to the Faculty of Science Degree Regulations for details.*

10.1.1 Admission to Programs

Students who wish to declare a Major in Biochemistry or Biochemistry (Nutrition) or who wish to apply for Honours standing in any of our programs are strongly recommended to do so by May 31 in any year. Failure to apply by the recommended date may result in your application not being processed before your registration time. In addition, students who do not declare by this date may not be considered for departmental scholarships or other awards.

10.1.2 Major in Biochemistry

Entry to the Biochemistry Majors program is based on academic standing.

1. To be considered for admission to the program students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%. In addition, students must be eligible for entry to Chemistry 2400.
   a. English 1090 or the former English 1080, 1110 (or equivalent)
   b. Chemistry 1050 and 1051 (or 1200 and 1001)
   c. Mathematics 1000, 1001 (or Mathematics 1090, 1000, or Mathematics 109A/B, 1000)
   d. Physics 1050 (or 1020), 1051 (or 1021), or Biology 1001, 1002
2. Required courses to complete the major:
   a. Biochemistry 2100, 2101, 3105, 3106, 3107, 3108.
   b. At least 12 credit hours in courses from Biochemistry 2600, 3203, 4002, 4101, 4103, 4104, 4105, 4200, 4201, 4230-4239.
   c. Medicine 310A/B or 6 credit hours from Biochemistry 4240-4249, Biology 2060, 3050, 3401, 3402, 3530, 4200, 4245, 4404, Chemistry 4201, 4701.
   d. Biology 1001 and 1002; Mathematics 1001; and Physics 1050 (or 1020), 1051 (or 1021) for those students who did not complete them in first year. (See Notes 2. and 3. below).
   e. Chemistry 1051 is a required course for the Major in Biochemistry and must normally be completed prior to entrance into 2nd year Chemistry and Biochemistry courses. Students who do not meet the requirements for entry into Chemistry 1050 from high school can first take Chemistry 1010 followed by Chemistry 1050 and 1051. It is strongly recommended that these students complete Chemistry 1051 prior to second year.
   f. Chemistry 2301 or Physics 2053; Chemistry 2400, 2401.
   g. One of Chemistry 2100, Environmental Sciences 3210.

   Notes: *1. Students are required to complete at least 78 credit hours in Science courses for the General Degree.*
   2. Students taking Mathematics 1000 should take Physics 1050 as their first Physics course.
   3. It Is recommended that students who wish to pursue future studies in biophysics or related fields or who are considering postgraduate health professional programs take Physics 1050 as their first Physics course.
   4. For the purposes of a Biochemistry degree, Medicine 310A/B count as Biochemistry courses.
3. Students are encouraged to choose a minor.

10.1.2.1 Honours Degree in Biochemistry

Students normally should apply for an Honours program at the completion of their third year of studies. Honours students would normally follow the Biochemistry Majors program before applying to honours, and must meet its admissions requirements as follows:

1. To be considered for admission to the majors program prior to admission to honours, students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%. In addition, students must be eligible for entry to Chemistry 2400.
   a. English 1090 or the former English 1080, 1110 (or equivalent)
   b. Chemistry 1050 and 1051 (or 1200 and 1001)
   c. Mathematics 1000, 1001 (or Mathematics 1090, 1000, or Mathematics 109A/B, 1000)
   d. Physics 1050 (or 1020), 1051 (or 1021), or Biology 1001, 1002
2. To be eligible for admission, students must be in Honours standing. To be considered for early admission to an Honours program in Biochemistry at the end of second year, students must have achieved at least 70% in each of Biochemistry 2100 and 2101 and Chemistry 2400, 2401.
3. Required courses:
   a. Biochemistry 2100, 2101, 3105, 3106, 3107, 3108, 4102, 499A, 499B, Medicine 310A/B.
   b. Biochemistry 4210 or 4211.
   c. Twelve credit hours in courses from Biochemistry 4002, 4101, 4103, 4104, 4105, 4200, 4201, 4230-4239.
   d. At least 6 credit hours in courses from Biochemistry 2600, 3203, 4240-4249, Biology 2060, 3050, 3530, 4200, 4245, 4404, Chemistry 4201, 4701.
   e. Biology 1001 and 1002; Mathematics 1001; and Physics 1050 (or 1020), 1051 (or 1021), for those students who did not complete them in first year. (See Notes 1. and 2. below).
   f. Chemistry 1051 is a required course for the major in Biochemistry and must normally be completed prior to entrance Into 2nd year Chemistry and Biochemistry courses. Students who do not meet the requirements for entry into Chemistry 1050 from high school can take Chemistry 1010 followed by Chemistry 1050 and 1051. It is strongly recommended that these students complete Chemistry 1051 prior to second year.
   g. Chemistry 2301 or Physics 2053, Chemistry 2400, 2401, one of Chemistry 3411 or 4410.
   h. One of Chemistry 2100, Environmental Sciences 3210.
   i. Statistics 2550 or equivalent.

   Notes: *1. Students taking Mathematics 1000 should take Physics 1050 as their first Physics course.*

2. *It is recommended that students who wish to pursue future studies in biophysics or related fields or who are considering postgraduate health professional programs take Physics 1050 as their first Physics course.*
3. *For the purposes of a Honours Degree in Biochemistry, Medicine 310A/B count as Biochemistry courses.*

4. Students are encouraged to choose a minor.

   Those courses in which a grade "B" or an average of 75% or higher are required, as specified under **Academic Standing**, clause 1. of the **Regulations for the Honours Degree of Bachelor of Science**, are 45 credit hours in Biochemistry courses and 15 credit hours in other courses (beyond the 1000-level) chosen from Biochemistry, Biology, or Chemistry. Biology 2040, 2041, 3820 and the former Chemistry 2600, the former Chemistry 2601 may not be used to meet this requirement. Medicine 310A/B counts as Biochemistry for these 60 credit hours.

10.1.2.2 Minor in Biochemistry

Students who take a minor in Biochemistry will complete:

1. Biochemistry 2101, 3106.
2. One of Biochemistry 2100, 2600, Biology 2250.
3. Nine credit hours in Biochemistry at the third or fourth year level; or 6 credit hours in Biochemistry at the third or fourth year level and Biology 3050.
4. Either Chemistry 2400, 2401 or Chemistry 2440 and 3 additional credit hours from the Biochemistry courses listed in 3. above.

Course prerequisites stipulated in the course descriptions shall apply to a minor in Biochemistry.

Note: *For the purposes of a Biochemistry minor, Medicine 310A/B count as Biochemistry courses.*

10.1.3 Nutrition Program

10.1.3.1 Major in Nutrition

Entry to the Nutrition majors program is based on academic standing.

1. To be considered for admission to the program students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%.
   a. English 1090 or the former English 1080, 1110 (or equivalent)
   b. Chemistry 1050, 1051 (or Chemistry 1010, 1011 or 1200, 1001)
   c. Mathematics 1090, 1000 (or Mathematics 109A/B, 1000, or Mathematics 1000 and one elective)
   d. Biology 1001, 1002 or Physics 1020, 1021 (or equivalent)
2. Required courses to complete the major:
   a. Biochemistry 2005, 2100, 2101, 2600, 3106, 3203, 3402, 4300, 4301, Medicine 310A/B
   b. Six credit hours in courses from Biochemistry 3052, 3107, 3108, 3202, 3600, 4002, 4101, 4103, 4104, 4105, 4200, 4201, 4230-4249, Biology 3050
   c. Biology 1001 and 1002; and Physics 1020 and 1021 (or equivalent), for those students who did not complete them in first year
   d. Chemistry 2440 (or Chemistry 2400, 2401)
   e. Statistics 2550 or equivalent
3. Students are encouraged to choose a minor.

Notes: *1. Students are required to complete at least 78 credit hours in Science courses for the General Degree.*
2. Students who choose to complete Chemistry 2400/2401 are advised to take the appropriate prerequisites for those courses.
3. For the purposes of a Biochemistry (Nutrition) degree, Medicine 310A/B count as Biochemistry courses.

10.1.3.2 Honours Degree in Nutrition

Students normally should apply for an Honours program at the completion of their third year of studies. Honours students would normally follow the Biochemistry (Nutrition) Majors program before applying to honours, and must meet its admissions requirements as follows:

1. To be considered for admission to the majors program prior to admission to honours, students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%:
   a. English 1090 or the former English 1080, 1110 (or equivalent)
   b. Chemistry 1050, 1051 (or Chemistry 1010, 1011, or 1200, 1001)
   c. Mathematics 1090, 1000 (or Mathematics 109A/B, 1000, or Mathematics 1000 and one elective)
   d. Biology 1001, 1002 or Physics 1020, 1021 (or equivalent)
2. To be eligible for admission to the honours program, students must be in Honours standing. To be considered for early admission to an Honours program in Nutrition at the end of second year, students must have achieved at least 70% in each of their required 2000 level Biochemistry and Chemistry courses.
3. Required courses:
   a. Biochemistry 2005, 2100, 2101, 2600, 3106, 3107, 3203, 3402, 3600, 4002, 4300, 4301, 4502, 499A, 499B, Medicine 310A/B.
   b. Twelve additional credit hours chosen from Biochemistry 3052, 3105, 3108, 3202, 4101, 4103, 4104, 4105, 4200, 4201, 4210, 4211, 4230-4249, Biology 3050, Chemistry 4701.
   c. Biology 1001 and 1002; and Physics 1020 and 1021 (or equivalent), for those students who did not complete them in first year.
   d. Chemistry 2440 (or Chemistry 2400, 2401).
   e. Statistics 2550 or equivalent.
4. Students are encouraged to choose a minor.
5. Those courses in which the grades specified under **Academic Standing, clause 1** of the **Regulations for the Honours Degree of Bachelor of Science** are 60 credit hours chosen from Biochemistry courses and Biology 3050.

Notes: *1. Students who choose to complete Chemistry 2400/2401 are advised to take the appropriate prerequisites for those courses.*
2. For the purposes of a Biochemistry (Nutrition) Honours degree, Medicine 310A/B count as Biochemistry courses.

10.2 Biology

www.mun.ca/biology

The following undergraduate programs are available in the Department:

1. Biochemistry and Cell Biology Joint Honours
2. Biology and Earth Sciences (Geology) Joint Honours
3. Biology and Psychology Joint Honours
4. Biology and Psychology (Behavioural Neuroscience) Joint Honours
5. Biology and Statistics Joint Honours
6. Joint Major in Marine Biology
7. Major or Honours in Biology
8. Major or Honours, or Major (Co-operative) or Honours (Co-operative), in Biology (Cell and Molecular)
9. Major or Honours, or Major (Co-operative) or Honours (Co-operative), in Biology (Ecology and Conservation)
10. Honours, or Honours (Co-operative), in Biology (Marine)
11. Minor in Biology

Details of joint programs are given after the **Regulations for the Honours Degree of Bachelor of Science**.

Biology course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Biology**.

10.2.1 Entrance Requirements

Entry to the Biology Majors Program is competitive and based on academic standing.

To be considered for admission to the program students must have completed Biology 1001/1002 with an average of at least 65%. In addition, applicants will normally have completed the following courses (or their equivalents) and must have a minimum overall average of 60% in these courses.

1. English 1090 or the former English 1080, 1110 or equivalent
2. Mathematics 1090 and Mathematics 1000 (or Mathematics 109A/B and Mathematics 1000, or Mathematics 1000 only)
3. Chemistry 1010/1011 (or equivalent) or Physics 1020/1021 (or equivalent)
4. If Mathematics 1000 taken, any one other first year course.

Chemistry 1010/1011 (or 1050/1051) should be taken in the first year, as it is a prerequisite for other required courses in the programs, and delaying chemistry until second year may make it difficult to complete the program in the normal eight semesters.

10.2.2 Minor in Biology

A minor in Biology will consist of 24 credit hours in Biology courses: 1001 and 1002 (or equivalent) plus any 18 credit hours chosen from the list of Biology courses except Biology 2040, 2041, 2120, 3053, and 3820. The choice of courses must be made in consultation with the Head of Biology or delegate and it is recommended (but not required) that students take at least two Biology courses at the 3000 level or above.

10.2.3 General Degrees

Each Major is assigned a faculty advisor who should be consulted on academic problems, including course selection.

10.2.3.1 Major in Biology

All students majoring in Biology are required to complete a minimum of 45 credit hours in courses from the Department of Biology offering. Those 45 credit hours must include: Biology 1001 and 1002 or their equivalents; the 15 credit hours in core courses listed below; and 24 credit hours in Biology electives at the 2000, 3000 or 4000 level except Biology 2040, 2041, 2120, 3053, and 3820.

Biology Core (15 credit hours): Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404.

A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

All majors must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Extra Science courses as necessary to fulfil the requirement for 78 credit hours in Science as stipulated in Clause 3.a. of the **Regulations for the General Degree of Bachelor of Science**.

It is recommended, but not required, that a Computer Science course be included and the Department of Biology strongly recommends Computer Science 1000 or 1600.

Note: *To minimize timetabling problems, students on the St. John's campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and 2060 and 2900 in their fourth semester (Winter).*

10.2.3.2 Major in Biology (Cell and Molecular)

All students majoring in Biology (Cell and Molecular) are required to complete a minimum of 45 credit hours in courses from the Department of Biology offering. Those 45 credit hours must include: Biology 1001 and 1002 or their equivalents; the 15 credit hours in core courses listed below; Biology 3530 and 4241; 6 credit hours from the recommended Biology courses for Biology (Cell and Molecular) listed below; and 12 credit hours from Biology electives at the 2000, 3000 or 4000 level except Biology 2040, 2041, 2120, 3053, and 3820.

Biology Core (15 credit hours): Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404.

Recommended Biology courses for Biology (Cell and Molecular)) are 3050, 3052, 3401, 3402, 3500, 3620, 3950, 3951, 4010, 4040,

4050, 4200, 4245, 4250, 4251, 4255, 4404, 4550, 4605, and 4607.

A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

All majors must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Extra Science courses as necessary to fulfil the requirement for 78 credit hours in Science as stipulated in Clause 3.a. of the **Regulations for the General Degree of Bachelor of Science**.

It is recommended, but not required, that a Computer Science course be included and the Department of Biology strongly recommends Computer Science 1000 or 1600.

Note: *To minimize timetabling problems, students on the St. John's campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and 2060 and 2900 in their fourth semester (Winter).*

10.2.3.3 Major in Biology (Ecology and Conservation)

All students majoring in Biology (Ecology and Conservation) are required to complete a minimum of 45 credit hours in courses from the Department of Biology offering. Those 45 credit hours must include: Biology 1001 and 1002 or their equivalents; the 15 credit hours in core courses listed below; Biology 4650 and 4651; 6 credit hours from the recommended Biology courses for Biology (Ecology and Conservation) listed below; and 12 credit hours from Biology electives at the 2000, 3000 or 4000 level except Biology 2040, 2041, 2120, 3053, and 3820.

Biology Core (15 credit hours): Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404.

Recommended Biology courses for Biology (Ecology and Conservation) are 3041, 3050, 3295, 3300, 3610, 3620, 3640, 3709, 3710, 3711, 3714, 3715, 3750, 4040, 4141, 4180, 4182, 4250, 4306, 4307, 4360, 4405, 4505, 4605, 4607, 4620, 4630, 4701, 4710, 4750, and 4820.

A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

All majors must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Extra Science courses as necessary to fulfil the requirement for 78 credit hours in Science as stipulated in Clause 3.a. of the **Regulations for the General Degree of Bachelor of Science**.

It is recommended, but not required, that a Computer Science course be included and the Department of Biology strongly recommends Computer Science 1000 or 1600.

Note: *To minimize timetabling problems, students on the St. John's campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and 2060 and 2900 in their fourth semester (Winter).*

10.2.3.4 Major in Biology (Marine)

Important Notice

The Major in Biology (Marine) is no longer being offered. Students who have already declared this major may complete the program in accordance with ***UNIVERSITY REGULATIONS*****, Degree and Departmental Regulations, Year of Degree and Departmental Regulations - Faculty of Humanities and Social Sciences and Faculty of Science**, or may instead switch to the **Joint Major in Marine Biology** by completing a Change of Academic Program form.

10.2.3.5 Major in Biology (Co-operative) Program (BCOP)

This program is available to full-time Biology majors only.

The Biology (Co-operative) Program (BCOP) provides an opportunity for students to learn valuable practical skills while working in fields related to Biology. Students complete three Work Terms, which consist of full-time paid employment in the field of Biology of at least 12 weeks in duration. The timing of the Work Terms is such that employers stand to gain from the acquired skills of biology majors in training. The objectives of the Work Term component of the BCOP are embodied in the Work Term descriptions found at the end of the Faculty of Science section under **Course Descriptions, Biology, Work Term Descriptions**.

1. **Admission Requirements**
   a. Admission is limited, competitive, and selective.
   b. The primary criterion used in reaching decisions on applications for admission is overall academic achievement.
   c. A student must first be admitted to the Biology Major.
   d. Application deadline: November 15 for the following Spring semester work term (normally the third semester in year two).
   e. To be admitted to the program, a student must have completed the second year Biology Core, with an overall average of at least 65%, and an overall average of at least 65% in all Biology courses. A student must have an overall average of 65% in all other required courses, and must be registered for 15 credit hours in the semester in which application is made.
2. **Program of Study**
   a. In addition to the requirements below, a student must fulfill all requirements for one of a Major in Biology; Major in Biology (Cell and Molecular); Major in Biology (Ecology and Conservation); Honours in Biology; Honours in Biology (Cell and Molecular); Honours in Biology (Ecology and Conservation); or Honours in Biology (Marine).

b. To remain in BCOP, a student must receive a passing grade in all required courses, and must maintain an overall average of at least 65% in all Biology courses and an overall average of at least 65% in all courses, including electives. A student who fails a required course, fails to maintain an overall average of 65% in Biology courses, or fails to maintain an overall average of 65%, will be required to withdraw from BCOP. The student in question may apply for readmission in a subsequent year after passing the specified required course(s) previously failed, or re-establishing the required average.

c. A student is required to complete three work terms, one of which must be either in the Fall or Winter semester.

3. **Work Term Placement**

a. General management of the work terms in BCOP is the responsibility of Co-operative Education. Co-operative Education is responsible for assisting potential employers to become involved in the program, organizing competitions for Work Term employment, arranging student-employer interviews and facilities, data base management, and for the continual development of employment opportunities. Co-operative Education will work with the Biology Co-op Liaison to counsel students, visit students on work assignments and evaluate the work term.

b. Work placement is not guaranteed but every effort is made to ensure that appropriate employment is made available. In the case of students who are required to withdraw from the program, Co-operative Education has no responsibility for placement until they have been readmitted to the program.

c. A student who is admitted to the co-op program gives permission to the University to provide a copy of the applicant's resume, university transcript and work term evaluations to potential employers.

d. A student who has been accepted to BCOP may obtain his/her own work term placement outside the competition. Such employment positions must be confirmed by the employer, and must be approved by the DCE coordinator and the Biology Department Liaison.

e. Within a month after starting a Work Term, a student must submit a proposal for the work term report.

f. Salaries paid to co-operative students are determined by employers based on their internal wage structures.

4. **Registration and Evaluation of Performance**

a. In Work Terms I, II, and III, a student must register for Biology 199W, 299W, and 399W respectively.

b. Student performance evaluations are to be completed by the employer and returned to Co-operative Education. The Work Term evaluations shall consist of two components:

i. On-the-job Student Performance:

Job performance shall be assessed by Co-operative Education in consultation with the department using information gathered during the Work Term and input from the employer towards the end of the Work Term. Formal written documentation from the employer shall be sought. Evaluation of the job performance will result in one of the following classifications: OUTSTANDING, ABOVE EXPECTATIONS, SATISFACTORY, MARGINAL PASS, FAIL.

ii. The Work Report:

- A student is required to submit a Work Term report to Co-operative Education on the first day of final exams in the semester of the Work Term.
- Work Term reports shall be evaluated by a faculty member and Co-operative Education.
- If an employer designates a report to be of a confidential nature, both employer and Co-operative Education must agree as to the methods to protect the confidentiality of such a report before the report may be accepted for evaluation.
- Reports must contain original work related to the Work Term placement. The topic must relate to the work experience and will be chosen by the student in consultation with the employer. The topic must be approved by the coordinator and the Biology Co-op Liaison.

Evaluation of the work term will result in one of the following classifications: OUTSTANDING, ABOVE EXPECTATIONS, SATISFACTORY, MARGINAL PASS, FAIL.

The evaluation of the job performance and the work term report are recorded separately on the transcript. Overall evaluation of the work term will result in one of the following final grades being awarded:

- Pass with Distinction: Indicates OUTSTANDING PERFORMANCE in both the work report and the job performance.
- Pass: Indicates that PERFORMANCE MEETS EXPECTATIONS in both the work report and the job performance.
- Fail: Indicates FAILING PERFORMANCE in the work report or the job performance, or both. To remain in BCOP, a student must obtain a final grade of Pass or higher.

c. If a student fails to achieve the Work Term standards specified above, the student will be required to withdraw from BCOP. Such a student may reapply to the program, at which time the student will be required to repeat the Work Term with satisfactory performance. Only one Work Term may be repeated in the entire program.

d. In order to be considered for readmission, a student must formally apply for readmission to the program not later than the deadline date outlined under **Admission Requirements** above.

e. A student who withdraws from a Work Term without acceptable cause subsequent to a job placement will be required to withdraw permanently from BCOP.

f. A student who drops a Work Term without prior approval from both Co-operative Education and the Biology Co-op Liaison, or who fails to honour an agreement to work with an employer, or conducts him/herself in such a manner as to cause the discharge from the job, will be awarded an overall grade of FAIL for the Work Term in question and will be required to withdraw permanently from BCOP.

g. Permission to drop a Work Term does not constitute a waiver of degree requirements, and a student who has obtained such permission must complete an approved Work Term in lieu of the one dropped.

10.2.4 Honours Degrees

The attention of students wishing to take Honours is called to those sections of the Calendar dealing with Regulations for the Degree of Bachelor of Science (Honours).

Sixty-nine credit hours in courses, including the 6 first year credit hours and the 15 required core credit hours outlined in the regulations for the General Degree, and the Honours Dissertation (Biology 499A/499B), shall be taken from the Department of Biology offering. Students may elect to complete an Honours Program in Biology or in one of the joint Honours Programs listed under the heading "Programs in Biology". Programs of students taking Honours shall be drawn up in consultation with the student's supervisor, and must be approved by the Head of the Department (or his/her delegate) in accordance with **Admission and Registration**, clause 2. of the **Regulations for the Honours Degree of Bachelor of Science**.

Note: *Some Graduate Courses may be taken in the final year of the Honours Program with the permission of the Head of the Department and the course instructor.*

A dissertation (6 credit hours) is to be presented on some original piece of work undertaken by the candidate, under the guidance of a faculty member of the department, as appointed by the Head of Department. For students electing to take one of the Joint Honours Programs, the dissertation shall be on a topic representative of the selected program. The Department of Biology considers the dissertation to be an important part of the Honours Program.

The dissertation will be based on a 6 credit hours course (Biology 499A/499B). It will involve directed reading relevant to the dissertation topic, preparation of a dissertation outline, supervised research, data synthesis and interpretation, and preparation and defence of the dissertation.

Two typed copies of the dissertation, complete with figures and tables, are to be submitted not less than two weeks before the end of lectures in the semester in which the candidate is registered for Biology 499B. These copies must be submitted to the Head of Department, and must have met the prior approval of the candidate's Honours supervisor.

Before the last day for examinations in the semester, the candidate will be examined orally on the contents of the dissertation. The examining committee shall consist of the Head of the Department, or delegate, the candidate's supervisor, and an examiner appointed by the Head of the Department in consultation with the candidate's supervisor.

10.2.5 Honours in Biology

An Honours degree in Biology may comprise a broadly based selection of courses according to the student's interests, or it may be more narrowly focussed. An Honours student may focus on any area of Biology where an appropriate supervisor can be found. All Honours students should choose courses in consultation with their supervisors, but it is particularly important that students wishing to focus within the Honours degree should discuss course selection with an Honours supervisor within their area of interest.

10.2.5.1 Biology Course Requirements

Students seeking an honours degree in Biology are required to successfully complete a minimum of 69 credit hours in courses from the Department of Biology offering. Those 69 credit hours must include:

1. Biology 1001 and 1002 or their equivalents;
2. 15 credit hours in the following core courses: Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404; and
3. 42 credit hours from Biology electives at the 2000, 3000 or 4000 level (except Biology 2040, 2041, 2120, 3053, and 3820) and Biology 499A and 499B.
4. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

10.2.5.2 Core Course Requirements

All honours students must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Electives to make up 120 credit hours

To minimize timetabling problems, students on the St. John's Campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and Biology 2060 and 2900 in their fourth semester (Winter).

10.2.6 Honours in Cell and Molecular Biology

10.2.6.1 Cell and Molecular Biology Course Requirements

Students seeking an honours degree in Cell and Molecular Biology are required to complete a minimum of 69 credit hours in courses from the Department of Biology offering. Those 69 credit hours must include:

1. Biology 1001 and 1002 or their equivalents;
2. 15 credit hours in the following core courses: Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404;
3. Biology 3530 and Biology 4241;
4. 12 credit hours from the following recommended Biology courses for Cell and Molecular Biology: Biology 3050, 3052, 3401, 3402, 3500, 3620, 3950, 3951, 4010, 4040, 4050, 4200, 4245, 4250, 4251, 4255, 4404, 4550, 4605, 4607; and
5. 24 credit hours in Biology electives at the 2000, 3000 or 4000 level (except Biology 2040, 2041, 2120, 3053, and 3820) and Biology 499A and 499B.
6. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

10.2.6.2 Core Course Requirements

All honours students must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Electives to make up 120 credit hours

To minimize timetabling problems, students on the St. John's Campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and Biology 2060 and 2900 in their fourth semester (Winter).

10.2.7 Honours in Ecology and Conservation Biology

10.2.7.1 Ecology and Conservation Biology Course Requirements

Students seeking an honours degree in Ecology and Conservation Biology are required to complete a minimum of 69 credit hours in courses from the Department of Biology offering. Those 69 credit hours must include:

1. Biology 1001 and 1002 or their equivalents;
2. 15 credit hours in the following core courses: Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404;
3. Biology 4650 and 4651;
4. 12 credit hours from the following recommended biology courses for Ecology and Conservation Biology: Biology 3041, 3050, 3295, 3300, 3610, 3620, 3640, 3709, 3710, 3711, 3714, 3715, 3750, 4040, 4141, 4180, 4182, 4250, 4306, 4307, 4360, 4405, 4505, 4605, 4607, 4620, 4630, 4701, 4710, 4750, 4820; and
5. 24 credit hours in Biology electives at the 2000, 3000 or 4000 level (except Biology 2040, 2041, 2120, 3053, and 3820) and Biology 499A and 499B.
6. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

10.2.7.2 Core Course Requirements

All honours students must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Electives to make up 120 credit hours

To minimize timetabling problems, students on the St. John's Campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and Biology 2060 and 2900 in their fourth semester (Winter).

10.2.8 Honours in Marine Biology

10.2.8.1 Marine Biology Course Requirements

Students seeking an honours degree in Marine Biology are required to complete a minimum of 69 credit hours in courses from the Department of Biology offering. Those 69 credit hours must include:

1. Biology 1001 and 1002 or their equivalents;
2. 15 credit hours in the following core courses: Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404;
3. Biology 3710 and 3711;
4. 12 credit hours from the following recommended biology courses for Marine Biology: Biology 3014, 3050, 3295, 3620, 3640, 3709, 3712, 3714, 3715, 3951, 4122, 4141, 4182, 4360, 4601, 4605, 4607, 4620, 4630, 4710, 4750, 4810, 4912; and
5. 24 credit hours in Biology electives at the 2000, 3000 or 4000 level (except Biology 2040, 2041, 2120, 3053, and 3820) and Biology 499A and 499B.
6. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

10.2.8.2 Core Course Requirements

All honours students must also successfully complete the following courses or their equivalents:

1. English 1090 or the former English 1080 and 1110 (or equivalent)
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1000
4. Chemistry 1010 and 1011 (or equivalent), Chemistry 2440
5. Statistics 2550
6. Biochemistry 2101 and 3106
7. Electives to make up 120 credit hours

To minimize timetabling problems, students on the St. John's Campus are advised to take Biology 2250 and 2600 in their third semester (Fall), and Biology 2060 and 2900 in their fourth semester (Winter).

10.2.9 Honours in Biology (Co-operative)

10.2.9.1 Admission Requirements

See **Major in Biology (Co-operative)**.

10.2.9.2 Program of Study

1. In addition to the requirements below, a student must fulfill all requirements for either an Honours in Biology, Honours in Biology (Cell and Molecular), Honours in Biology (Ecology and Conservation), or Honours in Biology (Marine) as described under each specific program.
2. To remain in BCOP Honours, a student must receive a passing grade in all required courses, and must maintain an average of at least 65% in all Biology courses and an overall average of at least 70% in all courses, including electives.
3. A student is required to complete three work terms, one of which must be either in the Fall or Winter semester.

10.2.9.3 Work Term Placement

See **Major in Biology (Co-operative)**.

10.2.9.4 Registration and Evaluation of Performance

See **Major in Biology (Co-operative)**.

10.3 Chemistry

www.mun.ca/chem

The following undergraduate programs are available in the Department:

1. Applied Mathematics and Chemistry Joint Honours
2. Biochemistry and Chemistry Joint Honours
3. Chemistry and Earth Sciences Joint Honours
4. Chemistry and Physics Joint Honours
5. Major or Honours in Chemistry. (Option to complete a Minor in Applied Science - Process Engineering) (see Faculty of Engineering and Applied Science for details)
6. Minor in Chemistry

   Minor in Chemistry for Faculty of Engineering Process Engineering Majors
7. Major or Honours in Computational Chemistry
8. Major or Honours in Chemistry (Biological)

The Majors and Honours in Chemistry and Chemistry(Biological), and the Joint Honours with Applied Mathematics, Biochemistry, Earth Sciences, and Physics are accredited by the Canadian Society for Chemistry.

Details of joint programs are given under **Joint Programs**.

Chemistry course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Chemistry**.

10.3.1 Undergraduate Handbook

Additional information about the undergraduate program, individual courses and suggested timetables can be found in the Department of Chemistry Undergraduate Handbook which is available on the web at www.mun.ca/chem.

10.3.2 Faculty Advisors

Each student majoring in Chemistry will be assigned a Faculty Advisor who should be consulted on all academic matters. Individual programs must be drawn up in consultation with the advisor.

Note: *Students who have obtained a grade of 3 or better on the Advanced Placement courses in Chemistry will normally be eligible for direct entry into Chemistry 1051 or second year courses. Such students must consult the Department before registration.*

10.3.3 Minor in Chemistry

Students who take a minor in Chemistry will complete Chemistry 1050 and 1051 (or 1010, 1011 and the former 1031) (or 1200 and 1001), Chemistry 2100, 2210, 2301 or 2302, and 2400, and 6 credit hours in other chemistry courses at the 2000 level or above.

For Engineering students completing the **Process Engineering** major, a minor in Chemistry will consist of Chemistry 1050, 1051, 2100, 2210, 2301 (or Engineering 4602), 2302, 2400 and 3 credit hours chosen from the remaining Chemistry courses at the 2000 level or above.

10.3.4 General Degree - Major in Chemistry

The courses required for a Major in Chemistry are:

1. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, and 3411.
2. Physics 1050 (or 1020) and 1051 (or 1021).
3. Mathematics 1000, 1001, 2000, and 2050.
4. Biochemistry 2101.

Recommended courses: Mathematics 2051, Physics 2820 and/or 2750.

Students considering declaring Chemistry as their Major are encouraged to contact either the Head of the Department or the Deputy Head (Undergraduate Studies).

Chemistry Majors may complete a minor in **Applied Science - Process Engineering**. The requirements for this minor are detailed under **Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering**.

10.3.5 Honours Degree in Chemistry

Students wishing to take Honours should consult those sections of the Calendar dealing with **Regulations for the Honours Degree of Bachelor of Science**.

10.3.5.1 Required Courses

1. Chemistry 1050 and 1051 (or 1010, 1011 and the former 1031) (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, 3411, and 490A/B.
2. 12 credit hours selected from the 4000 level Chemistry courses chosen in consultation with the 490A/B supervisor for chemistry.
3. Physics 1050 (or 1020) and 1051 (or 1021).
4. Mathematics 1000, 1001, 2000, and 2050.
5. Biochemistry 2101.

Chemistry Honours students may complete a minor in **Applied Science - Process Engineering**. The requirements for this minor are detailed under **Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering**.

10.3.5.2 Other Information

1. Those courses in which a grade of B or an average of 75% or higher are required, as specified in **Regulations for the Honours Degree of Bachelor of Science, Academic Standing**, clause a., are the courses beyond first year used to satisfy clause 1. under **Required Courses** above.
2. Recommended courses: Mathematics 2051, Physics 2820 and/or 2750.
3. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
4. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
5. With approval of the Heads of the Chemistry and Biochemistry Departments prior to registration, a number of courses in Biochemistry may be substituted for a like number of Chemistry courses.
6. Prospective Honours students in Chemistry in their first year should take
   a. Six credit hours in English.
   b. Chemistry 1050 and 1051 (or 1200 and 1001),
   c. Physics 1050 and 1051 or 1020 and 1021.
   d. Mathematics 1000 and 1001.
   e. Six credit hours in other courses.
7. Students should consult the Undergraduate Student Handbook for timetabling details.
8. Students completing first year requirements for either Chemistry or Mathematics via the three course options (i.e. Chemistry 1010, 1050, 1051, Mathematics 1090, 1000, 1001 (or 109A/B, 1000, 1001)) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000, 1001) will require the corresponding number of extra credits to obtain an Honours degree.
9. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with the Faculty Advisor.
10. Certain advanced courses may only be offered in alternate years. Candidates therefore should consult the Head of the Department before registration
11. Certain Graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.
12. Details of Joint Honours programs with Biochemistry, Earth Sciences, Mathematics and Physics are outlined under **Joint Programs**.
13. Details of the Environmental Science (Chemistry Stream) Major or Honours are outlined under the **Grenfell Campus** section off the Calendar.

10.3.6 General Degree - Major in Computational Chemistry

Students wishing to take a Major in Computational Chemistry should consult those regulations of the Calendar dealing with **Regulations for the General Degree of Bachelor of Science**.

10.3.6.1 Required Courses

1. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, 4305.
2. Physics 1050 (or 1020) and 1051 (or 1021), and 2820.
3. Mathematics 1000, 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
4. Computer Science 1510 and 1001.
5. Computer Science 2500 and 2001.
6. Computer Science 3731 or Mathematics 3132.
7. English 1090 or the former English 1080 and English 1110 or equivalent.
8. A sufficient number of elective courses to bring the degree up to a total of 120 credit hours must also be completed.

10.3.6.2 Suggested Program of Study

Given appropriate circumstances the Major in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

1. English 1090 or the former English 1080 and English 1110 or equivalent.
2. Chemistry 1050 and 1051 (or 1200 and 1001).
3. Physics 1050 (or 1020) and 1051 (or 1021).
4. Mathematics 1000 and 1001.
5. Computer Science 1510 and 1001.

10.3.7 Honours Degree in Computational Chemistry

Students wishing to take Honours in Computational Chemistry should consult those sections of the Calendar dealing with **Regulations for the Honours Degree of Bachelor of Science**.

10.3.7.1 Required Courses

1. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, and 4305.
2. Physics 1050 (or 1020) and 1051 (or 1021), and 2820.
3. Mathematics 1000, 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
4. Computer Science 1510 and 1001.
5. Computer Science 2500 and 2001.
6. Computer Science 3731 or Mathematics 3132.

7. Chemistry 490A/B.
8. English 1090 or the former English 1080 and English 1110 or equivalent.
9. 3 additional credit hours in Biochemistry, Chemistry, Computer Science, Mathematics, or Physics at the 2000 level or above.
10. A sufficient number of elective courses to bring the degree up to a total of 120 credit hours must also be completed.

10.3.7.2 Suggested Program of Study

Given appropriate circumstances the Honours in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

1. English 1090 or the former English 1080 and English 1110 or equivalent.
2. Chemistry 1050 and 1051 (or 1200 and 1001).
3. Physics 1050 (or 1020) and 1051 (or 1021).
4. Mathematics 1000 and 1001.
5. Computer Science 1510 and 1001.

10.3.7.3 Other Information

1. Those courses in which a grade of B or an average of 75% or higher are required, as specified in **Regulations for the Honours Degree of Bachelor of Science, Academic Standing**, are the courses beyond first year used to satisfy the required course list.
2. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
3. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
4. Students completing first year requirements for any of Chemistry, Mathematics or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051, Mathematics 1090, 1000, 1001 or 109A/B, 1000, 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Chemistry 1200, 1001, Mathematics 1000, 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.
5. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with the Faculty Advisor.
6. Certain advanced courses may only be offered in alternate years. Candidates therefore should consult the Head of the Department before registration.
7. Certain Graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.

10.3.8 General Degree in Chemistry (Biological)

Students wishing to pursue a General Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible.

10.3.8.1 Required Courses

1. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, and 4410.
2. At least 6 credit hours from Chemistry 3210, 3303, 3411 or any 4000-level Chemistry course.
3. Biology 1001, 1002, 2250, 2060, and 3050 and at least 6 credit hours chosen from Biology 3530, 3950, 3951, 4010, 4050, 4245, 4251, 4404.
4. Biochemistry 2101 and at least 6 credit hours from Biochemistry 3105, 3106, 3107, 4101, and 4201.
5. Mathematics 1000 and 1001. Statistics 2550 is strongly recommended.
6. Physics 1050 (or 1020) and Physics 1051 (or 1021).
7. Six credit hours in English.

10.3.8.2 Other Information

In first year, prospective students for the General Degree in Chemistry (Biological) should complete:

1. Six credit hours in English, Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021) , and Mathematics 1000 and 1001.
2. This program fulfills the first and second teachable requirements for admission into the **Bachelor of Education (Intermediate/ Secondary)** at this University with Chemistry and Biology as the first and second teachable subjects, respectively.
3. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
4. Some courses listed under **Required Courses** above require one or more prerequisites that are not defined as part of the program.

10.3.9 Honours Degree in Chemistry (Biological)

Students wishing to take Honours should consult those sections of the Calendar dealing with **Regulations for the Honours Degree Bachelor of Science**. Students wishing to pursue an Honours Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible.

10.3.9.1 Required Courses

1. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410 and 490A/B.
2. At least 3 credit hours from Chemistry 3210, 3303, 3411 or any 4000-level Chemistry course not used to fulfill clause 3. below.
3. At least 3 credit hours from Chemistry 4151, 4201, 4206, 4305, or 4701.
4. Biology 1001, 1002, 2060, 2250, and 3050 and at least 6 credit hours chosen from Biology 3530, 3950, 3951, 4010, 4050, 4245, 4251, 4404.
5. Biochemistry 2101 and at least 6 credit hours from Biochemistry 3105, 3106, 3107, 4101, and 4201.

6. Mathematics 1000 and 1001. Statistics 2550 is strongly recommended.
7. Physics 1050 (or 1020) and Physics 1051 (or 1021).
8. Six credit hours in English.

10.3.9.2 Other Information

In first year, prospective students for the Honours Degree in Chemistry (Biological) should complete:

1. Six credit hours in English, Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021) , and Mathematics 1000 and 1001.
2. Those courses in which a grade of B or an average of 75% or higher are required as specified in the **Regulations for the Honours Degree of Bachelor of Science, Academic Standing**, clause a., are the courses beyond first year used to satisfy clauses 1.-5. under **Required Courses** above.
3. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member. Chemistry 490A/B Projects are to be approved by the Head of the Department or delegate.
4. The Honours in Chemistry (Biological) program can be completed in four years. Students should consult the Undergraduate Student Handbook for timetabling details.
5. Students completing first year requirements for any of Chemistry, Mathematics, or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051 (or 1010, 1011, and the former 1031), Mathematics 1090, 1000, 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000, 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.
6. With the permission of the Head of the Department, 6000-level courses may be taken in the final year of the Honours Program.
7. This program fulfills the first and second teachable requirements for admission into the **Bachelor of Education (Intermediate/ Secondary)** at this University with Chemistry and Biology as the first and second teachables, respectively.
8. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
9. Some courses listed under **Required Courses** above require one or more prerequisites that are not defined as part of the program.

10.3.10 Course Restrictions

Students should be aware of a number of credit restrictions. For further information see the Chemistry course descriptions section found at the end of the Faculty of Science section under **Course Descriptions, Chemistry**.

10.4 Computer Science

www.mun.ca/computerscience

The following undergraduate programs are available in the Department:

1. Applied Mathematics and Computer Science Joint Major (B.Sc. only)
2. Computer Internship Option (CIIO)
3. Computer Science Honours (B.A., B.Sc.)
4. Computer Science and Economics Joint Major (B.Sc. only)
5. Computer Science and Geography Joint Honours (B.Sc. only)
6. Computer Science and Geography Joint Major (B.Sc. only)
7. Computer Science and Physics Joint Honours
8. Computer Science and Physics Joint Major
9. Computer Science and Pure Mathematics Joint Honours (B.Sc. only)
10. Computer Science and Pure Mathematics Joint Major (B.Sc. only)
11. Computer Science and Statistics Joint Honours
12. Computer Science and Statistics Joint Major (B.Sc. only)
13. Computer Science (Software Engineering) Honours (B.Sc. only)
14. Major in Computer Science (B.A., B.Sc.)
15. Major in Computer Science (Smart Systems) (B.Sc. only)
16. Major in Computer Science (Visual Computing and Games) (B.Sc. only)
17. Minor in Computer Science (B.A., B.Sc.)

Details of joint program offerings in the Faculties of Humanities and Social Sciences and Science may be found under the heading **Joint Programs** following the heading **Regulations for the Honours Degree of Bachelor of Science**.

Computer Science course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Computer Science**.

10.4.1 Major in Computer Science

1. Forty-five credit hours in Computer Science courses are required for a major in Computer Science:
   a. Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008.
   b. At least 6 additional credit hours in Computer Science at the 4000 level.
   c. Twelve additional credit hours in Computer Science at the 3000 level or beyond.
2. Additional courses required are: Mathematics 1000, 1001, 2000, 2050, and Statistics 1510 or 2550.

Note: *Students are encouraged to take Business 2000, Mathematics 3000, and Statistics 2560.*

10.4.2 Major in Computer Science (Smart Systems) (B.Sc. only)

1. Forty-five credit hours in Computer Science courses are required for a major in Computer Science (Smart Systems):
   a. Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008;
   b. Computer Science 3200, 3201, 3202 and 3301; and
   c. Six additional credit hours in Computer Science courses selected from Computer Science 3401, 3550, 4301, 4303, 4750, 4766.
2. Additional courses required are: Mathematics 1000, 1001, 2000, 2050, and Statistics 1510 or 2550.

10.4.3 Major in Computer Science (Visual Computing and Games) (B.Sc. only)

1. Forty-five credit hours in Computer Science courses are required for a major in Computer Science (Visual Computing and Games):
   a. Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008;
   b. Computer Science 3300, 3301, and 4300;
   c. Six additional credit hours in Computer Science courses selected from Computer Science 2300, 4301, 4302, 4303, 4304; and
   d. Three additional credit hours in Computer Science courses selected from those listed in c. above, or Computer Science 2100, 4766, 4768.
2. Additional courses required are: Mathematics 1000, 1001, 2000, 2050, and Statistics 1510 or 2550.

10.4.4 Honours in Computer Science

1. See **Regulations for the Honours Degree of Bachelor of Arts** or **Regulations for the Honours Degree of Bachelor of Science** (as appropriate).
2. Sixty-three credit hours in Computer Science courses are required for the Honours Degree in Computer Science, including:
   a. Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 4780.
   b. Fifteen additional credit hours in Computer Science at the 4000 level.
   c. Eighteen additional credit hours in Computer Science courses at the 3000 level or beyond.
3. Additional courses required are: Mathematics 1000, 1001, 2000, 2050, and Statistics 1510 or 2550.

Note: *Students are encouraged to take Business 2000, Mathematics 3000, and Statistics 2560.*

10.4.5 Honours in Computer Science (Software Engineering) (B.Sc. Only)

Completion of the Honours in Computer Science (Software Engineering) Program does not qualify persons to hold the designation "Professional Engineer" as defined by various Provincial Acts governing the Engineering Profession.

1. See **Regulations for the Honours Degree of Bachelor of Science**.
2. Sixty-three credit hours in Computer Science courses are required for the Honours Degree in Computer Science (Software Engineering), including:
   a. Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 4770, 4780.
   b. Nine additional credit hours in Computer Science chosen from 4718, 4721, 4723, 4751, 4753, 4756, 4759, 4766, and 4768.
   c. Nine additional credit hours in Computer Science at the 4000 level.
   d. Twelve additional credit hours in Computer Science at the 3000 level or beyond.
3. Additional courses required are: Mathematics 1000, 1001, 2000, 2050, and Statistics 1510 or 2550.

Note: *The Honours project (4780) must be in the area of Software Engineering.*

10.4.6 Minor in Computer Science

For a Minor in Computer Science, a student must complete at least 24 credit hours in Computer Science courses, including:

1. Computer Science 1000, 1001, 2001.
2. At least 6 credit hours selected from Computer Science 1002, 2002, 2003, 2004, 2005, 2006, 2007, 2008.
3. Three additional credit hours at the 3000 level or above.
4. Additional courses as necessary to fulfill the requirement for 24 credit hours in Computer Science.

10.4.7 Computer Industry Internship Option (CIIO):

The Computer Industry Internship Option (CIIO) provides an opportunity for qualified students to obtain rewarding placements that help them develop practical skills in a real work setting before graduation. The CIIO is available to Computer Science Majors who will typically apply between their third and fourth year of studies.

10.4.7.1 Admission Requirements

In order to be considered for admission to the CIIO, an applicant:

1. must be a declared Computer Science Major;
2. must have successfully completed Computer Science 1000, 1001, 1002, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008 and 6 credit hours at the 3000 level;
3. must have at least 15 credit hours remaining after the internship in order to satisfy degree requirements, 3 of which must be in Computer Science; and
4. is expected to return to University as a full-time student after the internship.

In addition to meeting the above, applicants are also subject to academic performance.

10.4.7.2 Internship Duration:

Subject to the availability of job openings, a student may choose either an 8, 12 or 16 consecutive month internship period.

10.4.7.3 Internship Guidelines:

1. Internship employment is normally organized by Co-operative Education; however, students who have been accepted to the CIIO may also obtain their own internship placements. All placements are subject to the approval of Co-operative Education and of the Head of the Department of Computer Science.
2. Students who have applied to the internship program give permission to Co-operative Education to supply prospective employers with copies of their resume and transcript.
3. After being placed with an employer, students are not permitted to drop their internship without prior approval from Co-operative Education and the Head of the Department of Computer Science. Students who drop an internship without permission, who fail to honour an agreement to work with an employer, or who conduct themselves in such a manner as to cause their discharge from the placements, will normally be awarded a fail grade for the internship period and may not be permitted to reapply.

Note: *Students should also refer to the **UNIVERSITY REGULATIONS - General Academic Regulations (Undergraduate)**.*

10.4.7.4 Expectation of Work

Within two weeks of starting the internship, students are required to submit a list of their internship objectives to Co-operative Education. They are also required to submit a report to Co-operative Education due the last day of classes of each semester in which they are working. A progress report is required in semesters where the internship is continuing into the next semester. The progress report need only discuss the activities in that particular semester. A final report is required in the student's final internship semester. The final report must discuss the entire internship. Both reports will include a description of the student's internship projects and activities as well as the student's internship objectives and accomplishments. A completed Employer Evaluation Form should be submitted to Co-operative Education at the end of each semester.

10.4.7.5 Registration, Assessment of Performance, and Assignment of Grades:

Students must register for the course Computer Science 3700 every semester during their internship.

Computer Science 3700 is a non-credit course open only to students who have been accepted into the Internship Program.

During the internship, the employer and intern will complete student performance evaluations every four months and will submit them to Co-operative Education. The final assessment of total work performed is the responsibility of Co-operative Education, and will be based upon both input from the employer and the intern's final internship report.

The Internship evaluation shall consist of two components:

1. On-the-job Student Performance: Job performance shall be assessed by Co-operative Education in consultation with the Department using information gathered during the internship and input from the employer. Evaluation of the on-the-job student performance will result in one of the following classifications: PASS WITH DISTINCTION, PASS, FAIL.
2. The Final Internship Report: Evaluation of the final internship report will result in one of the following classifications: PASS WITH DISTINCTION, PASS, FAIL.

The evaluation of the on-the-job student performance and the final internship report are recorded separately on the transcript.

Overall evaluation of the internship will result in one of the following final grades being awarded:

1. PASS WITH DISTINCTION: indicates outstanding performance in both the final internship report and the on-the-job student performance. PASS WITH DISTINCTION has been awarded to each of the final internship report and the on-the-job student performance.
2. PASS: indicates that performance meets expectations in both the final internship report and on-the-job student performance. The student meets the requirements of a passing mark in the final internship report and on-the-job student performance.
3. FAIL: indicates failing performance in either the final internship report or on-the-job student performance or both.

Also, the following will be noted in the transcript of the intern:

1. Requirements for the Computer Industry Internship Option have been completed. Internship Duration: - months.
2. A grade of NC (No Credit) for Computer Science 3700 will be awarded in all semesters of the Internship Option prior to the final Semester.

10.4.7.6 CIIO and Honours Program:

In case a student is enrolled in both the Honours program and the CIIO, the requirements of both must be met. Upon approval from the honours project supervisor within the Department, the employer and the Head of the Department of Computer Science, an internship project may be submitted as a component of an honours project. These arrangements must be made within the first semester of the Internship placement.

10.4.8 Supplementary Examinations

Supplementary examinations will be allowed in certain Computer Science courses which have written final examinations. Students should refer to the **Faculty of Science Degree Regulations** for details.

10.4.9 Faculty Advisors

The Department has an Undergraduate Advisor for Computer Science majors to consult with on academic matters.

10.4.10 Undergraduate Handbook

Additional information about the undergraduate Computer Science programs and courses can be found in the Computer Science Undergraduate Handbook available from the General Office, Department of Computer Science or from www.mun.ca/computerscience/.

10.5 Earth Sciences

www.mun.ca/earthsciences

The following undergraduate programs are available:

120 credit hour programs

1. Chemistry and Earth Sciences Joint Honours
2. Earth Sciences and Geography Joint Honours
3. Earth Sciences and Physics Joint Honours
4. Earth Sciences and Physics Joint Major
5. General or Honours degrees in Earth Sciences
6. Geophysics and Physical Oceanography Joint Honours

135 credit hour program

1. Biology and Earth Sciences Joint Honours

24 credit hour program

1. Minor in Earth Sciences

Although Honours programs can be completed in 120 credit hours, students who do not select the prescribed **Common Block of Required Courses** will normally need more than 120 credit hours to satisfy degree requirements.

Earth Sciences course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Earth Sciences**.

10.5.1 Undergraduate Handbook

Additional information about the undergraduate program, individual courses and suggested timetables can be found in the Department of Earth Sciences Undergraduate Handbook which is available on the web at www.mun.ca/earthsciences.

10.5.2 Entrance Requirements

In order to be formally admitted to major programs in Earth Sciences, students must have successfully completed 3 first-year credit hours in each of the following departments: English, Mathematics, Earth Sciences, Chemistry and Physics; these courses must be selected from the list of required courses for degree programs in Earth Sciences. Students are encouraged to declare their major in their first year of study at the university.

Most of the 2000 level Earth Sciences courses that are required for major and minor programs in Earth Sciences have Physics and Chemistry prerequisites, and students are advised to complete these prerequisites in their first year of study.

Students will not normally be permitted entry to 3000 level (or above) Earth Sciences courses without having completed all 1000-level courses listed in the **Common Block of Required Courses** specified in Clause 1. in the **Major Programs in Earth Sciences**.

10.5.3 Minor in Earth Sciences

A Minor in Earth Sciences will consist of the following:

1. Earth Sciences 1000 and 1002.
2. Eighteen credit hours chosen from Earth Sciences courses at the 2000 level or higher with at least 5 credit hours from courses at the 2000 level. Credit hours from Earth Sciences 2150, 2311, 2914, 2915, 2916, 2917, 2918, 4310 and 4950 cannot be used to fulfil this requirement.

Due to the prerequisite structure, availability of courses at the 3000 level and higher depends on courses taken at the 2000 level (see Undergraduate Handbook for some options).

10.5.4 Major Programs in Earth Sciences

Programs in Earth Sciences consist of a **Common Block of Required Courses** (below), and additional courses that depend on the degree being sought.

10.5.4.1 Common Block of Required Courses

All majors in Earth Sciences must complete those courses specified in Clauses 1. through 4. Students should examine prerequisites of 3000 level courses in order to decide which course to select under Clauses 3. and 4.

1. English 1090 or the former English 1080 and 1110 (or equivalent), Mathematics 1000 and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 or Chemistry 1200 and 1001, Physics 1050 and 1051 or Physics 1020 and 1021. Students are advised to consult the Department of Physics Course Descriptions section for credit restrictions.

   Students who intend or are required to complete higher level Physics courses must complete Physics 1051 as well, since it is a prerequisite for higher level Physics courses. Students should review the Department of Physics Calendar entry for these courses.
2. Earth Sciences 2030, 2031, 2401, 2502, 2702, 2905, 3420, 3905.
3. Mathematics 2000 or Statistics 2550.
4. Either Biology 2120 (or Biology 1001 and 1002); or both Physics 2055 and Physics 2820.

Students must ensure that the prerequisites for Earth Sciences courses are fulfilled. Great difficulties in timetabling may be encountered if the required first-year courses are not completed before the beginning of second year.

10.5.5 Honours B.Sc. Degree in Earth Sciences

Geoscientific careers vary widely in required background. The Honours B.Sc. program is designed with considerable choice in order that students may personalize their programs based on career goals. Note that the flexibility afforded by this program is not without limits. Some courses have prerequisites, and it is ultimately the student's responsibility to ensure that these prerequisites are satisfied. Students should consult faculty members and the departmental Student Handbook for guidance in selecting courses appropriate to particular career paths.

In addition to the **Common Block of Required Courses** listed under **Major Programs in Earth Sciences**, the following requirements must be completed to qualify for the Honours B.Sc. degree in Earth Sciences:

1. Earth Sciences 499A and 499B.
2. At least 27 additional credit hours from Earth Sciences courses at 3000 and/or 4000 levels with a minimum of 12 credit hours from courses at the 4000 level. Credit hours from Earth Sciences 4310 and 4950 cannot be used to fulfill this requirement.
3. Six credit hours from the Faculty of Science courses numbered 2000 or higher. Credit hours from Earth Sciences courses, courses that are cross-listed with Earth Sciences courses, and the former Physics 2050 are excluded. However, Physics 2820 is permitted.
4. Additional credit hours selected to conform with regulations for the Honours Degree of Bachelor Science so as to achieve a total of 120 credit hours. Students are encouraged to complete a minor in another department.
5. Three of the credit hours used to fulfill either requirement 3. or 4. above must be from Biology, Chemistry, Computer Science, Statistics or Physics. They may be from Mathematics only if Mathematics 2000 has not been taken as part of the **Common Block of Required Courses**.

10.5.6 General B.Sc. Degree in Earth Sciences

In addition to the **Common Block of Required Courses** listed under **Major Programs in Earth Sciences**, the following requirements must be completed to qualify for the General B.Sc. degree in Earth Sciences:

1. Eighteen additional credit hours from Earth Sciences courses at 3000 and/or 4000 levels with a minimum of 9 credit hours from courses at 4000 level. Credit hours from Earth Sciences 4310, 4950 and 499A/B cannot be used to fulfill this requirement.
2. Six credit hours from Science Faculty courses numbered 2000 or higher. Credit hours from Earth Sciences courses, courses that are cross-listed with Earth Sciences courses, and the former Physics 2050 are excluded. However, Physics 2820 is permitted.
3. Additional credit hours selected to conform with regulations for the General Degree of Bachelor Science so as to achieve a total of 120 credit hours. Students are encouraged to complete a minor in another department.

Students are advised that this is the minimum requirement for the General B.Sc. in Earth Sciences. Many provinces, including Newfoundland and Labrador, have legislation requiring registration of professional geoscientists. A basic requirement for registration is, in most cases, the course equivalent of an Honours B.Sc. degree. Students intending to make a career in Earth Sciences should consider taking the Honours Degree program of courses, regardless of whether honours standing is maintained.

10.5.7 Credit Restrictions for Present Earth Sciences (EASC) Courses with Former Courses Table

Present	Former Equivalents	Present	Former Equivalents
EASC 1000	EASC 1010, Geology 1000, Geology 1010	EASC 3611	EASC 4611
EASC 1001	EASC 1011, Geology 1001, Geology 1011	EASC 3705	EASC 4700, Geology 3070
EASC 2030	EASC 203A, Geology 203A	EASC 3811	EASC 3801, EASC 2801, Geology 2801
EASC 2031	EASC 203B, Geology 203B	EASC 4053	Geology 4053
EASC 2150	Physics 2150	EASC 4054	EASC 4052, Geology 4052
EASC 2401	EASC 3400, EASC 3120, Geology 3120	EASC 4171	Physics 4171
EASC 2502	EASC 2501, EASC 3200, Geology 3200	EASC 4179	EASC 4970, Physics 4970
EASC 2702	EASC 3701, EASC 3070, Geology 3070	EASC 4211	Geology 4211
EASC 2905	EASC 2310, EASC 2300, EASC 2900, Geology 2900	EASC 4302	EASC 4501, Geology 4501
EASC 2914	EASC 2414, Geology 2414	EASC 4310	Geology 4310
EASC 2915	EASC 2415, Geology 2415	EASC 4400	EASC 4120, Geology 4120
EASC 3054	EASC 2503 and EASC 3053	EASC 4420	EASC 400A, EASC 4320, EASC 4901, Geology 400A
EASC 3055	EASC 2503 and EASC 3053	EASC 4502	EASC 4201, Geology 4201
EASC 3170	Physics 3170	EASC 4601	Geology 4601
EASC 3172	EASC 3171, Physics 3171	EASC 4800	EASC 4110, Geology 4110
EASC 3210	Geology 3210	EASC 499A/B	EASC 4991, Geology 4991
EASC 3420	EASC 2400, EASC 4901, EASC 2161, EASC 2070, Physics 2070		

Notes:
1. *Students wishing to pursue study within the programs offered by Earth Sciences are strongly advised to keep in close contact with the Department to discuss course programs before registration in order to maintain proper sequencing.*
2. *Students wishing to take some Earth Sciences courses without intending to major in Earth Sciences should consult with the Head of Department (or delegate) to determine the courses most suitable to their needs and capabilities. Earth Sciences 2914, 2915, 2916, 2917, 2918, and 2150 are especially suitable for such students and have no Earth Sciences prerequisites.*
3. *Most courses comprise six hours of instruction per week, usually three hours of lectures or seminars and a three-hour laboratory period; however, at an advanced level other methods of instruction may be adopted.*
4. *The field courses 2905, 3705, 3905 and 4905 require payment of a participation fee to cover costs for logistics and equipment. Registration for these courses will be by application only and may be competitive.*
5. *The prerequisites for courses 4302, 4902 and 4903 refer to core courses in the Faculty of Science. For the purposes of these prerequisite statements, core courses are defined as those courses that are specified by each department as mandatory to fulfil the course requirements for their General or Honours programs.*
6. *Certain 4000 level courses may not be offered every year.*
7. *At most 6 credit hours in courses at the 1000-level can be used towards the course requirements in Earth Sciences for the Major, Minor, Joint Major, Honours or Joint Honours.*

10.6 Economics

The following programs are available in the Department of Economics:

1. Honours in Economics (B.A. or B.Sc.)
2. Honours in Economics (Co-operative), (B.A. or B.Sc.)
3. Joint Programs (B.Sc. Only)
4. Joint Program (Co-operative) (B.Sc. Only)
5. Major in Economics (B.A. or B.Sc.)
6. Major in Economics (Co-operative) (B.A. or B.Sc.)
7. Minor in Economics

For Departmental Regulations and Course Descriptions, see Faculty of Humanities and Social Sciences section of the Calendar.

10.7 Geography

The following undergraduate programs are available in the Department of Geography:

1. Diploma in Geographic Information Sciences
2. Focus Area in Geography
3. Honours in Geography (B.A., B.Sc)
4. Joint Programs
5. Major in Geography (B.A., B.Sc)
6. Minor in Geography (B.A., B.Sc)

For Departmental Regulations and Course Descriptions, see Faculty of Humanities and Social Sciences section of the Calendar.

10.8 Mathematics and Statistics

www.mun.ca/math

The following undergraduate programs are available in the Department:

1. Applied Mathematics and Chemistry Joint Honours (B.Sc. only)
2. Applied Mathematics and Computer Science Joint Major (B.Sc. only)
3. Applied Mathematics and Economics Joint Major (B.Sc. only)
4. Applied Mathematics and Physics Joint Honours (B.Sc. only)
5. Applied Mathematics and Physics Joint Major (B.Sc. only)
6. Biology and Statistics Joint Honours (B.Sc. only)
7. Computer Science and Pure Mathematics Joint Honours (B.Sc. only)
8. Computer Science and Pure Mathematics Joint Major (B.Sc. only)
9. Computer Science and Statistics Joint Honours (B.Sc. only)
10. Computer Science and Statistics Joint Major (B.Sc. only)
11. Economics and Pure Mathematics Joint Major (B.Sc. only)
12. Economics and Statistics Joint Major (B.Sc. only)
13. Economics and Statistics (Co-operative) Joint Major (B.Sc. only)
14. Honours in Applied Mathematics (B.Sc. only)
15. Honours in Pure Mathematics
16. Honours in Statistics
17. Major in Applied Mathematics (B.Sc. only)
18. Major in Pure Mathematics
19. Major in Statistics
20. Minor in Mathematics
21. Minor in Statistics
22. Pure Mathematics and Statistics Joint Honours

Details of these programs are given after the **Regulations for the Honours Degree of Bachelor of Science**.

Mathematics and Statistics course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Mathematics and Statistics**.

10.8.1 Regulations

1. At most 9 credit hours in Mathematics will be given for courses completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.
2. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for Mathematics 1050 or Mathematics 1051 and cannot receive credit for either course.
3. Students with credits in Mathematics or Statistics not listed in this Calendar must consult the Department for equivalency before taking any course listed under **Course Descriptions, Mathematics and Statistics**.
4. Placement in Mathematics 1000, 1050, 1051, 1090, and 109A/B and Statistics 1510, shall be determined by the Department of Mathematics and Statistics on the basis of the student's score on the Mathematics Placement Test (MPT), SAT Subject Test in Mathematics Level 1, or other acceptable criteria-based test.

10.8.2 Faculty Advisors

Normally, the Program Officer will be the advisor for each student who has undertaken a major in Applied or Pure Mathematics, and the

Deputy Head (Statistics) will be the advisor for any student involved in a major in Statistics. Students should consult with their advisor at least once each semester to ensure that their choice of courses is appropriate.

Note: *The Department of Mathematics and Statistics will endeavour to give appropriate advice to students registered in its programs. However, the Department points out that it is the responsibility of the student to see that his or her academic program meets the University's Regulations in all respects. Students are referred to the* ***UNIVERSITY REGULATIONS - General Academic Regulations (Undergraduate), Registration, Student Responsibility.*** *The Department accepts no responsibility for any matter arising from an inappropriate and/or improperly recorded registration.*

10.8.3 Course Numbering System

The subject area of all courses offered by the Department of Mathematics and Statistics is identified by the second digit of the course number:

Second Digit
0 – Common Core Mathematics courses
1 – Applied Mathematics courses
2 – Applied Mathematics and Pure Mathematics courses
3 – Pure Mathematics courses
4 – Pure Mathematics and Statistics courses
5 – Statistics courses

Unless otherwise specified, where a regulation makes reference to Mathematics courses, this shall include courses in any of the categories listed above.

Where a regulation makes reference to Applied Mathematics courses, this shall include all courses with second digit 1 or 2. Where a regulation makes reference to Pure Mathematics courses, this shall include all courses with second digit 2, 3 or 4. Where a regulation makes reference to Statistics courses, this shall include all courses with second digit 4 or 5.

10.8.4 Major in Applied Mathematics (B.Sc. Only)

Students shall complete the following requirements:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2260, 3000, 3001, 3100, 3132, 3161, 3202, 4160, 4190.
2. Three credit hours in courses numbered 3000 or higher that are offered by the Department of Mathematics and Statistics, excluding the former Mathematics 3330.
3. A computing course, early in your program. Computer Science 1510 is highly recommended.
4. A designated technical writing course offered by a Science department. Mathematics 2130 is recommended. The technical writing course is prerequisite to some 3000-level courses.
5. Physics 1050 (or 1020) and 1051.
6. A statistics course. Statistics 3410 is recommended.

10.8.5 Major in Pure Mathematics

Students shall complete the following requirements:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2320, 3000, 3001, 3320;
2. One of Mathematics 2260, 3202, 3210;
3. One of Mathematics 3331, 3370;
4. Twelve further credit hours in Pure Mathematics courses numbered 3000 or higher, excluding the former Mathematics 3260 and 3330, at least 6 credit hours of which must be in courses numbered 4000 or higher;
5. A computing course. Computer Science 1510 is recommended.
6. A designated technical writing course offered by a Science department. Mathematics 2130 is recommended.
7. A statistics course. Statistics 3410 is recommended.

10.8.6 Major in Statistics

Students shall complete the following requirements:

1. Mathematics 1000, 1001, 2000, 2050, 2051, Statistics 2560, 3410, 3411, 3520, 3521, 4530;
2. One of Statistics 1510, 2500, or 2550;
3. Nine further credit hours in Statistics courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher excluding Statistics 4581;
4. A computing course. Computer Science 1510 is recommended.
5. Mathematics 3000 and 3001 are recommended.

10.8.7 Honours in Applied Mathematics (B.Sc. Only)

See **Regulations for the Honours Degree of Bachelor of Science**. Students shall complete the following:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 3000, 3001, 3100, 3111, 3132, 3161, 3202, 3210, 4160, 4180, 4190, 419A/B;
2. At least one of Mathematics 4162 or 4170;
3. Statistics 3410;
4. Nine further credit hours in courses numbered 3000 or higher that are offered by the Department of Mathematics and Statistics, excluding the former Mathematics 3330, at least 3 of which must be in courses numbered 4000 or higher;
5. A computing course early in the program is required. Computer Science 1510 is recommended.
6. Physics 1050 (or 1020), 1051, 2820, 3220.

10.8.8 Honours in Pure Mathematics

See **Regulations for the Honours Degree of Bachelor of Science**. Students shall complete the following requirements:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 2130, 2260, 2320, 3000, 3001, 3202, 3210, 3300, 3320, 3331, 4300, 4310, 439A/B, Statistics 2550;
2. Either Mathematics 3340 or 3370;
3. Either Mathematics 4000 or 4001;
4. Either Mathematics 4320 or 4321;
5. Twelve further credit hours in Pure Mathematics courses numbered 3000 or higher, excluding the former Mathematics 3330, at least 9 credit hours of which must be in courses numbered 4000 or higher;
6. A computing course early in the program is required. Computer Science 1510 is recommended.

10.8.9 Honours in Statistics

See **Regulations for the Honours Degree of Bachelor of Science**. Students shall complete the following requirements:

1. Mathematics 1000, 1001, 2000, 2050, 2051, 3000, 3001, 3132, 3202, 3210, Statistics 2560, 3410, 3411, 3520, 3521, 4410, 4530, 4590, 459A/B;
2. One of Statistics 1510, 2500, or 2550;
3. Eighteen further credit hours in Statistics courses including at least 12 credit hours in courses numbered 4000 or higher excluding Statistics 4581;
4. A computing course. Computer Science 1510 is recommended.
5. Mathematics 4000 is recommended.

10.8.10 Minor in Mathematics

A total of 24 credit hours in courses offered by the Department of Mathematics and Statistics is required of which only 6 credit hours shall be in courses at the 1000 level and at least 6 credit hours shall be in courses numbered 3000 or higher.

10.8.11 Minor in Statistics

The courses required for a minor in Statistics are:

1. Mathematics 1000, 1001; Statistics 1510 or 2500 or 2550, Statistics 2501 or 2560.
2. Twelve further credit hours in Statistics courses numbered 3000 or higher excluding Statistics 4581.

It is recommended that Mathematics 2000 and Mathematics 2050 be taken since they are prerequisite to several further Statistics courses.

10.9 Ocean Sciences

www.mun.ca/osc

The Department of Ocean Sciences is the newest Department within the Faculty of Science. It was created in 2012, from the transition of the **Ocean Sciences Centre**, a research unit and facility that was first opened in 1967. The Department's mandate as an interdisciplinary unit is to focus on increasing our understanding of biological and chemical processes within the oceans, and how they relate to aquaculture and other applied marine fields.

The Department offers graduate programs in Marine Biology outlined under **School of Graduate Studies**.

The Department offers the following undergraduate programs:

1. **Minor in Oceanography**
2. **Minor in Sustainable Aquaculture and Fisheries Ecology**
3. **Major in Ocean Sciences**
4. **Major in Ocean Sciences (Environmental Systems)**
5. **Joint Major in Marine Biology**

Details of the **Joint Major in Marine Biology** can be found under Joint Majors.

Ocean Sciences course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Ocean Sciences**.

10.9.1 Minor in Oceanography

Students who take a Minor In Oceanography will complete 24 credit hours as follows:

1. Ocean Sciences 1000, 2100, 2200, 2300;
2. Ocean Sciences 2000 or Biology 3710;
3. Earth Sciences 1000; and
4. the remaining 6 credit hours should be selected from Biology 3014, 3709, 3711, 3712, 3714, 3715, 4122, 4601, 4710, 4750, 4810, Chemistry 2100, 3110, 4151, 4156, Earth Sciences 4302, Geography 3120, 3510, 4190, 4300, Environmental Science 3072, 3210, 3211, 4230, Ocean Sciences 2001, 3000, 3002, 3620, 4000, 4122, 4601, and Physics and Physical Oceanography 3300, 3340, 4300, 4340.

Course prerequisites stipulated In the **Course Descriptions** section shall apply to the Minor In Oceanography.

10.9.2 Minor in Sustainable Aquaculture and Fisheries Ecology

Students who take a minor in Sustainable Aquaculture and Fisheries Ecology will complete 24 credit hours as follows:

1. Ocean Sciences 1000, 2001, 3000, 3002;
2. Biology 4750 or Geography 4300;
3. one of Ocean Sciences 2000 (or Biology 3710), 3620, 3640, 4000, 4100, 4122, 4601;

4. one of Biology 2122, 3401, 3640, 3715, 4251, 4605; and
5. one of Biochemistry 2600, 3107, 3402, 4002, 4101, 4104, 4105, 4200, 4201.

Course prerequisites stipulated in the **Course Descriptions** shall apply to the Minor in Sustainable Aquaculture and Fisheries Ecology.

10.9.3 Major in Ocean Sciences and Major in Ocean Sciences (Environmental Systems)

The Major in Ocean Sciences is an interdisciplinary program that provides a solid foundation in ocean studies, including the basic principles of its main sub-disciplines (physical, chemical, geological, and biological oceanography).

The Major in Ocean Sciences (Environmental Systems) is a stream of the major that provides a geological/geographical context to biological and chemical phenomena in ocean sciences, and covers such key ocean-related topics as climate change and natural hazards.

Students wishing to take one of these major programs are encouraged to carefully consult the **Degree Regulations, Regulations for the General Degree of Bachelor of Science**.

More information, including on how to declare a Major in Ocean Sciences, the recommended courses and time tables, can be found in the *Handbook of Undergraduate Studies in Ocean Sciences* at www.mun.ca/osc/undergrad/Ocean_Sciences_Handbook.pdf.

10.9.3.1 Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems)

Admission to the Ocean Sciences Major Programs is based on academic standing. To be considered for admission to one of the major programs, students must normally have completed 30 credit hours with an overall average of at least 65%. The following courses should have been completed:

1. Biology 1001 and 1002;
2. Chemistry 1050 and 1051 (or 1010 and 1011) or (1200 and 1001);
3. Earth Sciences 1000;
4. English 1090 and 1110 (or equivalent);
5. Mathematics 1000 (or equivalent);
6. Ocean Sciences 1000 with a minimum grade of 65%; and
7. Physics 1020 or Physics 1050.

Students who wish to enroll in any of these programs should plan well in advance so that they have the appropriate prerequisites. Entry to required courses may be limited and determined by academic performance. Students are advised to consult with the Department at the earliest opportunity to prepare adequately for program admission. Each student registered in the Major will be assigned a faculty advisor who should be consulted on academic issues, including course selection.

10.9.3.2 Program Regulations for the Bachelor of Science with Major in Ocean Sciences

Students must successfully complete:

1. the 30 specified credit hours required under **Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems)**;
2. Statistics 2550 (or equivalent);
3. Physics 1021 or Physics 1051;
4. a minimum of 30 credit hours in Ocean Sciences, including:
   a. Ocean Sciences 2000 (or Biology 3710), 2001, 2100 and 2500. Ocean Sciences 1000, completed under **Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems),** will count as 3 of the required 30 credit hours in Ocean Sciences;
   b. at least one of Ocean Sciences 2200 or 2300; and
   c. at least 9 credit hours at the 3000 and/or 4000 level. Choices include but are not limited to Ocean Sciences 3000, 3002, 3620, 3640, 4000, 4100, 4122, 4601;
5. extra Science courses as necessary to fulfil the minimum requirement for 78 credit hours in Science as stipulated in Clause 3.a. of the **Degree Regulations, Regulations for the General Degree of Bachelor of Science**. The program should include a minimum of 15 credit hours in Science courses at the 3000 and/or 4000 level; and
6. elective courses as necessary to make up the total of 120 credit hours.

10.9.3.3 Program Regulations for the Bachelor of Science with Major in Ocean Sciences (Environmental Systems)

Students must successfully complete:

1. the 30 credit hours required under **Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems)**;
2. Statistics 2550 (or equivalent);
3. Physics 1021 or Physics 1051;
4. Geography 1050, and at least two of Geography 2102, 2195, or 2425;
5. Earth Sciences 1002, 2502;
6. at least 9 credit hours at the 3000 and/or 4000 level chosen from:
   a. Geography 3120, 3140, 3250, 3425, 3510, 3905, the former 3907, 4250, 4908, 4917; and
   b. Earth Sciences 3600, 4605, 4903.
7. a minimum of 30 credit hours in Ocean Sciences, including:
   a. Ocean Sciences 2000 (or Biology 3710), 2001, 2100 and 2500. Ocean Sciences 1000, completed under **Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems),** will count as 3 of the required 30 credit hours in Ocean Sciences;
   b. at least 9 credit hours at the 3000 and/or 4000 level. Choices include but are not limited to Ocean Sciences 3000, 3002, 3620, 3640, 4000, 4100, 4122, 4601; and

8. elective courses as necessary to make up the total of 120 credit hours.

10.10 Physics and Physical Oceanography

www.mun.ca/physics

The following undergraduate programs are available in the Department:

1. Applied Mathematics and Physics Joint Honours
2. Applied Mathematics and Physics Joint Major
3. Biochemistry and Physics Joint Honours
4. Chemistry and Physics Joint Honours
5. Computer Science and Physics Joint Honours
6. Computer Science and Physics Joint Major
7. Earth Sciences and Physics Joint Honours
8. Earth Sciences and Physics Joint Major
9. Geophysics and Physical Oceanography Joint Honours
10. Honours in Environmental Physics
11. Honours in Physics
12. Major in Environmental Physics
13. Major in Physics
14. Minor in Physics

Details of these joint programs are given after the **Regulations for the Honours Degree of Bachelor of Science**. Other joint programs may be arranged in consultation with the departments concerned.

Physics and Physical Oceanography course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Physics and Physical Oceanography**.

Notes:
1. *The attention of students intending to follow any one of the programs listed above is drawn to the **UNIVERSITY REGULATIONS - General Academic Regulations (Undergraduate)**, governing the appropriate degree. Additional Departmental requirements are given below.*
2. *Faculty advisors are available to provide advice to students who are registered in, or who are considering registering in, any of the programs. Students are urged to consult with these advisors at their earliest opportunity in order to ensure that they select appropriate courses and programs. Students with credits in Physics courses which are not listed in this calendar should consult with the Department.*
3. *The six course stream consisting of Physics 1050, 1051, 2053, 2055, 2750, and 2820 or alternatively the seven course stream of Physics 1020, 1021, 1051, 2053, 2055, 2750, and 2820 is intended to provide a cohesive overview of Physics for potential Physics majors. Students who receive a grade of greater than 70% in Physics 1020 may proceed directly into Physics 1051 without taking Physics 1021.*
4. *Physics 1050 is recommended for students who have completed Level II Physics, Level III Physics and Level III Advanced Mathematics. Mathematics 1000 must be taken at the same time as, or be completed prior to, taking Physics 1050. Students who have completed Mathematics 1000 and Physics 1050 are required to register for or complete Mathematics 1001 before registering for Physics 1051.*
5. *Physics 1020 is intended for students who have no background in Physics or who are pursuing degree programs which do not require Physics 1050. Students who complete Physics 1020 (with a grade of at least 70%) and Mathematics 1000 are eligible for admission to Physics 1051. Students may receive credit for only one of Physics 1050 and 1020.*
6. *Students who have successfully completed Advanced Placement courses in both Physics and Mathematics will normally be eligible for direct entry into Physics 1051, which can be taken concurrently with Physics 2053 and 2750. Eligible students are advised to consult the Department.*
7. *Where circumstances warrant, any prerequisites listed below may be waived by the Head of the Department.*

10.10.1 Minor in Physics

A minor in Physics will consist of 24 credit hours in Physics courses which must include Physics 1050 (or 1020), 1051, 2053, 2055, 2750, 2820. Only 6 credit hours at the 1000 level can be used to fulfill the 24 credit hours. For those students whose major is Chemistry or Biochemistry, the 24 credit hours in Physics will not include 2053.

For Electrical Engineering students, 24 credit hours in Physics which must include Physics 1050 (or 1020), 1051, 2750, 3000, and 3550 with an additional 9 credit hours selected from Physics 2820, 3600, 3750, 3751, 3800, 4000, 4220, 4600 or other 3000 or 4000 level courses subject to approval by the Head of Physics and Physical Oceanography and the Chair of Electrical and Computer Engineering.

10.10.2 Major in Physics

1. English 1090 or the former English 1080 and English 1110 (or equivalent).
2. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031).
3. Mathematics 1000 and 1001.
4. Mathematics 2000, Mathematics 2050 and Mathematics 2260.
5. Physics 1050 (or 1020) and 1051.
6. Physics 2053, 2055, 2750, 2820, 3220, 3400, 3500, 3750 and 3900.
7. An additional 12 credit hours in physics courses numbered 3000 or higher which shall include at least 6 credit hours selected from the courses numbered Physics 3000, 3150, 3300, the former 3410, 3550, 3600, 3751.
8. Physics 3810 or Mathematics 3202.

Mathematics 1001, 2000 and 2050 are prerequisites to many Physics courses and should be completed by the end of second year. Mathematics 2260 is co-requisite to Physics 3220 and should be completed before the Winter of the third year. Those who intend to make a career in Physics should note that additional Physics courses are strongly recommended. Mathematics 2051 and Computer Science 1510 or the former 2602 are also recommended.

10.10.3 Honours in Physics

1. English 1090 or the former English 1080 and English 1110 (or equivalent).
2. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031).
3. Mathematics 1000 and 1001.
4. Computer Science 1510.

5. Mathematics 2000, 2050, and 2260.
6. Physics 1050 (or 1020) and 1051.
7. Physics 2053, 2055, 2750, 2820, 3220, 3230, 3400, 3500, 3600, 3750, 3820, 3900, 4400, 4500, 4820, 4850, 4900, 490A/B.
8. Physics 3810 or Mathematics 3202.
9. An additional 12 credit hours in physics courses numbered 3000 or higher which shall include at least 6 credit hours selected from physics courses numbered 4000 or higher.
10. Fifteen credit hours in applicable elective courses

Note: *Certain graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.*

Only 6 credit hours at the 1000 level in each of Physics, Chemistry and Mathematics can be used to fulfil the 120 credit hours required for the Honours program. The inclusion of Mathematics 1090 (or 109A/B), the sequence of Physics 1020, 1021, and 1051 or the substitution of Chemistry 1010, 1011 and the former 1031 for Chemistry 1050 and 1051 will each increase the number of credit hours required for the Honours Physics program by three.

An Honours thesis is to be presented on work undertaken by the candidate under the guidance of a Department of Physics and Physical Oceanography faculty member. The thesis comprises the 6 credit hour course Physics 490A/B. Students should seek departmental advice regarding a thesis project no later than the winter preceding the semester in which the project will be started.

The Honours Physics program in and beyond the third year requires a familiarity with computer programming and numerical analysis. In choosing electives for this program, the Department recommends that students supplement the prescribed program with the following courses Computer Science 2500 or 2510, and 3731 (or Mathematics 2130 and 3132). Mathematics 2051 and 3000 are also suitable electives. For specific courses and recommendations about electives, consultation with a faculty advisor in the Department is suggested.

The Department recommends that students wishing to complete the Honours Physics program in 120 credit hours follow the schedule given below. This schedule is intended for students who qualify for Physics 1050 and 1051. Other suggested course schedules are available from the Head of the Department.

Recommended Course Schedule - Honours Physics Program

Year	Semester I	Semester II
I	Chemistry 1050 English 1090 or the former English 1080 Mathematics 1000 Physics 1050 Elective	Chemistry 1051 Computer Science 1510 English 1110 (1191 or the former 1101, 1192 or the former 1102) Mathematics 1001 Physics 1051
II	Mathematics 2000 Mathematics 2050 Physics 2053 Physics 2820 Elective	Mathematics 2260 Mathematics 3202 Physics 2055 Physics 2750 Elective
III	Physics 3220 Physics 3400 Physics 3500 Physics 3750 Physics 3820	Physics 3900 Physics 3600/4500 Physics 3230/4400 Physics 4820 Physics Elective
IV	Physics 4900 Physics 4850 Physics 490A Physics Elective Elective	Physics 4500/3600 Physics 4400/3230 Physics 490B Physics Elective Physics Elective

10.10.4 Major in Environmental Physics

1. English 1090 or the former English 1080 and English 1110 (or equivalent)
2. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031)
3. Mathematics 1000 and 1001
4. Mathematics 2000, Mathematics 2050, Mathematics 2260, Mathematics 3202
5. Physics 1050 (or 1020) and 1051
6. Physics 2053, 2055, 2750, 2820, 3220, 3820, 3300, 3340, 4340
7. Physics 3400 or 3500
8. Earth Sciences 1000, 1002, 2502, 3170, 3172
9. Geography 2102, 2195, 3120
10. Biology 2120, 2600

The Major degree offers students a fair degree of latitude in choosing electives, students are encouraged to take electives from Geography and Earth Sciences: of particular merit would be any of Earth Sciences 3600, 3611 or 4105.

10.10.5 Honours in Environmental Physics

1. English 1090 or the former English 1080 and English 1110 (or equivalent)
2. Chemistry 1050 and 1051 (or Chemistry 1010, 1011, and the former 1031)
3. Mathematics 1000 and 1001
4. Mathematics 2000, Mathematics 2050, Mathematics 2260, Mathematics 3202
5. Physics 1050 (or 1020) and 1051

6. Physics 2053, 2055, 2750, 2820, 3220, 3300, 3340, 3820,4205, 4300, 4340, 4820, 490A/B
7. Physics 3400 or 3500
8. Earth Sciences 1000, 1002, 2502, 3170 and 3172
9. Geography 2102, 2195, 3120
10. Biology 2120, 2600

An honours thesis is to be presented on work undertaken by the candidate under the guidance of a Department of Physics and Physical Oceanography faculty member. The thesis comprises the 6 credit hour course Physics 490A/B. Students should seek departmental advice regarding a thesis project no later than the winter preceding the semester in which the project will be started.

The Department recommends that students wishing to complete the Honours Environmental Physics program in 120 credit hours follow the schedule given below. This schedule is intended for students who qualify for Physics 1050 and 1051. Other suggested course schedules are available from the Head of the Department.

Those courses in which a grade of "B" or better or an average of 75% or higher are required, as specified under **Academic Standing, clause 1** of the **Regulations for the Honours Degree of Bachelor of Science**, are 45 credit hours in Physics courses, and 15 credit hours in other courses (beyond the 1000 level) selected from the specified program courses in Earth Sciences, Geography and Biology.

Recommended Course Schedule - Honours Environmental Physics Program

Year	Semester I	Semester II
I	Chemistry 1050 Earth Sciences 1000 English 1090 or the former English 1080 Mathematics 1000 Physics 1050	Chemistry 1051 Earth Sciences 1002 English 1110 Mathematics 1001 Physics 1051
II	Geography 2102 Mathematics 2000 Mathematics 2050 Physics 2053 Physics 2820	Geography 2195 Mathematics 2260 Mathematics 3202 Physics 2750 Elective
III	Earth Sciences 2502 Physics 3220 Physics 3820 Physics 3400/3500 Physics 3340	Biology 2120 Earth Sciences 3170 Geography 3120 Physics 2055 Physics 4820
IV	Biology 2600 Earth Sciences 3172 Physics 3300 Physics 490A Elective	Physics 4205 Physics 4300 Physics 4340 Physics 490B Elective

Credit Restrictions for Present Physics Courses with Former Courses Table

Credit May Be Obtained For Only One Course From Each of The Pairs of Courses Listed in This Table

Present Course	Former Course	Present Course	Former Course
1020	1200	1051	2050
1021	1201	1051	1061
1051	1052	3750	3700
2820	2200	3750	3850
2053	2450	490A/B	4990
2055	2550	1051	2054
2750	2700	1051	2550
3220	3200	4400	3410
3230	2210	4820	3821
		4900	3920

Physics 1021 and the former Physics 1201 will be considered equivalent for prerequisite purposes. Physics 1051 and 2820 will be considered equivalent to the former Physics 1054 and 2054 for prerequisite purposes. Physics 1051 and the former Physics 1052 and 2050 will be considered equivalent for prerequisite purposes.

Not all courses are offered every year. Students should check with the Department prior to registration to plan programs.

10.11 Psychology

www.mun.ca/psychology

The following undergraduate programs are available in the Department.

1. **Biochemistry and Psychology (Behavioural Neuroscience) Joint Honours (B.Sc. Hons. only)**
2. **Biochemistry (Nutrition) and Psychology (Behavioural Neuroscience) Joint Honours (B.Sc. Hons. only)**
3. **Biology and Psychology (Behavioural Neuroscience) Joint Honours (B.Sc. Hons. only)**
4. **Biology and Psychology Joint Honours (B.Sc. Hons. only)**
5. **Major** and **Honours in Behavioural Neuroscience (B.Sc. only)**
6. **Major** and **Honours in Behavioural Neuroscience (Co-operative) (B.Sc. Hons. only)**
7. **Major** and **Honours in Psychology (B.A. or B.Sc.)**
8. **Major** and **Honours in Psychology (Co-operative) (B.A. or B.Sc.)**
9. **Minor in Psychology (B.A. or B.Sc.)**

Details of the joint honours programs are given under the **Degree Regulations** of the Faculty of Science.

Psychology course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Psychology**.

10.11.1 Admission to Major Programs

Admission to the Major programs in the Department of Psychology is competitive and selective. Students who wish to enter these programs must submit a completed application form to the Psychology Department by June 1 for Fall semester registration. To be eligible for admission, students must have completed the 24 credit hours as listed below with an average of at least 65% in Psychology 1000/1001 and an overall average of at least 60% in Psychology, English, and Mathematics:

1. Psychology 1000, 1001.
2. English 1090 or the former English 1080 and one of 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110, or equivalent.
3. Mathematics 1000, or two of 1090, 1050, 1051 (or equivalent).
4. Six credit hours of electives (9 if only Mathematics 1000 is completed).

Students who fulfil the eligibility requirements compete for a limited number of available spaces. Selection is based on academic performance, normally cumulative average and performance in recent courses.

10.11.2 Admission to Honours Programs

The Honours programs in the Department of Psychology are designed for students who would like to concentrate their studies or pursue graduate work. Students who wish to be admitted to these programs must submit an "Application for Admission to Honours Program Faculties of Humanities and Social Sciences or Science" to the Department of Psychology by June 1 for Fall semester registration. This form is available at www.mun.ca/regoff/Application_Honours_Program.pdf. To be eligible for admission, students must have completed Psychology 2910, 2911, 2520, and 2930 and obtained in these courses a grade of "B" or better, or an average of 75% or higher. Students who fulfill the eligibility requirements compete for a limited number of available spaces. Selection is based on academic performance in the required courses. In special circumstances, students may be admitted to Honours Programs at times other than June.

Note: *Students are advised to consult the general regulations for **Honours in the Faculty of Humanities and Social Sciences** or the **Faculty of Science**, as appropriate.*

10.11.3 Requirements for a Major in Psychology

Students completing this program cannot receive credit for Psychology 2920. Students who intend to pursue graduate studies should take courses leading to the Honours degree.

1. Students may Major in Psychology as part of either a B.A. or a B.Sc. program. All Majors are required to complete a minimum of 42 credit hours of Psychology as listed below:
   a. Psychology 1000, 1001, 2520, 2910, 2911, 2930.
   b. Twelve credit hours in Psychology chosen from the following: 3050, 3100, 3250, 3350, 3450, 3620, 3650, 3750, or one of 3800 or 3830.
   c. Twelve credit hours of 4000-level courses in Psychology, of which at least one must be a research experience course and one must be a selected topics course.
2. Psychology Majors following the B.Sc. program are also required to complete the following:
   a. Mathematics 1000 (or equivalent).
   b. Biology 1001 and 1002.
   c. Either Chemistry 1010 and 1011 (or 1050 and 1051); OR Physics 1020 (or 1050) and 1021 (or 1051).
      Note: *First year students should think carefully about whether Chemistry or Physics best suits their future program needs. Students should examine the prerequisites for upper-level science courses and attempt to take them in their first year.*
   d. Six credit hours of laboratory courses at the 2000 level or above in one of Biology, Chemistry, or Physics.
      Note: *Biology/Psychology 4701 and Biology 3053 cannot be used to satisfy the requirement of 6 laboratory credit hours at the 2000 level or above in either Biology, Chemistry, or Physics.*
3. Psychology Majors following the B.A. program are also required to complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent), and are encouraged to complete at least 6 credit hours in Biology.

10.11.4 Requirements for Honours in Psychology

Students completing this program cannot receive credit for Psychology 2920.

1. Honours students in Psychology are required to complete the 60 credit hours of Psychology as listed below:
   a. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3900, 4910, 499A/B
   b. Eighteen credit hours chosen from the alternatives listed in Clause 1. b. of the requirements for a Major in Psychology

c. Twelve credit hours of 4000-level courses in Psychology, of which at least one must be a research experience course and one must be a selected topics course.

2. Honours students must also complete the requirements listed in either Clause 2. or Clause 3., as applicable, of the requirements for a Major in Psychology.
3. Honours students will be required to submit in their graduating year, an undergraduate thesis (Psychology 499A/B) which demonstrates their competence in Experimental Psychology.

10.11.5 Requirements for a Major in Behavioural Neuroscience (B.Sc. Only)

Students completing this program cannot receive credit for Psychology 2920.

A program is offered in the Psychology Department to provide an education in Behavioural Neuroscience. Students planning to enroll in the program are advised to consult with the Head of the Department at the earliest opportunity because certain course choices may restrict later options. Students who intend to pursue graduate studies should take courses leading to the Honours degree.

The program for a Major in Behavioural Neuroscience shall include:

1. a. Psychology 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800, 3820.
   b. Three credit hours in Psychology chosen from the following: 3050, 3100, 3350, 3450, 3620, 3650, 3750.
   c. Any research experience course and one of Psychology 4250, 4251, 4850 or 4851; or, any selected topics course and one of Psychology 4270 or 4870.
2. a. Mathematics 1000 (or equivalent) and 1001.
   b. Chemistry 1010 and 1011 (or 1050 and 1051), and 2440 (or 2400/2401).
   c. Physics 1020 (or 1050) and 1021 (or 1051).
   d. Biology 1001 and 1002.
   e. English 1090 or the former English 1080 and one of 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110, or equivalent.
3. Eighteen credit hours from the following courses chosen from at least two different sciences:
   a. Biochemistry: Any 2000-, 3000-, or 4000-level course except the former 2000, 2005, the former 2010, the former 2011, 3202, 3402, or 4502.
   b. Biology: 2060, 2122, 2210, 2250, 2900, 3050, 3160, 3202, 3295, 3401, 3500, 3530, 3540, 3750, 4200, 4241, 4245, 4250, 4402, the former 4450, 4601, 4605, 4701, the former 4900 (see note below).
   c. Chemistry: 2100, 2210, 2301 (or the former Chemistry 2300) or any 3000 or 4000 level course.
   d. Computer Science: Any 2000, 3000, or 4000 level course except the former 2650 and the former 2801.
   e. Mathematics: 2000, 2050, 2051, 3000, 3001 or any 3000 or 4000 level pure or applied mathematics course.
   f. Physics: Any 2000, 3000, or 4000 level course except 2151, 3150, 3151.

   Notes: *1. Credit may not be obtained for both Biology 3750 and Psychology 3750 or for both Biology 4701 and Psychology 4701.*
   2. The courses listed under Clause 3 may have prerequisites. It is the student's responsibility to ensure that all prerequisites have been met, or that waivers have been obtained, before registering for these courses.

10.11.6 Requirements for Honours in Behavioural Neuroscience (B.Sc. Only)

Students completing this program cannot receive credit for Psychology 2920.

1. Honours students in Behavioural Neuroscience are required to complete the following Psychology courses: 1000, 1001, 2520, 2910, 2911, 2930, 3250, 3800, 3820, 3900, 499A/B, one further course in Psychology chosen from the following: 3050, 3100, 3350, 3450, 3620, 3650, 3750; any research experience course and one of Psychology 4250, 4251, 4850 or 4851; or, any selected topics course and one of Psychology 4270 or 4870.
2. Honours students in Behavioural Neuroscience must also complete the requirements listed in Clauses 2. and 3. of the requirements for a Major in Behavioural Neuroscience.
3. In accordance with **Academic Standing, clause 1** of the **Regulations for the Honours Degree of Bachelor of Science**, Honours candidates must obtain a grade of "B" or better, OR an average of 75% or higher in all the required courses listed in Clauses 1. and 3. of the requirements for a major in Behavioural Neuroscience and Clause 1 of the requirements for honours in Behavioural Neuroscience, except those at the 1000 level.

10.11.7 Requirements for a Minor in Psychology

Students who Minor in Psychology are required to complete a minimum of 24 credit hours of Psychology as follows:

a. Psychology 1000, 1001, and 2920 (or 2910 or 2925)
b. Fifteen other credit hours of Psychology.

10.11.8 Requirements for Major and Honours in Psychology (Co-operative) (B.A. or B.Sc.), and Major and Honours in Behavioural Neuroscience (Co-operative) (B.Sc. only)

Psychology Co-op Program (PCOP)

The Psychology Co-op Program (PCOP) is available to full-time Psychology (B.A. and B.Sc.) and Behavioural Neuroscience Majors and Honours students only.

The PCOP provides an opportunity for students to learn valuable practical skills while working in fields related to Psychology. Students complete three Work Terms, which consist of full-time paid employment. The timing of the Work Terms is such that employers stand to gain from the acquired skills of psychology majors in training. The objectives of the Work Term component of the PCOP are embodied in the **Work Term Descriptions**.

10.11.8.1 Admission Requirements

1. Admission is limited, competitive, and selective.
2. The primary criterion used in reaching decisions on applications for admission is overall academic achievement. Students with average overall academic records are unlikely to be admitted.

3. Students must first be admitted to the Psychology (B.A. or B.Sc.) or Behavioural Neuroscience Major.
4. To be eligible for admission, students must have completed a minimum of 30 credit hours with an overall average of at least 65%, and an average of at least 65% in all Psychology courses. Students must have a passing grade in all required courses, and must be registered for 15 additional credit hours in the semester in which they apply.
5. The deadline date for application is December 15.

10.11.8.2 Program of Study

1. In addition to the requirements below students must fulfill all requirements for either a Major in Psychology (B.A.), a Major in Psychology (B.Sc.), Major in Behavioural Neuroscience, Honours in Psychology (B.A.), Honours in Psychology (B.Sc.), or Honours in Behavioural Neuroscience. Courses in each program are normally taken in blocks as shown in the appropriate program table. Students should consult with a faculty advisor each semester regarding course selection.
2. Students' status in the program is assessed at the end of each semester. To remain in PCOP, students must receive a passing grade in all required courses, and must maintain an average of at least 65% in all Psychology courses and a cumulative average of at least 65%. A student who fails a required course, fails to maintain an average of 65% in Psychology courses, or fails to maintain a cumulative average of 65%, will be required to withdraw from PCOP. The student in question may apply for readmission in a subsequent year after passing the specified required course(s) previously failed, or re-establishing the required average.
3. Students are required to complete three work terms at the prescribed times.

10.11.8.3 Work Term Placement

1. General management of the work terms in PCOP is the responsibility of Co-operative Education. It is responsible for assisting potential employers to become involved in the program, organizing competitions for Work Term employment, arranging student-employer interviews and facilities, data base management, and for the continual development of employment opportunities. Co-operative Education will work with the department to counsel students, visit students on their work assignments and evaluate the work term.
2. Work placement is not guaranteed but every effort is made to ensure that appropriate employment is made available. In the case of students who are required to withdraw from the program, Co-operative Education has no responsibility for placement until they have been re-admitted to the program.
3. A student who applies for admission to the co-op program gives permission to the University to provide a copy of the applicant's resume, university transcript and work term evaluations to potential employers.
4. A student who has been accepted to PCOP may obtain his/her own work term placement outside the competition. Such employment positions must be confirmed by the employer, and must be approved by Co-operative Education.
5. Students are expected to submit to Co-operative Education, within a month from starting a Work Term, a plan of the intended work that term.
6. Salaries paid to co-operative students are determined by employers based on their internal wage structures. However, students should not expect the income from work terms to make them completely self-supporting.

10.11.8.4 Registration and Evaluation of Performance

1. In Work Terms I, II, and III, students must register for Psychology 199W, 299W, and 399W respectively.
2. Student performance evaluations are to be completed by the employer and returned to Co-operative Education. The Work Term evaluations shall consist of two components:
   a. On-the-job Student Performance: Job performance shall be assessed by Co-operative Education in consultation with the Department using information gathered during the Work Term and input from the employer towards the end of the Work Term. Formal written documentation from the employer shall be sought. Evaluation of the job performance will result in one of the following classifications: OUTSTANDING, EXCEEDS EXPECTATIONS, SATISFACTORY, OR FAIL
   b. The Work Report
   i. Students are required to submit a Work Term report to Co-operative Education on the first day of final exams.
   ii. Work Term reports shall be evaluated by a faculty member and Co-operative Education.
   iii. If an employer designates a report to be of a confidential nature, both employer and Co-operative Education must agree as to the methods to protect the confidentiality of such a report before the report may be accepted for evaluation.
   iv. Reports must contain original work related to the Work Term placement. The topic must relate to the work experience and will be chosen by the student in consultation with the employer. The topic must be approved by Co-operative Education or a faculty member of the Department of Psychology.

   Evaluation of the work term report will result in one of the following classifications: OUTSTANDING, EXCEEDS EXPECTATIONS, SATISFACTORY, OR FAIL.

   The evaluation of the job performance and the work term report are recorded separately on the transcript. Overall evaluation of the work term will result in one of the following final grades being awarded:

   - Pass with Distinction: Indicates OUTSTANDING PERFORMANCE in both the work report and the job performance.
   - Pass: Indicates that PERFORMANCE MEETS EXPECTATIONS in both the work report and the job performance.
   - Fail: Indicates FAILING PERFORMANCE in the work report or the job performance, or both.

   To remain in PCOP, a student must obtain a final grade of PAS.
3. If a student fails to achieve the Work Term standards specified above, the student will be required to withdraw from PCOP. Such a student may reapply to the program, at which time the student will be required to repeat the Work Term with satisfactory performance. Only one Work Term may be repeated in the entire program.
4. In order to be considered for readmission, students must formally apply for readmission to the program not later than the deadline date specified in **Admission Requirements**.
5. A student who withdraws from a Work Term without acceptable cause subsequent to a job placement will be required to withdraw permanently from PCOP.
6. Students who drop a Work Term without prior approval from both Co-operative Education and the Head of the Department of Psychology, or who fail to honour an agreement to work with an employer, or conduct themselves in such a manner as to cause their discharge from the job, will be awarded an overall grade of FAL for the Work Term in question and will be required to withdraw permanently from PCOP.

7. Permission to drop a Work Term does not constitute a waiver of degree requirements, and students who have obtained such permission must complete an approved Work Term in lieu of the one dropped.

10.11.9 Suggested Course Sequences

The tables below show suggested course sequences for the **B.A. in Psychology (Co-operative)**, the **B.Sc. in Psychology (Co-operative)**, the **B.A. Honours in Psychology (Co-operative)**, the **B.Sc. Honours in Psychology (Co-operative)**, the **B.Sc. in Behavioural Neuroscience (Co-operative)**, and the **B.Sc. Honours in Behavioural Neuroscience (Co-operative)**.

Table 1 Suggested Course Sequence for B.A. in Psychology (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement English 1090 or the former English 1080 Mathematics 1000 or one of Mathematics 1090, 1050, 1051 Psychology 1000
Winter **Semester 2**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 One of Mathematics 1000, 1090, 1050 or 1051* Psychology 1001
Fall **Semester 3**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology 3000-Level Core
Winter **Semester 6**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology 3000-Level Core
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 4000-Level Psychology Selected Topics course
Winter **Work Term 3**	Psychology 399W
Fall **Semester 8**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 4000-Level Psychology Research Experience course
*Psychology Majors are required to complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.	

Table 2 Suggested Course Sequence for B.Sc. in Psychology (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Biology 1001 Chemistry 1010 (1050) or Physics 1020 (1050)* English 1090 or the former English 1080 Mathematics 1090 or 1000 Psychology 1000
Winter **Semester 2**	Biology 1002 Chemistry 1011 (1051) or Physics 1021 (1051) English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 Mathematics 1000 or Elective or Science requirement Psychology 1001
Fall **Semester 3**	Biology, Chemistry, or Physics Lab Course Elective or Science requirement Elective or Science requirement Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	Biology, Chemistry, or Physics Lab Course Elective or Science requirement Elective or Science requirement Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology 3000-Level Core Psychology 3000-Level Core
Winter **Semester 6**	Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology 3000-Level Core Psychology 3000-Level Core
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology 4000-Level Psychology Selected Topics
Winter **Work Term 3**	Psychology 399W
Fall **Semester 8**	Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology 4000-Level Psychology Research Experience
*Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090).	

Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement English 1090 or the former English 1080 Mathematics 1000 or one of Mathematics 1090, 1050, 1051 Psychology 1000
Winter **Semester 2**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 One of Mathematics 1000, 1090, 1050 or 1051* Psychology 1001
Fall **Semester 3**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology 3000-Level Core Psychology 3000-Level Core Psychology 3900
Winter **Semester 6**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology Research Experience course Psychology 4910
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology 4000-Level Core Psychology Selected Topics course Psychology 499A
Winter **Work Term 3**	Psychology 399W
Spring (Optional)	Psychology 499A
Fall **Semester 8**	Elective or Humanities and Social Sciences requirement Elective or Humanities and Social Sciences requirement Psychology 3000-Level Core Psychology 4000-Level Core Psychology 499B
*Psychology Majors are required to complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.	

Table 4 Suggested Course Sequence for B.Sc. (Honours) in Psychology (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Biology 1001 Chemistry 1010 (1050) or Physics 1020 (1050)* English 1090 or the former English 1080 Mathematics 1090 or Mathematics 1000 Psychology 1000
Winter **Semester 2**	Biology 1002 Chemistry 1011 (1051) or Physics 1021 (1051) English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 Mathematics 1000 or Elective or Science requirement Psychology 1001
Fall **Semester 3**	Biology, Chemistry, or Physics Lab Course Elective or Science requirement Elective or Science requirement Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	Biology, Chemistry, or Physics Lab Course Elective or Science requirement Elective or Science requirement Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	Elective or Science requirement Elective or Science requirement Psychology 3000-Level Core Psychology 3000-Level Core Psychology 3900
Winter **Semester 6**	Elective or Science requirement Psychology 3000-Level Core Psychology 3000-Level Core Psychology Research Experience Psychology 4910
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	Elective or Science requirement Psychology 3000-Level Core Psychology 4000-Level Psychology Selected Topics Psychology 499A
Winter **Work Term 3**	Psychology 399W
Spring (Optional)	Psychology 499A
Fall **Semester 8**	Elective or Science requirement Elective or Science requirement Psychology 3000-Level Core Psychology 4000-Level Core Psychology 499B
*Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090).	

Table 5 Suggested Course Sequence for B.Sc. in Behavioural Neuroscience (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Biology 1001 or Physics 1020 (1050)* Chemistry 1010 (1050) English 1090 or the former English 1080 Mathematics 1090 or Mathematics 1000 Psychology 1000
Winter **Semester 2**	Biology 1002 or Physics 1021 (1051) Chemistry 1011 (1051) English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 Mathematics 1000 or Mathematics 1001 Psychology 1001
Fall **Semester 3**	BHNR Requirement 1** Chemistry 2440*** Physics 1020 (1050)* or Biology 1001 Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	BHNR Requirement 2 Physics 1021 (1051) or Biology 1002 Mathematics 1001 or Elective or Science requirement Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	BHNR Requirement 3 Elective or Science requirement Elective or Science requirement Psychology 3250 Psychology 3800
Winter **Semester 6**	BHNR Requirement 4 Elective or Science requirement Elective or Science requirement Psychology 3000-Level Core Psychology 3820
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	BHNR Requirement 5 Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology Research Experience course
Winter **Work Term 3**	Psychology 399W
Fall **Semester 8**	BHNR Requirement 6 Elective or Science requirement Elective or Science requirement Elective or Science requirement Psychology Selected Topics course

*Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090).
BHNR Requirement 1-6 specified in clause 3, **Requirements for a Major in Behavioural Neuroscience (B.Sc. Only)
***Students may choose to instead take Chemistry 2400 and 2401. These students should consult with the Psychology Undergraduate Advisor.

Table 6 Suggested Course Sequence for B.Sc. (Honours) in Behavioural Neuroscience (Co-operative)

Term	Suggested Courses
Fall **Semester 1**	Biology 1001 or Physics 1020 (1050)* Chemistry 1010 (1050) English 1090 or the former English 1080 Mathematics 1090 or 1000 Psychology 1000
Winter **Semester 2**	Biology 1002 or Physics 1021 (1051) Chemistry 1011 (1051) English 1191 or the former 1101, 1192 or the former 1102, 1193 or the former 1103, or 1110 Mathematics 1000 or 1001 Psychology 1001
Fall **Semester 3**	BHNR Requirement 1** Chemistry 2440*** Physics 1020 (1050)* or Biology 1001 Psychology 2520 or 2930 Psychology 2910
Winter **Semester 4**	BHNR Requirement 2 Mathematics 1001 or Elective or Science requirement Physics 1021 (1051) or Biology 1002 Psychology 2911 Psychology 2930 or 2520
Spring **Work Term 1**	Psychology 199W
Fall **Semester 5**	BHNR Requirement 3 Elective or Science requirement Psychology 3250 Psychology 3800 Psychology 3900
Winter **Semester 6**	BHNR Requirement 4 Elective or Science requirement Elective or Science requirement Psychology 3000-level core Psychology 3820
Spring **Work Term 2**	Psychology 299W
Fall **Semester 7**	BHNR Requirement 5 Elective or Science requirement Elective or Science requirement Psychology Research Experience course Psychology 499A
Winter **Work Term 3**	Psychology 399W
Spring (Optional)	Psychology 499A
Fall **Semester 8**	BHNR Requirement 6 Elective or Science requirement Elective or Science requirement Psychology Selected Topics course Psychology 499B
*Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090). **BHNR Requirement 1-6 specified in clause 3, **Requirements for a Major in Behavioural Neuroscience (B.Sc. Only)**. ***Students may choose to instead take Chemistry 2400 and 2401. These students should consult with the Psychology Undergraduate Advisor.	

10.12 Science

Science course descriptions are found at the end of the Faculty of Science section under **Course Descriptions, Science**.

11 Course Descriptions

In accordance with Senate's *Policy Regarding Inactive Courses*, the course descriptions for courses which have not been offered in the previous three academic years and which are not scheduled to be offered in the current academic year have been removed from the following listing. For information about any of these inactive courses, please contact the Head of the Department.

11.1 Biochemistry

Biochemistry courses are designated by BIOC.

1430 Biochemistry for Nurses is an introduction to the chemistry and structure-function relationships of carbohydrates, lipids and proteins. It will examine the basic metabolism of carbohydrates and fats, with emphasis on the biochemical fluctuations that occur in human health and disease, and will include a brief introduction to molecular genetics. Prospective fast-track program students should consult with the School of Nursing concerning admission to this course.
CR: the former BIOC 2430
LC: 4
PR: Level 3 Chemistry or Chemistry 1010 or Chemistry 1810 or equivalent,

and acceptance to Bachelor of Nursing (Collaborative)
UL: may not be used for credit to fulfil the requirements for a major in the Department of Biochemistry

2005 Food, Food Safety, and Health introduces the concepts of the composition of foods, and how the processing of food affects sensory appeal, shelf life and nutrient composition. Common food and water-borne illnesses (risks and prevention) are covered in the course content. Students will also be introduced to food biotechnologies, including genetically modified organisms, nutriceuticals and the development of functional foods.
CO: Chemistry 2400 or 2440

2100 Introduction to Molecular Biology and Genetics will cover the heritability of simple traits from phenotype to genotype; the discovery of DNA as the molecule of heredity; the structure and function of DNA; the elucidation of the genetic code; and the manipulation of DNA for recombinant DNA technology and biotechnology.
CO: BIOC 2101, Chemistry 2401, Physics 1021 or 1051. Students may replace the co-requisite Chemistry 2401 with Chemistry 2440 as a prerequisite. Chemistry 2440 may not be taken as a co-requisite of 2100
CR: Biology 2250
LH: up to four hours on alternate weeks which will normally consist of one three hour laboratory period plus one additional hour on the following day
PR: BIOC 2101, Chemistry 2401, Physics 1021 or 1051, and Science 1807. Students may replace the co-requisite Chemistry 2401 with Chemistry 2440 as a prerequisite. Chemistry 2440 may not be taken as a co-requisite of 2100.

2101 Introduction to Biochemistry is an introduction to the major organic substances of living organisms, proteins, carbohydrates and lipids: their structure, analysis and biochemical function. Other topics will include: enzymes; the biochemistry of membranes, including the plasma membrane and specialized intracellular membranes; and the biochemistry of selected differentiated cells.
CR: Pharmacy 2004, or the former Pharmacy 3110
LH: one three-hour laboratory period on alternate weeks
PR: Chemistry 2400 and 2401, or Chemistry 2440; and Physics 1020 or 1050, and 1021 (or 1051); and Science 1807. Chemistry 2401 and Physics 1021 or 1051 can be done concurrently.

2600 Introduction to Human Nutrition (same as Human Kinetics 2600) gives an overview of human nutrition with an emphasis on topics of current interest. Students will gain an understanding of nutrition in the context of health maintenance across the life span. Topics covered will include nutrition during pregnancy, nutrition for infants, Canadian Recommended Nutrient Intakes / Dietary Reference Intakes, weight loss and weight gain, nutriceuticals and ergogenic aids.
CR: Human Kinetics 2600 or the former Kinesiology 2600

3052 Food Microbiology (same as Biology 3052) is the study of the microbiology of water and food with regard to the beneficial and detrimental roles of microorganisms on interaction with these systems. Emphasis will be on the microbiology of food, fermentations, food spoilage and food borne vectors of human disease.
CR: Biology 3052, and the former BIOC 3054, BIOC 3401
LC: three hours per week
LH: three hours per week
PR: Biology 3050 and Science 1807

3105 Physical Biochemistry examines topics such as: types of intermolecular forces in biomolecules; the folding of biomolecules and the role of water; pH, buffers, and ionisation of biomolecules; thermodynamics: equilibria, coupled reactions, transport across membranes and redox reactions; and ligand binding. Other topics will include: size and shape of biomolecules; isotopes in biochemistry; and, spectroscopy of biomolecules.
OR: a two hour problem-solving class
PR: BIOC 2101; and the former Chemistry 2300 or 2301 or Physics 2053

3106 Metabolism examines the catabolism of carbohydrates, lipids and amino acids. Other topics will be: mitochondria, chloroplasts and ATP synthesis; biosynthesis of carbohydrates and lipids; metabolic specialization of differentiated cells and tissues; and, integration of metabolism.
CR: the former BIOC 3102 or Pharmacy 3111
LH: one three-hour laboratory or one-hour tutorial per week
OR: one-hour tutorial or one three-hour laboratory per week
PR: BIOC 2101 and Science 1807

3107 Nucleic Acid Biochemistry and Molecular Biology examines the structure, function and biochemistry of DNA and RNA and the biochemical processes in the flow of information from the gene to protein. These will include: DNA replication, recombination and repair processes; transcription of RNA and RNA splicing; and protein synthesis. The regulation of gene expression will also be covered at an introductory level. The course will also include an introduction to cloning methodology.
LH: up to four hours per week which will normally consist of one three hour laboratory period plus one additional hour on the following day.
PR: BIOC 2101; and BIOC 2100 or Biology 2250, and Science 1807

3108 Molecular Biochemistry of the Cell focuses on the molecular biochemistry of intracellular regulation, including advances in topics such as signal transduction, apoptosis and cancer. Other topics will include protein processing and sorting, cyclins, G-protein structure, function and regulation, cell adhesion molecules and the structure of the extracellular matrix.
PR: BIOC 2100 or Biology 2250; and BIOC 2101

311A/B Human Physiology - inactive course.

3202 Community Nutrition - inactive course.

3203 Fundamentals of Human Nutrition is the cornerstone course for the study of nutrition. The sources, uptake and physiologic roles of essential nutrients will be discussed in the context of growth, maintenance, reproduction and overall health in humans.
CO: BIOC 3106
CR: the former BIOC 3201
PR: BIOC 2101, 2600

3402 Food Chemistry examines the following topics: water structure and the role of water in chemical reactions and mechanical properties of foods; chemistry and physical properties of carbohydrates, proteins and lipids; food dispersions; pigments and natural colorants; food flavour; enzyme properties and applications; vitamins and minerals; chemistry of enzymic and non-enzymic browning; characteristics of: muscle tissue, milk, eggs, bread and edible plant tissue; food additives; and, chemical changes in foods during processing.
LH: one period per week
PR: BIOC 2005; BIOC 2101; Chemistry 2440 or Chemistry 2401, and Science 1807

3600 Sports and Exercise Nutrition deals with the specific roles of nutrients in sport and exercise, and the application of nutrition to sport and exercise.
CR: the former BIOC 4241
PR: BIOC 2600 or HKR 2600 or the former BIOC 3200/3201; and one of BIOC 311B, MED 310B, HKR 2320

4002 Biochemical Regulation examines metabolic regulation at the cellular and multicellular level. Topics will include: control theory; hormones: their biosynthesis and mechanism of action; signal transduction; and, endocrine coordination of metabolic processes. Principles will be illustrated by the use of case studies from the medical and veterinary literature.
LC: two to three hours per week, together with assigned reading and case studies
PR: BIOC 2100 or Biology 2250; BIOC 3106

4101 Proteins will review the history of protein research and the general properties of proteins and include other topics such as: strategy and methods for purification; chemical structure, properties, modification and determination of the protein amino acids; sequencing strategy, chain cleavage methods and end group analysis; folding of the protein main chain and techniques to determine structure; and, the relationship between structure and function: protein filaments, motors and regulators. It will also cover disease-related proteins and other examples from the current literature.
LC: two to three hours per week, together with assigned reading
PR: BIOC 3105

4102 Current Topics in Biochemistry is a seminar course in which faculty and students will discuss topics of current interest in the biochemical literature. Students will be responsible for reading and critically assessing recent literature.
PR: Honours Biochemistry students in their final year or permission of the Head

4103 Prokaryotic Gene Regulation is a detailed and up-to-date treatment of the mechanisms of genetic regulation found in bacterial cells. The course will develop topics based on the evidence of bacterial genetics and modern molecular biological experiments. Topics may include: theory of mutations, RNA transcription, positive and negative regulation of transcription; regulation of protein synthesis; control of DNA replication; bacterial operons and regulons; developmental molecular biology in bacterial systems; and evolution and molecular biology of organelles.
PR: BIOC 3107

4104 Eukaryotic Gene Regulation and Developmental Biology details the cellular and molecular aspects of eukaryotic gene regulation and development. Topics to be covered will include the DNA content and organization of eukaryotes, mechanisms controlling the expression of eukaryotic genetic information at the transcriptional and post-transcriptional levels, and the methodologies used to define these mechanisms. Detailed consideration will be given to the cell-surface events which regulate nuclear gene expression and cell lineage specification. Developmental mechanisms operating in a number of model systems will be discussed.
PR: BIOC 3107 or 3108

4105 Immunology (same as Biology 4200 and Pharmacy 3006 and the former Pharmacy 4105) is an introduction to the cells and organs of the innate and adaptive immune systems. The molecular and cellular basis of

allergy, autoimmunity, vaccination and cancer immunology will also be discussed.
CR: Biology 4200, Pharmacy 3006, the former Pharmacy 3105, the former Pharmacy 4105
PR: BIOC 2101

4200 Bioenergetics and Biological Oxidation examines topics such as: respiration and electron transport; the functional organization of energy transducing membranes; the structure and function of flavoenzymes, cytochromes, iron-sulfur proteins and quinones; enzyme reduction of oxygen; and, free radicals in biological systems.
LC: two to three hours per week and assigned reading
PR: BIOC 3106

4201 Membranes - Structure and Function examines the structure of model and biological membranes, the molecular interactions between membrane components and the effects of these interactions on the biophysical and functional properties of membranes. Other topics will include the structure-function of specialized membranous systems, such as lipoprotein, lung surfactant, and lipid rafts; membrane lipid composition in biochemical adaptation and function; and the role of membrane proteins in intracellular trafficking, receptor function, enzymatic activity and membrane-related diseases.
PR: BIOC 3105

4210 Biochemical Research Techniques I examines the proteome and the genome. This course is designed to familiarize students with current methodology employed in the analyses of the complements of proteins and genes resident in eukaryotic cells. Emphasis will be placed on techniques that facilitate the simultaneous functional analyses of large numbers of proteins or genes. A variety of techniques, used in the study of expression and functional proteomics, will be described, including 2D PAGE, tagged proteins, fluorophores, mass spectrometry and protein microarrays. Techniques used in the study of gene expression and functional genomics will also be described, including the use of reporter gene constructs, analysis of protein-DNA interactions, expressions of cloned genes and several experimental approaches used to define the eukaryotic transcriptome.
AR: attendance is required
PR: BIOC 3105

4211 Biochemical Research Techniques II is designed to familiarize students with methods used for the study of cellular and subcellular metabolism. This course may include a research project.
AR: attendance is required
LC: times as arranged
LH: times as arranged
PR: BIOC 3106

4230 Lipid and Lipoprotein Metabolism is designed to provide current knowledge about advances and controversies in lipid and lipoprotein metabolism in the context of health and disease. Topics to be covered include advanced knowledge about lipid and lipoprotein synthesis and regulation, reverse cholesterol transport, plus lipid and lipoprotein utilization to regulate cellular and physiological functions. The covered topics will be related to areas such as reproductive biology, atherosclerosis, AIDS, Alzheimer's, and cancer.
CR: BIOC 6000
PR: BIOC 3106 or Pharmacy 3111

4231-4239 Special Topics in Biochemistry will be given for senior undergraduates, and will cover a range of topics in specialized fields in Biochemistry. They may be taught by visiting specialists when available.
PR: to be determined at the time of offering

4240 Nutrigenetics and Nutrigenomics is designed to familiarize students with emerging discoveries in the area of diet-gene interaction and to further their understanding of the relationships between the genome and diet as well as the potential to design personalized diets for better health. Students will develop an appreciation for the role of nutrients in the prevention and/or development of disease.
PR: BIOC 2100 or Biology 2250; BIOC 3106; and one of BIOC 3203 or the former BIOC 3200

4242-4249 Special Topics in Nutrition will be given for senior undergraduates, and will cover a range of topics in specialized fields in Nutrition. They may be taught by visiting specialists when available.
PR: to be determined at the time of offering

4300 Advanced Nutrition is a course in which current controversies and trends in human nutrition are presented and discussed using the scientific literature.
PR: BIOC 3203 or the former BIOC 3200/3201, and either BIOC 311B or Medicine 310B

4301 Nutrition and Disease is a course which addresses the scientific basis for nutritional intervention in chronic human disease.
PR: BIOC 3203 or the former BIOC 3200/3201, and either BIOC 311B or Medicine 310B

4502 Techniques in Nutrition Research is a seminar course in which faculty and students will discuss concepts and methods used in the study of nutrition. Students will be responsible for reading and critically assessing recent literature.
PR: BIOC 4301
PR: Honours Nutrition students in their final year or permission of the Head

499A and 499B Dissertation is a two-semester linked course based on independent study of a problem in Biochemistry. The subject of study will be decided in consultation with Faculty advisors and must be approved in advance by the Department. This dissertation is obligatory for Honours students in Biochemistry. The dissertation will be submitted as a formal written report accompanied by appropriate illustration before the end of the tenth week of the second semester. Before the end of his/her final semester the student will give an oral presentation of his/her research.
CH: 6
PR: Honours students in their final year or permission of the Head; Science 1807

11.2 Biology

According to the nature of particular courses, the specified number of laboratory hours may consist of some combination of laboratory work, seminars or directed independent study relevant to the practical aspects of the subject matter.

Biology courses are designated by BIOL.

1001 Principles of Biology is an introduction to the science of Biology, including a discussion of the unity, diversity and evolution of living organisms.
LH: 3
PR: Science 1807
UL: credit may be obtained for only 6 1000-level credit hours in Biology

1002 Principles of Biology is an introduction to the science of Biology, including a discussion of the unity, diversity and evolution of living organisms.
LH: 3
PR: Science 1807; BIOL 1001
UL: credit may be obtained for only 6 1000-level credit hours in Biology

2010 Biology of Plants is a study of the structure, function and reproductive biology of plants, with emphasis on the vascular plants, and on their relationship to environment and human activities.
LH: 3
PR: Science 1807; BIOL 1001 and 1002; Chemistry 1010 or 1050 (or the former Chemistry 1000)

2040 Modern Biology and Human Society I examines various aspects of the human body, and the implications of modern biological research for human beings. Topics include cancer; diet and nutrition and associated diseases; circulatory disease, immunity, human genetics, biorhythms, new diseases, genetic engineering and reproductive engineering.
OR: seminars
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Biology

2041 Modern Biology and Human Society II examines the origins and consequences of the environmental crisis of the 20th century. Topics include the population explosion, energy, material cycles, air and water and land pollution, global food supplies, the fisheries, wildlands, renewable and non-renewable resources, environmental ethics.
OR: seminars
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Biology

2060 Principles of Cell Biology is a modern view of the biology of eukaryotic cells, organelles and molecules and their interactions in the functioning of living organisms.
CO: Physics 1021 or 1051; Biochemistry 2101
CR: the former BIOL 3060
LH: 3
PR: Physics 1021 or 1051; Biochemistry 2101
PR: Science 1807; BIOL 1001, 1002 and 2250; Chemistry 2440 or 2400

2120 Biology for Students of Earth Sciences is an introduction of the principles of Biology for students in Earth Sciences. Topics will include principles of classification, levels of biological organization, fundamental characteristics of living organisms and basic concepts in ecology.
CR: BIOL 1001 or 1002
LH: 3
PR: Science 1807; Earth Science major; Earth Sciences 1001 or 1002 or permission of the Head of Department.
UL: may not be used for credit by Biology Majors or Minors

2122 Biology of Invertebrates is a study of the invertebrates with emphasis on structure and function, adaptations and life histories. The laboratories will present a broad survey of the major invertebrate groups.

CR: the former BIOL 3122
LH: 3
PR: Science 1807; BIOL 1001, 1002

2210 Biology of Vertebrates is a study of the vertebrates, with emphasis on structure and function, adaptations and life histories.
CR: the former BIOL 3210
LH: 3
PR: Science 1807; BIOL 1001, 1002

2250 Principles of Genetics is an introduction to Mendelian and molecular genetics. Phenotype and genotype, behaviour of alleles in genetic crosses, chromosome theory of inheritance, genetic linkage, molecular biology of DNA, RNA and protein, molecular basis of mutation, recombinant DNA, applications of genetic biotechnology.
CO: Chemistry 2440 or 2400
CR: Biochemistry 2100 the former BIOL 3250
LH: 3
PR: Science 1807; BIOL 1001 and 1002; Chemistry 1010 and 1011 (or 1050/1051)
PR: Chemistry 2440 or 2400

2600 Principles of Ecology is a conceptual course introducing the principles of ecology, including theoretical, functional and empirical approaches.
CR: the former BIOL 3600
LH: 3
PR: Science 1807; BIOL 1001 and 1002

2900 Principles of Evolution and Systematics is an introduction to the processes and patterns of evolution, and the principles of classification. Natural selection and other microevolutionary processes, variation and adaptation, species and speciation, phylogenetic systematics, reconstruction of phylogeny, macro-evolutionary patterns in the fossil record and their interpretation.
CO: Statistics 2550 (or equivalent)
CR: the former BIOL 3900
LH: 3
PR: Science 1807; BIOL 1001, 1002, 2250
PR: Statistics 2550 (or equivalent)

3014 Biology and Ecology of Boreal and Arctic Seaweeds is a field course examination of seaweed biology and ecology with special study of living specimens in estuarine, fiordic and exposed coastal sites, demonstrating their physiological and ecological adaptations to cold-water habitats.
CR: the former BIOL 4014
OR: this course is offered at the Bonne Bay Marine Station during the Summer semester with two weeks of instruction followed by a week to complete course requirements
PR: Science 1807; BIOL 2600 or equivalent

3041 Boreal Flora - inactive course.

3050 Introduction to Microbiology is a course in which the basic principles underlying microbial life are studied. Aspects include structure, function, bioenergetics and growth with an emphasis on prokaryotes. Also studied are viruses, microbial diseases, introductory principles of immunology and the control of microorganisms. The laboratory sessions provide training in culture and determinative techniques using microorganisms.
LH: 3
PR: Science 1807; BIOL 1001 and 1002; Biochemistry 2101

3052 Food Microbiology (same as Biochemistry 3052) is the study of the microbiology of water and food with regard to the beneficial and detrimental roles of microorganisms on interaction with these systems. Emphasis will be on the microbiology of food, fermentations, food spoilage and food borne vectors of human disease.
CR: Biochemistry 3052 and the former Biochemistry 3054, Biochemistry 3401
LC: three hours per week
LH: three hours per week
PR: Science 1807; BIOL 3050

3053 Microbiology for Nurses examines the fundamentals of microbiology with an emphasis on medical microbiology. The course will include topics such as: host responses to infections, human diseases caused by microorganisms, and the control and exploitation of microorganisms.
LH: 2
PR: Science 1807; students admitted to the Bachelor of Nursing (Collaborative) program
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Biology, nor is it acceptable for any of the joint programs between Biology and other disciplines

3160 Insect Morphology and Physiology - inactive course.

3202 Comparative Vertebrate Anatomy examines the phylogenetic development and comparative anatomy of the vertebrates.
CR: the former BIOL 3200 or the former BIOL 3201
LH: 3
PR: Science 1807; BIOL 1001 and 1002

3295 Population and Evolutionary Ecology is an introduction to the theory and principles of evolutionary ecology and population dynamics.
CR: the former BIOL 4290
LH: 3
PR: Science 1807; BIOL 2600; at least one of BIOL 2010, 2122 or 2210

3300 Introductory Entomology is a study of the classification and ecology of insects within an evolutionary framework. Topics will include molecular biological and classical morphological issues surrounding insect taxonomy, evolutionary based higher systematics, and the ecological roles of insects in a variety of ecosystems.
CR: BIOL 4150 and the former BIOL 4140
LH: 3
PR: Science 1807; BIOL 2600. It is recommended that students have completed BIOL 2900

3401 Comparative Animal Physiology is a comparative study of the basic physiological processes, with special attention paid to those strategies invoked by animals which enable them to adapt to environmental changes.
CO: Biochemistry 3106
CR: the former BIOL 4401
LH: 3
PR: Science 1807; BIOL 2060 and 2210
PR: Biochemistry 3106

3402 Principles of Plant Physiology is a consideration of the principles of plant physiology, including water relations, nutrition, metabolism, growth and development.
CO: Biochemistry 3106
CR: the former BIOL 4403
LH: 3
PR: Science 1807; BIOL 2010 and 2060
PR: Biochemistry 3106

3500 Histology is a study of microstructure and ultrastructure of tissues and organ systems in vertebrates, particularly mammals, with emphasis on correlating structure and function.
LH: 3
PR: Science 1807; BIOL 2060 and 2210

3530 Molecular and Developmental Biology is a study of developmental model systems with a focus on the underlying principles and molecular mechanisms involved in embryogenesis, organogenesis, morphogenesis, cellular differentiation, growth and regeneration in animals (vertebrates and invertebrates) and plants. Current cellular and molecular biology techniques and the implications of developmental biology in modern biological and health research will be emphasized.
LH: 3
PR: Science 1807; BIOL 2060 and BIOL 2250 or Biochemistry 2100

3540 Histotechnique - inactive course.

3610 Boreal Ecology is a study of the principal features of terrestrial ecosystems, with emphasis on the boreal region. This course may be offered in a usual 13 week semester or as a two-week field course.
CR: Environmental Science 3131
LC: either three hours of lecture and three hours of laboratory per week or a two week field course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two week field course that embodies equivalent instructional time
PR: Science 1807; BIOL 2010, 2250, 2600 and 2900; Statistics 2550 or equivalent

3620 Aquatic Microbial Ecology (same as Ocean Sciences 3620) is a study of the nature, distribution and activities of microorganisms in the freshwater and marine environments. Field and laboratory work illustrate some of the investigative techniques used in this area of study.
CR: Ocean Sciences 3620 and the former BIOL 3603
LH: 3
PR: Science 1807; BIOL 2600 and 3050; Statistics 2550 or equivalent

3640 Environmental Physiology of Animals (same as Ocean Sciences 3640) covers physiological adaptations of animals facilitating their survival in natural environments with emphasis on physiological and biochemical responses of animals to extreme environments. Starting with the fundamental basis of physiological mechanisms, the course explores various aspects and the integration of major physiological processes (metabolism, respiration, osmoregulation) and how these relate to ecological niche.
CR: the former BIOL 3403 or the former BIOL 4455, Ocean Sciences 3640
PR: BIOL 2060; Biochemistry 3106
UL: may not be used to fulfill the physiology course requirement for a Biology major, honours or joint honours program.

3709 Field Course in Marine Principles and Techniques begins with a two-week field school immediately prior to the beginning of the Fall Semester. In the Fall Semester there are follow-up lectures, readings and submission of reports. The course is designed to introduce the principal

marine environments, organisms and techniques. It is strongly recommended that this course be taken before either BIOL 3710, 3711 or 4810.
PR: Science 1807; BIOL 2600; Statistics 2550 or equivalent and permission of the Head of Department

3710 Biological Oceanography is an introductory course in biotic and abiotic factors controlling marine biomass and primary production, emphasizing plankton and fishes. It introduces students to major groups of marine phytoplankton, zooplankton, and fishes, emphasizing how the physical, chemical, and geological environments interact with biology to define processes and pattern in marine organisms.
CR: Ocean Sciences 2000
LC: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
PR: Science 1807; BIOL 2122 and 2600

3711 Principles of Marine Biology is an introductory course in biology of the oceans. Introduces students to marine habitats and the organisms that inhabit them, emphasizing functional morphology, physiology, biodiversity, phylogeny, and ecology. Also includes introduction to marine biogeography, conservation, fisheries and pollution.
LC: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
PR: Science 1807; BIOL 2122, BIOL 2600

3712 Benthic Biology examines the biology of the aquatic benthos (bottom-dwelling organisms); their origins, adaptations, life histories and ecological roles. This course may be offered in a usual 13 week semester or as a two-week field course.
CR: the former Biology 3630
LC: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week field course that embodies equivalent instructional time
PR: Science 1807; Biology 2122, 2600 and 3710

3714 Estuarine Fish Ecology Field Course examines community structure, function and distribution of northern coastal fishes in fjords and estuarine environments. Emphasis on sampling, field techniques, taxonomy, quantitative characterization, adaptations and habitat relationships. A comparative approach will contrast fish communities from other areas. To be held as a two week field course.
PR: Science 1807; BIOL 2600

3715 Ecology and Evolution of Fishes (same as the former BIOL 4600) examines the evolutionary history and ecology of the world's fishes, with particular emphasis on those of ecological, economical and cultural importance to Eastern Canada. Topics will include taxonomy, life histories, behaviour, zoogeography, evolutionary ecology, population biology, contemporary evolution, and conservation biology.
CR: the former BIOL 4600
LH: 3
PR: Science 1807; BIOL 2600 and 2900

3750 Animal Behaviour I (same as Psychology 3750) is an introduction to the mechanisms, development, function and evolution of behaviour in animals. Topics include the history of ethology and comparative psychology, and behavioural ecology; methods of animal behaviour study, behaviour of animals in relation to physiology, learning, communication, mating systems, and other areas in Biology and Psychology.
CR: Psychology 3750
PR: BIOL 1001 and 1002; Statistics 2550 or equivalent

3811 Paleontology (same as Earth Sciences 3811) is taught and administered by the Department of Earth Sciences.
CR: Earth Sciences 3811, the former BIOL 3800, and the former Earth Sciences 3801
PR: either Earth Sciences 1002 and BIOL 2120 (or BIOL 1001 and 1002); or BIOL 2122 and 2210

3820 Foundations of Biology will introduce students to the development of biological understanding, from the classical Greeks to the present. The course consists of an online seminar series, which will cover topics such as the influence of Aristotle, Theophrastus, Hippocrates and Galen, the development of the microscope, the discovery of cells, paleontology, classification, Darwin and evolution, genetics, the discovery of DNA, multidisciplinary approaches to biology, and the impact of biology on everyday life.
OR: 10 on-line seminars prior to the beginning of the two week field course in Harlow and a two-week field component at Harlow Campus in the Spring semester
PR: completion of a minimum of 60 credit hours
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Biology

3950 Research Methods in Genetic Biotechnology (same as the former BIOL 4900) will include DNA extraction, DNA amplification by the Polymerase Chain Reaction (PCR), DNA cloning, DNA sequence analysis and Bioinformatics. Additional modules in gene expression and re-sequencing chip technologies may be included. Theory and methods will be introduced in a research framework.
CR: the former BIOL 4900
LH: Three hours of lecture and three hours of laboratory per week or a three week on-campus course that embodies equivalent instructor time
PR: Science 1807; BIOL 2060 and 2250

3951 Introduction to Bioinformatics (same as Computer Science 3550) deals with the development and application of computational methods to address biological problems. The course will focus on the fundamental concepts, ideas and related biological applications of existing bioinformatics tools. This course will provide hands-on experience in applying bioinformatics software tools and online databases to analyze experimental biological data, and it will also introduce scripting language tools typically used to automate some biological data analysis tasks.
CR: Computer Science 3550
LH: 3
PR: BIOL 2060 or Biochemistry 2101, and one Computer Science course at the 1000-level or above excluding Computer Science 1400, or Computer Science 1600 and Computer Science 2000; or Computer Science 2500 or Computer Science 2001, and one Biology course at the 1000-level or above excluding BIOL 2040 and BIOL 2041; or permission of the course instructor

4000 Bacterial Systematics - inactive course.

4010 Virology will examine topics about viruses infecting all forms of life including humans and other animals, plants and bacteria. The scope within the course ranges from the molecular biology of virus replication to virus evolution and ecology. Current issues concerning viruses and society are incorporated into the course including the practical applications of viruses, vaccines, and emerging viruses.
LH: Three hours of laboratory/seminar/discussion per week
PR: Science 1807; BIOL 2900 and 3050

4012 Phycology - inactive course.

4040 Mycology - inactive course.

4050 Advanced Topics in Microbiology examines the beneficial and harmful properties of microbes including topics on industrial microbiology and the discovery of new antimicrobial agents. The scope within the course ranges from the genetic manipulation of microbes for useful purposes to the isolation of bacteria for applications in various fields. Current issues concerning microbiology and society will also be discussed including the practical applications of microbes and bacterial diseases affecting society.
LH: 3
PR: Science 1807; BIOL 3050

4122 Advanced Studies in Marine Animal Diversity (same as Ocean Sciences 4122) provides an in-depth examination of cellular physiological, behavioural and ecological adaptations in marine animals. Lectures will be combined with discussions of relevant papers from the primary literature on topics of current interest, which may relate to morphology, ecology, evolution, natural history, species interactions and practical applications. Students will also gain hands-on experience by designing and conducting research projects involving live or preserved animals.
CR: Ocean Sciences 4122
LC: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
PR: Science 1807; BIOL 2122 and BIOL 2600

4141 Nematology - inactive course.

4150 Insect Systematics and Ecology - inactive course.

4180 General Parasitology - inactive course.

4182 Fisheries and Wildlife Parasitology - inactive course.

4200 Immunology (same as Biochemistry 4105 and Pharmacy 3006) is an introduction to the cells and organs of the innate and adaptive immune systems. The molecular and cellular basis of allergy, autoimmunity, vaccination and cancer immunology will also be discussed.
CR: Biochemistry 4105, Pharmacy 3006, and the former Pharmacy 4105
PR: Science 1807; BIOL 2060 and BIOL 3050

4241 Advanced Genetics has advanced topics in modern genetic analysis, including regulation of gene expression, developmental genetics, molecular basis of inherited disease, genomics, immunogenetics, behavioural genetics, and molecular evolution.
LH: 3

PR: Science 1807; BIOL 2250 and Biochemistry 2101

4245 Biophysics is an examination of the physical properties involved in defining diffusion, membrane properties, electrochemical potentials and the processes of bioenergetics within cells and organelles. Selected topics in biomechanics and the functioning of whole organisms with respect to size, shape, support, orientation, transport and motility.
LH: 3
PR: Science 1807; BIOL 2060 and Biochemistry 2101

4250 Evolutionary Genetics has advanced topics in the study of micro and macro-evolutionary phenomena. Genetic variation in natural populations; theory of genetic drift, mutation, migration, inbreeding, and natural selection; neutral theory of molecular evolution, patterns of nucleotide substitution, heritability and quantitative genetics.
LH: 3
PR: Science 1807; BIOL 2250 and 2900

4251 Genomics will have lecture, seminar, and laboratory components. Topics covered will include Technical Foundations of Genomics, Global Gene Expression Profiling, Bioinformatics, Comparative Genomics, Microbial Genomics, Genomics and Medicine, Genomics and Agriculture, Environmental Genomics, and Ethical Issues of Genomics. Each topic will involve a lecture component, in which theory and methods will be taught using the textbook and journal articles. Some lecture and lab times will be devoted to seminars on methods and papers related to lecture or laboratory components of the course. In the lab component, students will have the opportunity to use state-of-the-art genomic techniques to address a research question.
LH: 3
OR: seminar
PR: Science 1807; BIOL 2060, 2250

4255 Proteomics - inactive course.

4270 History of Biology - inactive course.

4306 Applied Biology - inactive course.

4307 Global Change Biology examines the evolution of biosphere, global role of photosynthesis in oxygen and carbon dioxide balance, glacial-interglacial oscillations, carbon sources and sinks in modern biosphere, greenhouse gases emissions, population dynamics, origin and global impact of agriculture, global changes in Holocene and Anthropocene.
LH: 3
PR: BIOL 2600, BIOL 2900 or permission of the instructor

4360 Community and Ecosystem Ecology is a study of the basic principles, patterns and processes of ecological communities and ecosystems.
OR: a seminar/discussion group each week
PR: Science 1807; BIOL 2250, 2600 and 2900 and one of BIOL 2010, 2122 or 2210; Statistics 2550 or equivalent

4402 Electron Microscopy in Life Sciences - inactive course.

4404 Microbial Physiology is a study of the structure and growth of microorganisms. Themes covered in this course include the structure, function and regulation of the microbial cellular machinery, the hierarchical regulation of cellular activities, and communication between cells. Quantitative experimental methodology relating to microbial physiology is studied in the laboratory.
LH: 3
PR: Science 1807; BIOL 2250 and BIOL 3050

4405 Landscape Ecology is an introduction to the theory and principles of landscape pattern and processes, including issues related to scale, networks, landform and vegetation patterns, species distributions, and natural and human-caused aspects of landscape change.
CO: Statistics 2550 or equivalent
LC: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
PR: Science 1807; BIOL 2600 and 18 credit hours in Biology; Statistics 2550 or equivalent, or permission from the course instructor

4505 Systematics and Biogeography is a study of the geographical distributions of plants and animals with particular reference to temporal and spatial variability and to theories advanced to explain historical and recent distribution patterns.
CR: the former Geography 4170
LH: 3
PR: BIOL 2250, 2600, 2900 and one of BIOL 2010, 2122 or 2210

4510 Distribution Patterns in the Sea - inactive course.

4550 Principles of Endocrinology comprises an introduction to basic concepts concerned with how chemical messages are transmitted and received between cells to coordinate body functions. Hormonal control of adaptation, reproduction, metabolism, growth, digestion, and electrolyte homeostasis will be discussed. Although the endocrinology of invertebrates and lower vertebrates will be mentioned as appropriate, the main emphasis will be on mammalian and human endocrinology at the level of the whole organism.
LH: 3
PR: Science 1807; BIOL 3401; Biochemistry 3106

4601 Functional Biology of Fish (same as Ocean Sciences 4601) is an introduction to anatomical, physiological and cellular aspects of selected processes in the life cycle of fishes.
CR: Ocean Sciences 4601
PR: BIOL 2060, 2210 or 3202, and BIOL 3401 or 3640

4605 Quantitative Methods in Biology (same as Statistics 4581 and the former Statistics 4605) is quantitative reasoning using verbal, graphical and statistical models of scaled quantities (units and dimensions). Exploratory and confirmatory analysis of field and laboratory data. Hypothesis testing, including randomization tests. Topics include the general linear model (t-tests, ancova etc), correlation, autocorrelation, geographic statistics, estimates of population size and multivariate methods.
CR: Statistics 4581 and the former Statistics 4605
LH: 3
PR: Statistics 2550

4606 Bioinformatics: Biological Data Analysis (same as Computer Science 4550) provides students with the basis to analyse a variety of biological data within an integrated programming environment for data manipulation, calculation and graphical display. Students will learn to extract meaningful information from data generated by high-throughput experimentation. The course will introduce one such integrated programming environment and will explore the computational and statistical foundations of the most commonly used biological data analysis procedures.
CR: Computer Science 4550
LH: 3
PR: BIOL 3951 or Computer Science 3550, and Statistics 2550 (or equivalent), or permission of the course instructor

4607 Models in Biology is a study of the design and analysis of statistical and mathematical models for exploring the biology of cells, genes, species, populations, communities and ecosystems. Qualitative, quantitative and graphical techniques are used to analyze models and to compare theoretical predictions with empirical data. Classic models of systems biology, population growth, species competition, predator-prey interactions, ecosystem nutrient cycling, immunology, evolutionary invasion analysis, and species distribution will be covered.
LH: 3
PR: BIOL 2060, 2600 and 2900; Statistics 2550 or equivalent. It is recommended that students complete BIOL 3295.

4620 Ornithology examines structure, classification, evolution, ecology and behaviour of birds, with particular reference to those of economic importance. Identification of the birds of Eastern Canada.
LH: 3
PR: Science 1807; BIOL 2210 and 2600

4630 Mammalogy examines evolution, systematics, life histories and distribution of mammals, with particular emphasis on eastern North American forms.
LH: 3
PR: Science 1807; BIOL 2210 and 2600

4650 Conservation Biology I: Conservation in Biology and Geography (same as Geography 4650) is an examination of how biological and geographical principles can be applied to conserving biological diversity in the natural world under conditions of exploitation and habitat loss. Special emphasis will be given to relevant provincial examples.
CR: Environmental Science 4133, Geography 4650
OR: 3 hours of seminar/discussion group each week
PR: 30 credit hours in either Biology or Geography

4651 Conservation Biology II: Conservation in Practice examines issues relevant to global conservation science. Topics will be covered through a series of modules, including conservation genetics, costs and consequences of small populations, effects of anthropogenic activity on biodiversity, spatial dynamics, and the interface between science and society.
PR: BIOL 2900, 3295 and 4650

4701 Animal Behaviour II (same as Psychology 4701) is an examination of the behaviour of animals with particular emphasis on evolution and ecology. Topics include behavioural genetics and evolution, reproductive strategies, social behaviour, habitat selection, territoriality, foraging behaviour, and other topics in biology and psychology.
CR: Psychology 4701
LH: 3
PR: BIOL 3750 or Psychology 3750

4710 Experimental Marine Ecology of Newfoundland Waters is a two-week field course examines the ecology of cold ocean environments,

focussing on energy flux through marine pelagic and benthic flora and fauna of Newfoundland waters, and how the dynamics of this environment influence linkages among organisms in different habitats. The course will be field intensive with some lecture component and a strong hands-on field component. Students will identify local organisms and study how and why they vary in time and space. This course will be offered during two weeks of the Spring semester.
PR: Science 1807; BIOL 2600

4750 Fisheries Ecology is the application of ecological principles to the problem of managing exploited fish populations. Laboratory exercises will be based on a simulation approach to fisheries problems using computer and animal models.
LH: 3
PR: BIOL 2600

4770 Research Experience in Animal Behaviour (same as Psychology 4770) allows students to gain research experience in selected areas of animal behaviour. This course may be offered in a usual 12-week semester or as a two-week field course.
CR: Psychology 4770
LC: either three hours of lecture per week or a two-week field course that embodies equivalent instructional time
PR: BIOL 3750 or Psychology 3750

4800 Advanced Palaeontology (same as Earth Sciences 4800) is a field, lecture, laboratory and seminar course dealing with selected topics in general and applied paleontology. Topics include measuring evolution and extinction, population paleontology, functional morphology, paleoecology, statistical methods for paleontological studies, and applications in petroleum, mining, and environmental studies. This course is taught and administered by the Department of Earth Sciences.
CR: Earth Sciences 4800
LH: 3
PR: Earth Sciences/BIOL 3811, and one of Statistics 2550, the former Statistics 2510 or Mathematics 2000

4810 Research Field Course in Marine Biology will consist of an intensive two-week field school designed to acquaint students with marine field research, experimental design, methodology and data analysis. Emphasis will be placed on individual projects. Projects must be designed and approved prior to the commencement of the course and will involve a written report. At the discretion of the Head of Department, another recognized field course may be substituted for BIOL 4810.
PR: Science 1807; BIOL 3710 and any two of BIOL 2010, 2122 or 2210, and permission of the Head of the Department. It is strongly recommended that students take BIOL 3709 before 4810.

4820 Field Course in Terrestrial Biology will begin with a three-week field school immediately prior to the beginning of the Fall Semester. It is designed to acquaint students with terrestrial organisms and environments, and emphasis will be placed on survey and sampling techniques. In the Fall Semester the material and data collected in the field will be used in lecture and laboratory periods dealing with identification, analytical methods, and report compilation.
PR: Science 1807; BIOL 2010, 2122, 2210, 2600 and permission of the Head of the Department. It is recommended that students complete BIOL 4605.

4822 Internship in Biology - inactive course.

4910-4920 Special Topics in Biology will be given for senior undergraduates and will be in a two-week format which will involve equivalent instruction time as a course on campus. These courses will cover a range of topics in specialized fields in Biology and may be offered at the Bonne Bay Field Station, at the Harlow campus or elsewhere as appropriate. They may be taught by visiting specialists when available.

499A and 499B Honours Dissertation is available only to students in the Honours Program. Requirements for the Dissertation are outlined under **Honours Degrees**.
PR: admission to the Honours Program

11.2.1 Work Term Descriptions

The following Work Terms are a requirement of the Biology (Co-operative) Program (BCOP) only.

199W Work Term I follows the successful completion of Semester 4. Students are expected to learn, develop and practice the high standards of behaviour and performance normally expected in the work environment. (A detailed description of each job is normally posted during the job competition.)
As one component of the Work Term, the student is required to complete a work report. The work report, as a minimum requirement should
1. analyse an issue/problem related to the student's work environment.
2. demonstrate an understanding of the structure of a professional report, and show reasonable competence in written communication and presentation skills. (Students should consult the evaluation form provided in the placement package.)

Late reports will be graded as FAIL unless prior permission for a late report has been given by Co-operative Education.
Seminars on professional development, conducted by Co-operative Education, are presented during Semester 4 to introduce and prepare the student for participation in the subsequent work terms. Topics may include, among others, work term evaluation, work report writing, career planning, employment seeking skills, resume preparation, self employment, ethics and professional concepts, behavioural requirements in the work place, assertiveness in the work place and industrial safety.
CH: 0
LC: 0
PR: Admission to the Biology Major and successful completion of semester 4

299W Work Term II follows the successful completion of Semester 6. Students are expected to further develop and expand their knowledge and work-related skills and should be able to accept increased responsibility and challenge. In addition, students are expected to demonstrate an ability to deal with increasingly complex work-related concepts and problems. The work report, as a minimum requirement should
1. analyze an issue/problem related to the student's work environment and demonstrate an understanding of practical application of concepts relative to the student's academic background
2. demonstrate competence in creating a professional report, and
3. show competence in written communication and presentation skills. Late reports will be graded as FAIL unless prior permission for a late report has been given by Co-operative Education.

CH: 0
LC: 0
PR: admission to the Biology Major and successful completion of semester 6

399W Work Term III follows the successful completion of semester 7 or Work Term II. Students should have sufficient academic grounding and work experience to contribute in a positive manner to the problem-solving and management processes needed and practiced in the work environment. Students should become better acquainted with their discipline of study, should observe and appreciate the attitudes, responsibilities, and ethics normally expected of professionals and should exercise greater independence and responsibility in their assigned work functions.
The work report should reflect the growing professional development of the student and, as a minimum requirement, will
1. demonstrate an increased ability to analyse a significant issue/problem related to the student's experience in the work environment
2. demonstrate a high level of competence in producing a professional report, and
3. show a high level of competence in written communication and presentation skills.

Late reports will be graded as FAIL unless prior permission for a late report has been given by Co-operative Education.
CH: 0
LC: 0
PR: admission to the Biology Major and successful completion of semester 7 or Work Term II

11.3 Chemistry

Chemistry courses are designated by CHEM.

1010 Introductory Chemistry I examines descriptive chemistry; measurements; atoms; molecules; the mole; mole calculations and reaction stoichiometry; the balancing of redox reactions; gases; thermochemistry; introduction to chemical kinetics and equilibrium; acids and bases.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 1200
LC: 4
LH: 3 hours biweekly alternating with tutorials
OR: 1.5 hour tutorial alternating with labs
PR: Science 1807. It is recommended that students have successfully completed high school Academic Mathematics 3201, or a pass in any university level mathematics course
UL: only 6 science credit hours will be awarded for a major or honours in Chemistry from the following course groups: CHEM 1010/1011/the former 1031, or CHEM 1010/1050/1051, or CHEM 1810/1200/1001 (Grenfell Campus)

1011 Introductory Chemistry II examines atomic structure; periodic properties; chemical bonding including VSEPR shapes and polarity; introduction to valence bond theory and hybridization; liquids, solids and intermolecular forces; solubility equilibrium; electrochemistry.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 1001 and CHEM 1051
LH: 3 hours biweekly alternating with tutorials

OR: 1.5 hour tutorial alternating with labs
PR: Science 1807; CHEM 1010
UL: only 6 science credit hours will be awarded for a major or honours in Chemistry from the following course groups: CHEM 1010/1011/the former 1031, or CHEM 1010/1050/1051, or CHEM 1810/1200/1001 (Grenfell Campus)

1050 General Chemistry I builds on basic chemistry concepts from high school. Topics include gases; thermochemistry; atomic structure; periodic properties; chemical bonding including valence bond theory; hybridization and introduction to molecular orbital theory; properties of liquids and solids.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 1200
LC: 4
LH: 3
PR: Science 1807; CHEM 1010 with a grade of at least 60% or high school CHEM 3202 with a grade of at least 65%. It is also recommended that students have successfully completed high school Mathematics 3200 or 3201.
UL: only 6 science credit hours will be awarded for a major or honours in Chemistry from the following course groups: CHEM 1010/1011/the former 1031, or CHEM 1010/1050/1051, or CHEM 1810/1200/1001 (Grenfell Campus)

1051 General Chemistry II builds on CHEM 1050 topics and on basic chemistry concepts from high school. Topics include solutions, kinetics, chemical equilibrium, equilibria involving acids and bases including polyprotic acids, buffers, acid-base indicators, titration curves, solubility and complex ion equilibrium, thermodynamics, and electrochemistry.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 1001 and CHEM 1011
LC: 4
LH: 3
PR: Science 1807; CHEM 1050 (or Chemistry 1200 with a minimum grade of 65%)
UL: only 6 science credit hours will be awarded for a major or honours in Chemistry from the following course groups: CHEM 1010/1011/the former 1031, or CHEM 1010/1050/1051, or CHEM 1810/1200/1001 (Grenfell Campus)

2100 Analytical Chemistry I is an introduction to analytical chemistry and includes preparation of samples and standards, calibration methods, statistical treatment of data, spectrophotometric trace analysis, gravimetric analysis and volumetric analysis including acid-base titrations, precipitation titrations, oxidation-reduction titrations, complexometric titrations and titrations in non-aqueous systems. Also introduced are liquid-liquid and other types of extraction, and chromatography with key methods of detection. Theoretical, practical and problem-solving aspects are covered.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: the former CHEM 3100
LH: 3
PR: Science 1807; minimum 60% in CHEM 1051 or a minimum 65% in either 1001 or the former 1031

2210 Introductory Inorganic Chemistry focuses on fundamental concepts in the chemistry of s, p, and d block elements and their compounds. Emphasis will be placed on periodic trends in physical and chemical properties, molecular symmetry, molecular orbital diagrams, simple crystal structures, Lewis acid/base theory, and introductory coordination chemistry.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: Science 1807; minimum 60% in CHEM 1051 or a minimum 65% in either CHEM 1001 or the former CHEM 1031; Mathematics 1000

2301 Thermodynamics and Kinetics builds upon knowledge of physical chemistry from first year. It covers the three laws of thermodynamics for ideal and real systems as well as chemical kinetics. Topics in thermodynamics include the thermodynamics of ideal and real gases, phases, and solutions, the Maxwell relations, equilibria between phases, and in electrolyte solutions. The integrated rate laws for simple and complex mechanisms, and the temperature dependence of reaction rates in terms of kinetic molecular theory are some of the topics discussed in the kinetics section of the course.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: the former CHEM 2300
LH: 3
PR: Science 1807; minimum 60% in CHEM 1051, or a minimum 65% in either CHEM 1001 or the former CHEM 1031; Mathematics 1001. Physics 1051 or Physics 1021 is recommended.

2302 Quantum Chemistry and Spectroscopy examines the quantum mechanics of simple systems such as the particle in a box, the harmonic oscillator, linear rotor, and hydrogen-like atoms. Topics also include orbital quantum numbers, spin, many electron atoms, an introduction to quantum mechanical methods, the electronic structures of molecules, bonding, and symmetry. Furthermore, electronic, rotational, and vibrational spectroscopy will be discussed as well as modern applications of spectroscopy and lasers.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CO: Mathematics 2000 is recommended
CR: the former CHEM 3301
LH: 3
PR: Science 1807; a minimum 60% in CHEM 1051, or a minimum 65% in either CHEM 1001 or the former CHEM 1031; Mathematics 1001 and Physics 1051 or Physics 1021

2400 Introductory Organic Chemistry I is a course on bonding involving carbon; conformations and sterochemistry; introduction to functional groups and nomenclature; properties, syntheses and reactions of hydrocarbons, alkyl halides,alcohols and ethers.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 2440
LH: 3
PR: Science 1807; a minimum 60% in CHEM 1051, or CHEM 1010 and 1011 with a grade of at least 80% in each; or CHEM 1011 with a grade of at least 85%; or CHEM 1001 (or the former 1031) with a grade of at least 65%

2401 Introductory Organic Chemistry II is an introduction to the interpretation of mass, infrared, ^{1}H and ^{13}C NMR spectra; properties, syntheses and reactions of simple aromatic and heteroaromatic compounds, ketones, aldehydes, amines, carboxylic acids and their derivatives; aldol and related reactions.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 2440
LH: 3
PR: Science 1807; CHEM 2400

2440 Organic Chemistry for Biologists is an introduction to the principles of organic chemistry with an emphasis on material relevant to biological molecules. The laboratory will introduce techniques and illustrate concepts covered in the course. This course is designed primarily for Biology Majors.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: CHEM 2400
LH: 3
PR: Science 1807; CHEM 1051 or a minimum 60% in CHEM 1011
UL: may not be used for credit by Chemistry or Biochemistry Majors and will not serve as a prerequisite for any other Chemistry course.

2610 Introductory Chemical Oceanography (same as Ocean Sciences 2100) provides an introduction to the fundamental chemical properties of seawater and the processes governing the concentrations of elements and compounds in the oceans. It is an introduction to the sources, distribution, and transformations of chemical constituents of the ocean, and their relation to biological, chemical, geological, and physical processes. Topics include: controls on average concentration of chemicals in the ocean; vertical and horizontal distributions of ocean constituents; air-sea interactions; production, export, and remineralization of organic matter; the ocean carbon cycle; human-induced changes; stable isotopes; and trace elements.
CR: Ocean Sciences 2100
PR: CHEM 1011 or 1051 which may be taken concurrently or CHEM 1001

3110 Analytical Chemistry II (same as the former CHEM 4110) builds upon the student's knowledge from CHEM 2100 (Analytical Chemistry I) and applies it to a more advanced level of instrumental quantitative analysis. The course examines error treatment, atomic emission an absorption spectroscopy, gas and liquid chromatography, capillary electrophoresis and supercritical fluid chromatography and extraction techniques, electoranalytical chemistry, molecular and atomic mass spectrometry, x-ray spectroscopy, ion and electron spectroscopy, surface analysis techniques and thermogravimetric analysis.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: the former CHEM 4100, the former CHEM 4101, or the former CHEM 4110
LH: 3
PR: Science 1807; CHEM 2100 or the former CHEM 3100

3210 Main Group and Materials Chemistry is a detailed examination of the chemistry of the s and p block elements and modern applications of inorganic chemistry in materials and nanotechnology.

AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: Science 1807; CHEM 2210, CHEM 2301 (or the former CHEM 2300), and CHEM 2302

3211 Inorganic Chemistry is a detailed examination of the structure, bonding, and chemistry of the d block elements.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: Science 1807; CHEM 2210

3303 Statistical Thermodynamics and Rate Theories examines physical chemistry from the microscopic viewpoint. Topics include probability distributions, quantum statistical mechanics, statistical thermodynamics, ensembles, kinetics and introduction to statistical rate theories as well as an introduction to computational chemistry (lab).
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CR: the former CHEM 3300
LH: 3
PR: Science 1807; CHEM 2301 (or Engineering 4602), CHEM 2302, Mathematics 2000 (or Engineering 3424)

3411 Synthetic Organic Chemistry I is an introduction to organic synthesis. It covers the principles of organic synthesis and a range of reactions that are used in its pursuit. These reactions fall under the general headings of functional group interconversion (oxidation, reduction, protection, deprotection, substitution, elimination) and skeleton-building (reactions of carbon nucleophiles with electrophiles, transition metal-catayzed reactions, pericyclic reactions and reactions involving reactive intermediates).
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: Science 1807, CHEM 2401

3600 Marine Chemistry - inactive course.

4150 Advanced Spectrometric Techniques - inactive course.

4151 Analytical Separations and Organic Mass Spectrometry examines advances in the traditional chromatographic techniques, the development of new analytical tools in separation science, the interfacing of mass spectrometers to chromatographic instruments, and other mass spectrometric techniques.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: Science 1807; CHEM 3110 (or the former CHEM 4100 or the former CHEM 4101 or the former CHEM 4110)

4152 Electroanalytical Techniques examines the principles and theory of dynamic electrochemistry, voltammetry, stripping analysis, electro-chemical sensors and detectors.
PR: CHEM 3110 (or the former CHEM 4100 or the former CHEM 4101 or the former CHEM 4110)

4156 Analytical Method Development and Sampling comprises the development and critical evaluation of analytical methods and sampling protocols for analyses in complex matrices, including those relevant to environmental, medical, food, and forensic sciences.
PR: CHEM 3110

4201 Coordination Chemistry in Biological Molecules - Structural, Mechanistic and Magnetic Studies examines the role of certain transition elements e.g. iron, copper, cobalt, and zinc, in proteins and enzymes will be discussed in terms of structural features, the natural ligands, magnetic properties, mechanisms, etc., and reinforced with examples of 'model compounds'. Magnetic theory, in particular for polynuclear transition metal complexes, will also be developed.
PR: CHEM 3211

4202 Selected Topics in Main Group Chemistry - inactive course.

4203 Organometallic Chemistry is principles and applications of organometallic chemistry with emphasis on compounds of the transition metals, lanthanides and actinides. A study of synthetic methods, structure, bonding, reactions and applications of these concepts to organic synthesis and to catalysis.
PR: CHEM 3211

4204 Inorganic Reaction Mechanisms and Catalysis is a survey of inorganic and organometallic reactions, their mechanisms and kinetic characteristics. In addition, stereochemical non-rigidity, reactions of coordinated ligands and homogeneous catalysis are discussed.
PR: CHEM 3211

4205 Photochemistry of Transition Metal Complexes is an introduction to the theory of electronic excited states in transition metal complexes. Applications to artificial photosynthesis, photodynamic therapy, molecular photovoltaics and molecular electronics.
CO: CHEM 3211 and CHEM 2302
PR: CHEM 3211 and the former CHEM 3301 or CHEM 2302

4206 Green Chemistry examines the benefits and limitations of new methods aimed at reducing the environmental impact of chemical processes including waste prevention, hazard/risk reduction, catalysts, renewable feedstocks and alternative solvents.
PR: CHEM 2401 and CHEM 3211

4304 Advanced Quantum Chemistry examines exact solutions to the Schrodinger equation, introduction to approximate methods, modern methods (wavefunction and density functional theories), spectroscopy, and applications of computational chemistry.
CR: the former CHEM 4300
PR: CHEM 2302 (or the former CHEM 3301) and Mathematics 2260. Due to the requirement of Mathematics 2260, students wishing to take this course should plan ahead.

4305 Advanced Statistical Thermodynamics examines intermolecular forces, the properties of liquids, the solvation of molecules and ions, and the structure and dynamics of macromolecules within the framework of statistical thermodynamics.
CR: the former CHEM 4303
PR: CHEM 3303 or the former CHEM 3301

4350 Advanced Physical Chemistry III: Selected Topics in Physical Chemistry is discussion of selected topics of current interest in physical chemistry and chemical physics, given in lecture or seminar form. Representative topics are crystal structure and x-ray crystallography, data processing and modelling, microwave spectroscopy, quantum chemical calculations. Arrangements to take this course should be made during the previous academic year.
PR: CHEM 3303

4410 Bio-organic Chemistry is a study of the major classes of biomolecules, their structure, function, and their chemistry. The chemistry and the biochemical reactions of carbohydrates, amino acids, peptides, lipids, coenzymes, nucleic acids, polyketides, and the shikimic acid pathway. An introduction to natural products and secondary metabolites. Synthesis of peptides, nucleosides and polynucleotides. Biosynthesis of fatty acids, terpenes, polyketides, shikimates, peptides and polynucleotides.
CR: the former CHEM 3410
PR: CHEM 2401

4411 Topics in Medicinal Chemistry - inactive course.

4420 Physical Organic Chemistry is an introduction to the quantitative and qualitative theories of reactions and reactivity and their application to organic reaction mechanisms and to mechanism elucidation.
CR: the former CHEM 4400 and the former CHEM 4401
PR: CHEM 2302 or the former CHEM 3301, and CHEM 3411 or the former CHEM 3401

4430 Synthetic Organic Chemistry II examines modern synthetic methods with particular attention placed on the synthesis of enantiomerically enriched compounds and newer methods for the formation of carbon-carbon bonds. Designing syntheses of complex organic molecules.
CR: the former CHEM 4410
PR: the former CHEM 3401 or 3411. CHEM 4420 is strongly recommended.

4500 Advanced Nuclear Magnetic Resonance Spectroscopy examines advances in modern and traditional NMR techniques, the principles and applications of solution and solid-state NMR spectroscopy and micro imaging.
AR: Attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
LH: 3
PR: CHEM 2302 and 2401

4620 Environmental Chemistry applies fundamental principles of chemistry to reactions and processes in the environment. Reaction mechanisms, physical processes, and application of analytical techniques to environmental chemistry will be discussed. The course will cover the chemistry underpinning current environmental problems such as long-range transport of persistent pollutants, photochemical smog, and climate change.
CO: CHEM 3110
CR: Environmental Science 4249
PR: CHEM 2400, CHEM 2301, CHEM 3110

4701 Principles of Pharmaceutical Chemistry will provide the necessary

foundation of knowledge to enable students to understand the principles of drug discovery, the main pharmacokinetics properties of drugs, the relationships between the chemical structure of drugs and their biological actions, their toxicity and side-effects, and the kinetics of inhibitory mechanisms and the metabolic reactions of drugs. It will also provide an overview of pharmaceutical regulatory affairs.
PR: Biochemistry 3105 or the former CHEM 3410 or permission of the instructor

490A/B Honours Research in Chemistry is available only to students in Chemistry Honours or Chemistry Joint Honours Programs. These courses are two single-semester, linked courses based on independent research carried out under the supervision of a faculty member in the Department of Chemistry. Research undertaken for these courses must have a clear disconnect from any research previously conducted. These courses are mandatory for Honours Chemistry students. A grade of pass in 490A is required to proceed to 490B. A written thesis is to be handed in by the end of the course. 490A and 490B are to be taken in the Fall and Winter semesters in the same academic year.
CH: 6
PR: admission to the Honours Chemistry Program or Chemistry Joint Honours Program and honours standing
UL: may be taken by students not in an Honours program or without Honours standing with the permission of the Head of the Department and a research supervisor.

11.4 Computer Science

Computer Science courses are designated by COMP.

11.4.1 First Year Courses

1000 Computer Science – An Introduction is a gentle introduction to computer science. In a breadth-first overview approach it discusses important aspects of computer science including fundamentals in algorithms, binary data representation, Boolean logic and its implementation, machine architecture, systems software, networking concepts, programming languages, databases, and selected Computer Science subfields.
CR: COMP 1700
LH: 3

1001 Introduction to Programming is an introduction to fundamental programming techniques, primitive data types, and to simple algorithms and their design concepts.
CR: COMP 1710
LH: 3

1002 Introduction to Logic for Computer Scientists introduces methods of reasoning and logic tools that underlie computer science. In particular, this course covers propositional and predicate logic, sets and other discrete structures, as well as modular arithmetic and basic counting, with emphasis on their applications in computer science.
CR: COMP 2742, Engineering 4424, Mathematics 2320. Students cannot receive credit for COMP 1002 if completed with, or subsequent to, Mathematics 2320.
LH: 3

1400 Computing in the 20th Century and Beyond will give an overview of the development of computing technologies over the last 75 years as well as both the perception of these technologies by, and their impact on, society. The course will be organized chronologically by decade, and within each decade will examine the dominant computing developments, their image in various print and pictorial media, and their social impact. The aim is to give students of all disciplines an appreciation of the abilities and limitations of computer technology and how such technologies interact with society.

1401 Computing at the Movies will both examine and counter common misconceptions about computing and the computing profession. This will be done by contrasting depictions of various aspects of computing in various movies and documentaries produced over the last 60 years with the reality of these aspects as given in selected readings and course lecture notes.

1510 An Introduction to Programming for Scientific Computing introduces students to basic programming in the context of numerical methods with the goal of providing the foundation necessary to handle larger scientific programming projects. Numerical methods to solve selected problems from Physics, Chemistry, and Mathematics will be covered.
CR: the former COMP 2602 and the former Mathematics 2120
LH: 2
PR: Mathematics 1000

1550 Introduction to Multimedia Application Development is an introduction to programming and computer science with an emphasis on the development of multimedia applications. The course introduces the fundamental principles of programming, including object-oriented and event-driven programming, how to use and create classes and methods and combine them with multimedia libraries to produce animations, handle input from keyboard and mouse, and import sounds and videos to produce multimedia applications which can be directly deployed on the Internet.
CR: COMP 2300
LH: 3

1600 Basic Computing and Information Technology offers an overview of information technology. It provides students with an understanding of basic concepts and necessary skills required to use spreadsheet, database and presentation software to manage, analyze, and present data.
CR: the former Business 2700, the former COMP 2650 and the former COMP 2801
LH: 3

1700 Introduction to Computer Science lays the foundation for the art and the science of computing. The course contains fundamental and topical issues in computers, languages, programming and applications. This course is designed for potential Computer Science majors without a background in programming, but is also available for non majors.
CR: COMP 1000
LH: 3

1710 Object-Oriented Programming I is an introduction to fundamental programming techniques, primitive data types and operations, program control structures and the use of objects, classes and methods.
CR: COMP 2710 or COMP 1001

11.4.2 Second Year Courses

2000 Collaborative and Emergent Behaviour is a survey of computation as a means of understanding, modelling, and describing artificial and natural systems. The emergence of complex behaviour from the interaction of simple rules governing individual components is illustrated and discussed, as well as the role of communication between system components. Selected systems to be studied will be drawn from different topic areas which may include the worldwide web, the mind (cognitive science), formal logic, autonomous robotics, chaos and fractals, and bioinformatics. Each topic will incorporate an associated laboratory experience.
LH: 3 hours bi-weekly

2001 Object-Oriented Programming and Human-Computer Interaction advances from Introduction to Programming and studies object-oriented programming. Additional topics include event-driven programming, program correctness and simple refactoring, as well as interfaces and human-computer interaction. A brief overview of programming languages is also provided.
CR: COMP 2710
LH: 3
PR: COMP 1001, Mathematics 1000

2002 Data Structures and Algorithms covers fundamental data structures, algorithms and algorithm design techniques. A problem-driven course, it focuses on computational problem solving from designing an efficient algorithm to implementing it using appropriate data structures.
CR: COMP 2711
LH: 3
PR: COMP 1001, COMP 1002

2003 Computer Architecture introduces computer architecture at the digital logic implementation level, at the instruction set level, and at the level where programming languages are translated into the underlying machine instructions.
CR: COMP 3724
LH: 3
PR: COMP 1001, COMP 1002

2004 Introduction to Operating Systems introduces fundamental techniques for interfacing between computer software and hardware platforms, including the composition of, and connections within, a multilevel operating system. Students learn how to design substantial parts of an operating system.
CR: COMP 3725
PR: COMP 2002, COMP 2003

2005 Software Engineering introduces students to the different software process models, to project management and the software requirements engineering process, as well as to systems analysis and design as a problem-solving activity.
CR: COMP 3716
PR: COMP 2001

2006 Computer Networking introduces students to the use of programming interfaces for computer networking and to understand how the Internet works on the level of protocols. It focuses on the most commonly used of those protocols that are in the vast majority of modern computer systems.
CH: 1
CO: COMP 2004
CR: COMP 3715
PR: COMP 2001, COMP 2002

2007 Introduction to Information Management introduces the basic

knowledge needed for managing large volumes of data. It covers topics in information management and database systems from storage and retrieval to security and privacy of data.
CH: 1
CO: COMP 2004
CR: COMP 3754
PR: COMP 2002

2008 Social Issues and Professional Practice covers ethical and social considerations of computing to provide students with the basis to address these issues by ethical and technical actions. Case studies are used to illustrate ethical and social issues of computing.
CH: 1
CR: COMP 2760
PR: COMP 1000

2100 Social Web Analysis covers the analysis of social network structures, the flow of data within them and the methods to extract useful information about these networks, their participants and the content of their communication. Security and trust issues are also covered.
PR: COMP 1000

2300 Introduction to Multimedia Programming is an introduction to programming and computer science with an emphasis on the development of multimedia applications. The course introduces the fundamental principles of programming, including object-oriented and event-driven programming. Students will develop an understanding of how to use and create classes and methods and combine them with multimedia libraries to produce animations, handle input from keyboard and mouse, and import sounds and videos to produce multimedia applications which can be directly deployed on the Internet.
CR: COMP 1550
LH: 3
PR: COMP 1000

2500 Data Analysis with Scripting Languages introduces the use of scripting languages to solve common data analysis tasks. The control structures and expressions of the language are first discussed. Script solution to storing/retrieving data sets, searching data sets, and performing numeric and statistical calculation are covered. Plotting and visualization for data sets are also presented.
PR: COMP 1510 or COMP 1700 or COMP 1710 or COMP 1000 or COMP 1001 (or equivalent)

2510 Programming in C/C++ is a comprehensive treatment of the C/C++ programming languages. It is intended for students with some first programming experience. This course starts with a discussion of fundamentals of C and C++, moves on to the object-oriented aspects of C++, and introduces some advanced topics. It is an essential course for mastering the power of this rich programming language.
CR: Engineering 3891
LH: 3
PR: COMP 1510 or COMP 1550 or COMP 1700 or COMP 1710 or COMP 1000 or COMP 1001 or Engineering 1020 (or equivalent)

2710 Object-Oriented Programming II continues from Object-Oriented Programming I, and studies object-oriented and event-driven programming. Additional topics include: recursion, basic analysis of algorithms, fundamental data structures such as simple linked structures and stacks, and fundamental computing algorithms such as binary search and quadratic time sorting. A brief overview of programming languages, virtual machines and language translations is also provided.
CR: COMP 2001
LH: 3
PR: COMP 1710 and Mathematics 1000

2711 Introduction to Algorithms and Data Structures includes the study of standard ways of organizing and manipulating data in computer storage. Fundamental concepts in the design and analysis of algorithms are also discussed.
CR: COMP 2002
LH: 3
PR: COMP 2710. It is recommended that students complete COMP 2742 prior to registering for COMP 2711

2718 Development Tools, Work Flows and Concepts covers tools, work flows and concepts used in software development in a concentrated introductory set of topics. The essential work flows (with their underlying concepts) used to edit, build, test, combine with existing software and find existing software are introduced. The tools covered include text editors, programming language translators, file management tools, debuggers, scripting tools, source control tools, and building, testing and deployment tools. The architecture and use of an Integrated Development Environment are discussed.
LH: 3
PR: COMP 2500 or COMP 2510 or COMP 2710

2742 Logic for Computer Science is an introduction to propositional and predicate logic with applications. The use of the system of boolean logic in reasoning and circuit design, as well as basic proof techniques and the resolution principle, for both propositional and predicate logic, will be covered. Concepts involving sets will be used to illustrate different types of proof techniques. The probable intractability of boolean logic and Goedel's incompleteness theorem will be presented.
CR: COMP 1002
PR: COMP 1710 or COMP 1001, and Mathematics 1000

2760 Encountering the Computer: Society and the Individual examines social, ethical, legal and cultural issues surrounding the use of computers in modern society. These broader social issues are followed by an examination of the use of social and individual psychology in user interface design. Students will be expected to demonstrate an understanding of these issues both directly (through verbal and written discourse) and practically, as applied to the creation of actual software artifacts.
CO: COMP 2710 or COMP 2001
CR: COMP 2008
PR: two 1000-level English courses, or equivalent

11.4.3 Third Year Courses

3200 Algorithmic Techniques for Smart Systems covers basic algorithmic techniques and data structures that are used to embed basic intelligent behaviors, such as problem solving, reasoning and learning in software systems and agents.
CR: COMP 4753
PR: COMP 2001 and COMP 2002, and Statistics 1510 or Statistics 2550

3201 Introduction to Nature-Inspired Computing provides an overview of popular nature-inspired computing methods. Methods that are inspired by both biological and non-biological systems are considered. These methods have been applied to solve problems in various areas of computing such as optimization, machine learning, and robotics. Particular examples of nature-inspired computing methods studied include cellular automata, neural networks, evolutionary computing, swarm intelligence, artificial life, and complex networks. Contributions made in the field of nature-inspired computing that have led to advances in the natural sciences are also discussed.
CR: COMP 4752
PR: COMP 2002

3202 Introduction to Machine Learning introduces concepts and algorithms in machine learning for regression and classification tasks. The course gives the student the basic ideas and intuition behind model selection and evaluation, and selected machine learning methods such as random forests, support vector machines, and hidden Markov models.
PR: COMP 3200; or COMP 2001 and COMP 2003 and Statistics 2550

3300 Interactive Technologies provides exposure to traditional desktop, mobile and games contexts with respect to interaction design theory and practice. The impact of context on design principles is explored. An introduction to each programming context will be provided and a minimal set of software development tools for each context will be introduced. Practical application of interaction design principles will involve design and prototyping of desktop, mobile and games applications.
PR: COMP 2001

3301 Visual Computing and Applications provides students with the fundamental knowledge and skills in the fields of computer vision, computer graphics, and visualization. Visual perception is responsible for most of our impressions about the world around us. This course introduces how computers are used to both mimic the human visual system (e.g., recognize shapes) and to create visual content (e.g. synthesize images). Related techniques on image synthesis, processing and analysis are discussed under a unified framework. How visual computing principles were used to create visual effects in movies and commercials is also examined.
PR: COMP 2002

3401 Introduction to Data Mining introduces students to the basic concepts and techniques for data mining and knowledge discovery. Students will develop an understanding of the essential data mining technologies, and be able to design and evaluate methods for simple data mining applications.
PR: COMP 2002, COMP 2007 and Statistics 2550

3550 Introduction to Bioinformatics (same as Biology 3951) deals with the development and application of computational methods to address biological problems. The course will focus on the fundamental concepts, ideas and related biological applications of existing bioinformatics tools. This course will provide hands-on experience in applying bioinformatics software tools and online databases to analyze experimental biological data, and it will also introduce scripting language tools typically used to automate some biological data analysis tasks.
CR: Biology 3951
LH: 3
PR: Biology 2060 or Biochemistry 2101, and one Computer Science course at the 1000-level or above excluding COMP 1400, COMP 1600 and COMP 2000; or COMP 2500 or COMP 2710 or COMP 2001, and one Biology course at the 1000-level or above excluding Biology 2040 and Biology 2041; or permission of the course instructor

3700 Industrial Experience is a course for students who are admitted to CIIO. Students are required to register for this non-credit course every semester during their internship. This course is open only to students who have been accepted into the Internship Program and provides an opportunity for qualified students to obtain rewarding job experience of 8, 12 or 16 months of continuous duration, during the course of their studies.
CH: 0
PR: admission to the Computer Industry Internship Option (CIIO)

3710 Vocational Languages is a study of several programming languages of vocational significance. The use of appropriate programming paradigms to solve some significant problems will be illustrated.
PR: COMP 2711 or COMP 2002

3715 Network Computing with WEB Applications studies how distributed applications (e.g., client/server Web applications) are constructed using the Internet. Topics covered include: the socket interface for network communication, client/server applications, browser scripting using Javascript, content generation for web applications (e.g., jsp, php), html/css documents, and the use of cryptography to handle security.
CR: COMP 2006
PR: COMP 2711 or COMP 2002

3716 Software Methodology studies the development of software by gathering the requirements of the software program, analysing the requirements to create a development model, and creating the software and documents for the software product. This course studies techniques for all three software development activities.
CR: COMP 2005
PR: COMP 2711 or COMP 2002

3718 Programming in the Small demonstrates the tools and techniques used in the construction of small software systems. The software tools and techniques to be covered include analysis and design of software components, software construction tools (e.g. linkers, builders, debuggers), software library use and design, and system integration.
PR: COMP 2711 or COMP 2002

3719 Theory of Computation and Algorithms is an introduction to formal algorithmic problem solving. Various algorithm design techniques that sometimes yield efficient solutions are studied. Deterministic and nondeterministic machines (finite state automata, pushdown automata and Turing machines) are discussed and used to efficiently solve problems such as the String Matching Problem, the parsing of Context-free Languages, and to introduce the theory of NP-completeness. In addition, Turing machines are used to prove the unsolvability of certain problems. Tractable, intractable and undecidable problems are contrasted. Basic issues related to parallelization are discussed as well.
CR: the former COMP 3711 and the former COMP 3740
PR: COMP 2711 or COMP 2002; and Mathematics 2320 or COMP 1002

3724 Computer Organization can be studied at the digital logic implementation level, the instruction set architecture level, and the translation of programming languages to the underlying machine instruction level. This course studies computer organization at these levels.
CR: COMP 2003
PR: COMP 2711 or COMP 2002; and COMP 2742 and Mathematics 2320, or COMP 1002

3725 Computer Architecture and Operating Systems covers system design and the architectural implementations of these designs. The objective is to develop the basic concepts of processor design, memory management, operating systems, and I/O devices and their interactions.
CR: COMP 2004
PR: COMP 3724 or COMP 2003

3731 Introduction to Scientific Computing main objectives are the development of algorithms for the numerical solution of mathematical problems and the study of the numerical stability of these algorithms. The efficiency of these algorithms with respect to speed and storage requirements is considered as well. Emphasis is also placed on the study of the sensitivity of selected problems to perturbations in the data. There is also a brief introduction to the development of numerical algorithms that take advantage of advanced computer architectures, such as pipeline processors, array processors and parallel processors.
CR: Mathematics 3132
PR: Mathematics 2000 and Mathematics 2050, and COMP 2710 or COMP 1001

3753 Computational Aspects of Linear Programming is an introduction to the Linear Programming Problem (LPP). The emphasis is placed upon developing the most recent and numerically reliable algorithms for the solution of the Linear Programming Problem. The numerical stability of these algorithms will be examined as well. Geometric understanding of the LPP. Simplex method for the LPP. Sparse matrix LPP. Duality and postoptimality analysis. Extensions to the simplex algorithm. Principles of interior algorithms for the LPP.
PR: Mathematics 2050, and COMP 2710 or COMP 2001

3754 Introduction to Information and Intelligent Systems introduces students to application areas that are away from usual number-based and text-based processing. Students will learn the basic concepts and become aware of the historical developments and social and ethical issues related to the application areas such as intelligent systems and information management. This exposure will help students to become knowledgeable about managing large volumes of data and dealing with problems that are well defined but whose algorithmic solutions are not feasible or problems that are fuzzily defined.
CR: COMP 2007
PR: COMP 2711 or COMP 2002, and COMP 2742 or COMP 1002

11.4.4 Fourth Year Courses

4300 Introduction to Game Programming is an introductory course for students interested in learning the fundamentals of game programming. Topics include vector math for games, fundamentals of rendering, introduction to animation and artificial intelligence, collision detection, game physics and user-interfaces. Students are required to write a fully functional game during the course.
PR: COMP 2001

4301 Computer Vision (same as Engineering 8814) studies how to develop methods that enable a machine to “understand” or analyze images. The course introduces the fundamental problems in computer vision and the state-of-the-art approaches that address them. Topics include feature detection and matching, geometric and multi-view vision, structure from X, segmentation, object tracking and visual recognition.
CR: Engineering 8814
PR: COMP 3301 or Engineering 7854 or permission of the instructor

4302 3D Computer Graphics introduces the students to the state-of-the-art concepts and developments in the field of 3D computer graphics. The underlying algorithms, as well as the basic techniques to develop interactive 3D graphics systems including games and simulators, are presented. Topics of the course include 3D geometrical transformations, 3D projections, 3D modeling and rendering, 3D graphics languages and systems. Advanced photorealistic rendering and image-based rendering techniques may also be covered.
CR: COMP 4751
PR: COMP 3301

4303 Artificial Intelligence in Computer Games provides an introduction to specific state-of-the-art algorithmic techniques and data structures that are used to efficiently implement human-like abilities (e.g., awareness, memory, rational decision-making (under uncertainty), movement, co-operation in groups) in computer game agents.
PR: COMP 3200

4304 Data Visualization covers interactive representation of data using a modern programming library. Topics include an introduction to the software platform and the principles for data selection, analysis, design and creation of dynamic visualizations. Students produce interactive web-based objects, addressing problems in the presentation and understanding of large data collections. The techniques discussed are applicable to different sources and types of data.
CR: COMP 4767
PR: COMP 2001, COMP 2002

4550 Bioinformatics: Biological Data Analysis (same as Biology 4606) provides students with the basis to analyse a variety of biological data within an integrated programming environment for data manipulation, calculation and graphical display. Students will learn to extract meaningful information from data generated by high-throughput experimentation. The course will introduce one such integrated programming environment and will explore the computational and statistical foundations of the most commonly used biological data analysis procedures.
CR: Biology 4606
LH: 3
PR: Biology 3951 or COMP 3550, and Statistics 2550 (or equivalent), or permission of the course instructor

4711 Structure of Programming Languages covers programming language design considerations; syntactic and semantic structure; survey of typical features and operations; analysis of facilities for control and data structuring; language extensibility; execution models; formal specification of programming languages.
PR: COMP 3719, and COMP 3724 or COMP 2003

4712 Compiler Construction studies properties of formal grammars and languages; syntax-directed parsing and code generation; top-down and bottom-up parsing methods; LL(k) and LR(k) grammars and parsers; Code optimization; compiler writing tools.
PR: COMP 3719, and COMP 3724 or COMP 2003

4715 and 4717 Special Topics in Programming Languages will have topics to be studied announced by the Department.

4718 Survey of Software Engineering surveys the major topics of software engineering. Areas covered include: requirements capture, system design

and design approaches, verification and validation (including formal methods and testing), and management of the software development process.
PR: COMP 3716 or COMP 2005

4721 Operating Systems studies the design and implementation of an operating system's kernel. The main components used in operating system implementations include: context switches, process management, memory management, interprocess communication, file systems and system calls. The data structures and algorithms used in implementing the above components are studied. The different architectural styles of kernel implementation are also considered. Real-time operating systems are also discussed.
CR: Engineering 8894
PR: COMP 3725 or COMP 2004

4723 Introduction to Microprocessors examines the architecture and instruction sets for several microprocessors. The use of microprocessors as device controllers; comparisons of hardware and programmed techniques; microprocessor interfacing with external devices; methods of I/O; bus structures; modern microprocessor support devices are discussed.
LH: Minimum of three hours per week. Practical experience with basic principles will be obtained through laboratory experience.
PR: COMP 3724 or COMP 2003

4726-4729 Special Topics in Computer Systems will have topics to be studied announced by the Department.

4734 Matrix Computations and Applications is an introduction to linear algebra; solution to linear systems; scaling, improving and estimating accuracy; the linear least squares problem; the eigenvalue problem; singular value decomposition of a matrix; the generalized eigenvalue problem.
PR: COMP 3731

4736-4739 Special Topics in Numerical Computations will have topics to be studied announced by the Department.

4740 Design and Analysis of Algorithms will give an overview of techniques for the design of efficient optimal-solution and heuristic algorithms. It will include an introduction to various advanced data structures for set and string processing that are used to further optimize algorithm efficiency.
PR: COMP 3719

4741 Formal Languages and Computability is an in-depth study of various types of formal machines and their associated languages. Effective computability and other formalisms, such as lambda calculus will be studied as well.
CR: the former COMP 3740
PR: COMP 3719

4742 Computational Complexity is an in-depth discussion of computational complexity theory. Topics covered in the course include: models of computation (for both serial and parallel computations); complexity measures; reducibility; complexity classes (NP, PSPACE, NC, LOGSPACE and P); and randomized computations.
PR: COMP 3719

4743 Graph Algorithms and Combinatorial Optimization discusses classical problems in combinatorial optimization and graph algorithms, including matching, colorability, independent sets, isomorphism, network flows and scheduling. Special families of graphs are discussed and algorithms that would otherwise be NP-hard or complete are shown to be polynomial time when restricted to such families.
PR: COMP 3719

4745-4749 (Excluding 4748) Special Topics in Theoretical Aspects will have topics to be studied announced by the Department.

4748 Introduction to the Science of Complexity is an exploration of the use of computers in the simulation of complex systems. Some theories and models, such as cellular automata, artificial life, fractals, genetic algorithms, chaos, and evolution will be discussed and will be used in the modelling of "real-life" systems. The approach in this course is practical. Students have to write a number of programs of different levels of sophistication including a final project.
PR: COMP 3719

4750 Introduction to Natural Language Processing covers tasks involving human languages, such as speech recognition, text understanding, and keyword-based information retrieval which underlie many modern computing applications and their interfaces. To be truly useful, such natural language processing must be both efficient and robust. This course will give an introduction to the algorithms and data structures used to solve key NLP tasks, including utterance understanding and generation and language acquisition, in both of the major algorithmic paradigms used today (rule-based and statistical). The emphasis will be primarily on text-based processing though speech-based processing will be addressed where possible.
PR: COMP 3719 and Statistics 1510

4751 Computer Graphics examines display devices, display processors, display file compilers, display transformations, structured display files, graphical input devices, perspective, hidden line elimination, languages and graphics systems.
CR: COMP 4302
LH: 3
PR: COMP 3719 and Mathematics 2050

4752 Introduction to Computational Intelligence provides an introduction to four of the fundamental computational intelligence methods: artificial neural networks, evolutionary computation, swarm intelligence and fuzzy systems. The integration of these techniques for problem solving will also be introduced.
CR: COMP 3201
PR: COMP 3719 and COMP 3754

4753 Artificial Intelligence has selected topics from AI programming languages; heuristic searching; problem solving; game-playing; knowledge representations; knowledge-based systems; reasoning in uncertainty situations; planning; natural language understanding; pattern recognition; computer vision; and machine learning.
CR: COMP 3200
PR: COMP 3719 and COMP 3754

4754 Database Systems introduces students to database processing, database management systems and database design considerations. It will cover the theory and methodologies essential for the relational database design, implementation, manipulation, optimization and management.
PR: COMP 3725 or 2004, and COMP 3754 or COMP 2007

4756 Image Processing will centre on the key analytical and algorithmic tools and concepts of digital image processing. Topics will include Transformations, Enhancement, Encoding, Data Bases, Segmentation and Description.
CR: Engineering 7854
LH: 3
PR: COMP 3719

4759 Computer Networks looks at how the operation of computer networks requires the following: a) communication between two computers, b) information transfer between two computers not directly connected, and c) services that need computer communication. This course focuses on the standard solutions and services used to fulfill the previous requirements. These include: physical transmission of signals, reliable communication based on unreliable communication channels, the routing of messages between connected computers to reach computers that are not directly connected, e-mail, file transfer, name servers, remote terminal access and the World Wide Web. Particular attention will be placed on the workings of the Internet.
PR: COMP 3715 or 2006, and COMP 3725 or COMP 2004

4762 Introduction to Computational Molecular Biology will give an overview of computational problems and algorithms for these problems associated with a variety of analyses of biological molecular data.
PR: COMP 3719

4766 Introduction to Autonomous Robotics examines the fundamental constraints, technologies, and algorithms of autonomous robotics. The focus of this course will be on computational aspects of autonomous wheeled mobile robots. The following topics will be covered: major paradigms in robotics, methods of locomotion, kinematics, simple control systems, sensor technologies, stereo vision, feature extraction, modelling uncertainty of sensors and positional information, localization, SLAM, obstacle avoidance, and 2-D path planning.
LH: 3
PR: COMP 2711 or COMP 2002, Mathematics 2000, Mathematics 2050, and Statistics 1510 or Statistics 2550 or the former Statistics 2510

4767 Information Visualization and Applications focuses on the design and implementation of interactive visualization techniques for the analysis, comprehension, exploration, and explanation of large collections of abstract information. Topics to be covered include principles of visual perception, information data types, visual encodings of data, representation of relationships, interaction methods, understanding user goals and tasks, and evaluation techniques. Case studies of accepted techniques and the current state-of-the-art in information visualization will be presented.
CR: COMP 4304
PR: COMP 2760 or COMP 2008, and COMP 3719

4768 Software Development for Mobile Devices focuses on the design and implementation of software in a mobile networking environment. The primary topics to be covered in this course include software engineering, network computing, graphics programming, and human-computer interaction for mobile devices. A modern mobile device with advanced networking and graphic features, including multi-touch interaction and motion sensors will be used as the primary platform for development in this course.
LH: One and one-half hours per week
PR: COMP 2760 or COMP 2008, COMP 3715 or COMP 2006, and COMP 3716 or COMP 2005

4770 Team Project has as its main objective to develop a working prototype of a software system as a team effort. A group of students will work on a project for a term, experiencing the advantages and difficulties of team projects.
AR: attendance is required
PR: COMP 3715 or COMP 2006, COMP 3716 or COMP 2005, COMP 3724 or COMP 2003, and COMP 3754 or COMP 2007

4780 Honours Project introduces computer science honours students to research activities, familiarizes them with a special problem in computer science, and provides independent study on an advanced topic under the direct supervision of a member of the computer science faculty. The topic is decided in consultation with the supervisor. The student is required to produce a written report on the project, to include the literature search on the topic, and to present this work at a departmental seminar prior to the last week of the semester.
PR: admission to the honours program and permission of the Head of Department

4800-4825 Special Topics will be offered as departmental resources permit.
CO: Special topics courses are not offered on a regular basis, but whenever departmental resources permit. For these reasons, the co-requisites can vary each time the courses are offered.
PR: Special topics courses are not offered on a regular basis, but whenever departmental resources permit. For these reasons, the prerequisites can vary each time the courses are offered.

11.5 Earth Sciences

The first digit of each course number designates the level (year) of the course. The second digit indicates the area of Earth Sciences into which the course best fits, as follows:

Second Digit
0 - mineralogy and petrology
1 - geophysics
2 - economic geology
3 - stratigraphy and marine geology
4 - structural geology and tectonics
5 - geochemistry
6 - environmental geoscience and technical fields
7 - sedimentation, petroleum geology and geomorphology
8 - paleontology
9 - general and dissertation

Earth Sciences courses are designated by EASC.

11.5.1 First Year

1000 Earth Systems is a survey of the structure, function and interrelations of Earth's lithosphere, hydrosphere, atmosphere and biosphere. Topics include an exploration of the physical and chemical properties of planetary materials, forces driving and sustaining Earth systems, and biological modifiers (including humankind) on the Earth today.
LH: 3

1001 Evolution of Earth Systems - inactive course.

1002 Concepts and Methods in Earth Sciences provides an introduction to a broad range of concepts concerning the development of the geological record and the Earth; practical methods for collection of field based data; topics in map interpretation and geometric analysis, stratigraphy, paleontology, structure and petrology. The course is presented with an emphasis on the development of practical skills needed to pursue a career in Earth Sciences.
LH: 3
PR: EASC 1000

11.5.2 Second Year

2030 Mineralogy provides an introduction to crystallography and the structure of minerals; introduction to crystal optics; study of the rock forming minerals and minerals of economic significance. Laboratory work comprises study of the structures and symmetries of minerals, chemistry of rock forming minerals, introduction to transmitted light microscopy of rocks, hand specimen recognition of common rocks and minerals.
CO: EASC 2502
CR: the former EASC 203A/B
LH: 3
PR: EASC 1000 and 1002 with a grade of at least 55% in each, Chemistry 1051 (or 1001), Physics 1051 (or 1021 or 1054), and Mathematics 1000

2031 Mineralogy and Petrography examines the optical and chemical properties of rock-forming minerals, the petrography and classification of igneous and metamorphic rocks and applications of relevant phase equilibria to the study of minerals. Laboratory work comprises optical mineralogy and petrography of igneous and metamorphic rocks.
CO: Mathematics 1001
CR: the former EASC 203A/B
LH: 3
PR: EASC 2030, 2502, Mathematics 1001

2150 The Solar System describes the basic astronomy of the Solar System, tracing the search to understand motion of the Sun, Moon and planets in the sky; modern observations of planets, moons, comets, asteroids and meteorites and what they tell us about the origin and evolution of the Solar System.
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Earth Sciences

2311 Geoscience Communication is an introduction to the fundamentals of preparation of written and oral geoscience reports, emphasizing organization, correct use of terminology, concise description, preparation of abstracts and introductions, integration of numerical data and publication-quality illustrations, and oral presentation skills. Topics for reports will be selected from the subject matter of other 2000 level Earth Sciences courses.
LC: 2
OR: tutorials three hours per week
PR: Earth Sciences 2905 and 6 credit hours in English

2401 Structural Geology provides an introduction to basic concepts; the physics of rock deformation, the classification and descriptive geometry of major and minor structures and their relationship to stress and strain. Laboratory work will concentrate on analysis of structural orientation data, and the analysis of structures in geological maps and cross-sections. Earth Sciences majors are advised to complete field course, EASC 3905, immediately following completion of this course.
CR: the former Geology 3120 or the former EASC 3120 or the former EASC 3400
LH: 3
PR: EASC 2905 or (for students following a Minor in Earth Sciences) permission of the Head of the Department

2502 Introduction to Geochemistry provides an overview of both low- and high-temperature geochemistry. Topics include: origin and classification of the elements; chemical differentiation of the solar system and solid Earth; aqueous geochemistry and the stability of minerals; radiogenic and stable isotopes. Geochemical concepts are illustrated using data and processes drawn from Earth systems. The laboratory component emphasizes the development of numerical skills needed in geochemistry.
CO: Mathematics 1001
LH: 3
PR: EASC 1000 and 1002 with a grade of at least 55% in each, Chemistry 1051 (or 1001)

2702 Sedimentology and Stratigraphy is a study of the origin and composition of sediments with a focus on depositional processes and resulting sedimentary structures. Study of environments of deposition and the stratigraphic framework of sedimentary successions. Laboratories involve local field trips, petrographic analysis, and the study of hand samples of sedimentary rocks.
CR: the former Geology 3070 or the former EASC 3070 or the former EASC 3701
LH: 3
PR: EASC 1000 and 1002 with a grade of at least 55% in each

2905 Introduction to Geological Mapping is based on approximately six days of geological mapping in Precambrian rocks near St. John's, and two days of in-class work preparing a digital map and written report. Emphasis is placed on the recognition and description of sedimentary and igneous rocks in the field, and techniques of geological mapping and the taking of field notes. This course will be given during a special session immediately preceding the fall semester.

AR: attendance is required
CH: 2
CR: the former EASC 2310 or the former EASC 2300
OR: field based course
PR: EASC 1000 and 1002 with a grade of at least 55% in each, and an application to the Head of the Department

2914 The Earth's Energy Resources: Past, Present and Future - inactive course.

2915 The Earth's Material Resources: Past, Present and Future - inactive course.

2916 Natural Hazards on a Dynamic Earth describes the surface of the Earth being in a constant state of change, thereby posing risks and challenges for society. A basic understanding of geological processes in the past and present provides some context for appreciating the risks related to earthquakes, volcanic activity and mass movements, challenges related to water resources, land-use planning and waste disposal, and some background to interpret sources and consequences of climate change. The course will provide a broad perspective on contemporary issues facing society. This course is designed for students taking Earth Sciences as an elective subject. This course complements traditional disciplines such as history, economics, and political science and should be of particular interest to prospective teachers.
CR: Environmental Science 2360
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Earth Sciences.

2917 Gems: The Science and Politics introduces students to precious and semi-precious stones both from the perspective of their nature and origin and from the perspectives of geography and the socio-political issues of mining, recovery, trade and cartels. The properties that confer value upon gems (colour, clarity, cut and carat), the techniques used to enhance, fake and imitate gems and the techniques used to detect fraudulent “gems” will be covered. The course will include discussion of the diamond industry in Canada and consideration of some famous gems. This course is designed for students taking Earth Sciences as an elective subject. This course complements traditional disciplines such as history, economics, and political science and should be of particular interest to teachers.
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Earth Sciences.

2918 Earth's Story is an overview of Earth's dynamic past of episodes of supercontinent collision and breakup, massive flooding, global warming and freezing, magnetic field reversals and continents travelling over large distances. The evolution of life is tied to this history and has had equally dramatic turns of rich growth and catastrophic extinction. Discussion will be based on Canadian geology and includes an introduction to techniques used to decipher the rock record.
UL: not acceptable as one of the required courses for the Minor, Major or Honours programs in Earth Sciences.

2919 Introduction to Marine Geology (same as Ocean Sciences 2200) is a study of the formation and evolution of oceans, including plate tectonics, mid-ocean ridges (birth place of oceans), subduction zones (where oceans are consumed), sedimentary environments such as estuaries, deltas, beaches and barrier islands, continental shelves, slopes and deep abyssal plains and special topics, including anoxic events, evolution of tides, atmosphere-ocean interactions, formation of banded iron formations, snowball Earth, black and white smokers, and how Earth modulates its climate through atmosphere, hydrosphere, biosphere and lithosphere interactions.
CR: Ocean Sciences 2200
PR: EASC 1000 with a grade of at least 55%

11.5.3 Third Year

3030 Mineralogy and Materials Science provides a review of elementary crystallography, introduction to space groups and crystal structures, bonding, properties of metals, semiconductors and insulators, crystallographic aspects of order-disorder, solid solution and mixing. Crystal growth, chemical zoning and diffusion. Phase changes in the solid state (exsolution, polymorphism and polytypism). Students will be introduced to the techniques used to study solids (X-ray diffraction, scanning and transmission electron microscopy, electron-microprobe analysis, luminescence, and computer simulation). Laboratory work will emphasize practical skills using these techniques. Examples will be chosen from among minerals, ceramics, semiconductors, metals and glass, making the course suitable for Earth Scientists, Engineers, Chemists and Physicists.
LH: 3
PR: EASC 2031 or permission of the instructor

3054 High-Temperature Geochemistry and Igneous Petrology is an integrated course dealing with the geochemistry, origin and classification of igneous rocks. Topics include trace element geochemistry; physical properties of magmas, physical and chemical processes in magma chambers (fractional crystallization, differentiation, assimilation and partial melting), phase equilibria and application to magmas, petrology of the mantle, and igneous rocks of specific tectonic settings (oceanic lithosphere, continental margins, continental lithosphere). Laboratories include geochemical calculations and examination of rock samples and thin sections.
CR: the former EASC 3053 in combination with the former 2503
LH: 3
PR: EASC 2031 and 2502

3055 Thermodynamics and Metamorphic Petrology is an integrated course dealing with the geochemistry, origin and classification of metamorphic rocks. Topics include thermodynamic background and kinetics (transfer of mass and energy in geochemical systems of the Earth's interior, thermodynamic laws, phase equilibria, solid-solid reactions, reaction rates); metamorphic facies, field gradients, isograds and reactions; mineral assemblages and textures of common metamorphic rocks. Laboratories include thermodynamic and phase diagram problems, hand specimen and thin section studies.
CR: the former EASC 3053 in combination with the former 2503
LH: 3
PR: EASC 2031 and 2502, Mathematics 1001

3170 Seismic and Potential Fields Methods in Geophysics examines fundamentals of seismic energy transmission in the Earth; basic methods in seismic exploration - data acquisition, processing and interpretation for refraction and reflection surveys; fundamentals of gravity and magnetic data acquisition, processing and interpretation; introduction to gravity and magnetic modelling.
LH: 3
PR: Physics 1051 (or 1021 or the former 1054); Mathematics 1001; Mathematics 2000 or Statistics 2550 or the former Statistics 2510; EASC 2905 or permission of the Head of the Department for students following a Minor in Earth Sciences or a Major in Environmental Physics

3172 Electric and Electromagnetic Methods in Geophysics is an introduction to electrical and electromagnetic methods in geophysics applied in mineral exploration, petroleum well logging and environmental studies, and examples of application of various techniques; use of data processing and modelling techniques in interpretation; introduction to radiometric methods used in mineral and petroleum exploration. The laboratory component involves outdoor surveys using geophysical equipment, and computer-based presentation and analysis of collected data using modern geophysical software.
AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.
CO: EASC 2905 or permission of the Head of the Department
LH: 3
PR: Physics 1051 (or 1021 or the former 1054); Mathematics 1001; Mathematics 2000 or Statistics 2550 or the former Statistics 2510; EASC 2905 or permission of the Head of the Department for students following a Minor in Earth Sciences or a Major in Environmental Physics

3179 Mathematical Methods for Geophysics covers subjects required for quantitative analysis of geophysical phenomena. Vector calculus with emphasis on integral theorems is covered in the context of Maxwell's equations; Derivations and solutions of ordinary and partial differential equations with emphasis on hyperbolic, parabolic and elliptic equations in the context of the wave, heat, and potential-field equations, respectively; tensor algebra and analysis in the context of theory of elasticity and electromagnetism; Fourier analysis as a tool for solution of differential equations and signal analysis. The course may also include such topics as the calculus of variations, curvilinear coordinates on differentiable manifolds, differentiation in the sense of distributions.
LH: 3
PR: Mathematics 2000, Physics 2055 and 2820

3210 Economic Mineral Deposits is an introduction to the study of mineral deposits and definition of the basic physio-chemical parameters of ore deposit formation. The course involves a systematic review of genetic models for the principal types of metallic mineral deposits, and links these models to a common theme of the relationship between lithosphere-hydrosphere-biosphere interactions and metallogeny. Laboratory exercises involve examination of representative suites of samples from different types of metallic mineral deposits and provide an introduction to the use of reflected light microscopy.
LH: 3
PR: either EASC 2031, 2502 and 2905; or EASC 2031 and Chemistry 3211; or Engineering 3610 and the former Engineering 3205

3420 Global Tectonic Processes examines how horizontal and vertical motions of the Earth’s surface are influenced by heat and mass transfer within its interior. Surface motions are described qualitatively and quantitatively within the framework of plate tectonics, and used to identify major controls on the igneous, metamorphic and sedimentary rock records. Laboratory exercises emphasize geologic and geophysical applications of the material developed in lectures.
CR: the former EASC 2070, 2161, 2400 and 4901

LH: 3
PR: EASC 2031, 2401, 2502, 2702, Mathematics 1000 and 1001, Physics 1021 or 1051

3600 Environmental Geology examines the application of basic concepts and fundamental principles of geochemistry in evaluating natural and human-induced change through time on the interaction of the Earth's lithosphere, hydrosphere, atmosphere and biosphere; includes the effects of contaminants on global change. Laboratory time will be used for short field-based studies and for exercises examining the effects of contaminants on global change.
LH: 3
PR: either EASC 2502; or EASC 1000, Chemistry 2210 and the former CHEM 2300

3610 Hydrogeology (same as the former EASC 4610) examines geology and its relationship to groundwater occurrence and exploitation: basic theory, groundwater flow systems, surface-groundwater interactions and changes in water quality, field and laboratory techniques, hydrogeological aspects of waste disposal and resource development.
CR: Environmental Science 4479, the former EASC 4610
LH: 3
PR: Physics 1051 (or 1021); Mathematics 2000 or Statistics 2550 or the former Statistics 2510; EASC 2502

3611 Engineering Geology - inactive course.

3700 Geomorphology (same as Geography 3150) is a study of the relationships between geomorphic processes and landforms. Practical work will involve collection of data and samples in the field and analytical laboratory techniques.
CR: Geography 3150
LH: 3
PR: EASC 2905 or Geography 2102; Mathematics 1000

3702 Lithification, Diagenesis and Sedimentary Rock Properties provides a conceptual and practical overview of the transformation of sediments into sedimentary rocks through compaction, cementation and mineral reactions, and the resultant modifications of rock composition, rock fabrics, and associated porous media characteristics (e.g. porosity). Both descriptive and analytical methods are integrated in laboratories that include carbonate and sandstone petrology (hand samples and thin sections), geological analysis of selected wireline logs, and the analysis of fluid reservoir properties.
LH: 3
PR: EASC 2031, 2702 and 2905

3705 Field Course in Sedimentology, Reservoir Architecture and Sequence Stratigraphy is a ten day field and lecture based course normally offered in the first two weeks of the Spring semester that aims to teach students to use sedimentological and palaeontological data for palaeoenvironmental analysis. The course will demonstrate the use of sedimentary facies models and facies architectural studies in reservoir geology, particularly when coupled with the principles of sequence stratigraphy. Students will be taught to create sedimentary logs and facies architectural panels.
CO: EASC 3811, 3905
CR: the former EASC 4700 or the former Geology 4700
OR: field based course
PR: EASC 2702, 3811, 3905

3811 Paleontology (same as Biology 3811) outlines the major changes in life forms from Archean times through the Phanerozoic to the present day, including details of invertebrate and vertebrate faunas and major floral groups; mechanisms and effects of mega- and micro-evolution in the fossil record; biology and classification of organisms and summaries of their geological significance in biostratigraphy, paleoecology and rock-building; relationships between major cycles of evolution and extinction to global processes.
CR: Biology 3811 or either the former EASC 3801 or the former Biology 3800
LH: 3
PR: either Biology 2120 (or Biology 1001 and 1002) and EASC 1002; or Biology 2122 and 2210

3905 Field Methods in Structural Geology and Stratigraphy is based on approximately 5 days of geological mapping in Precambrian rocks near St. John's. Emphasis is placed on application of techniques of structural analysis. Evenings will be dedicated to data analysis and preparation of structural maps and sections. Students are advised to complete this course immediately following EASC 2401. This course will be offered during a special session immediately following the examination period in a given semester.
AR: attendance for all of the field school days is required. Failure to attend may result in a failing grade or withdrawal from the course.
CH: 1
OR: field based course
PR: EASC 2401 and 2905 and an application to the Head of the Department

11.5.4 Fourth Year

4053 Petrogenesis of Igneous Rocks investigates the origin of topical and important groups of igneous rocks based on experimental petrology, phase equilibria and application of geochemical tools. It further investigates the classification of igneous rocks, including the study of volcaniclastic rocks and aspects of physical volcanology. The laboratory component of the course emphasizes practical aspects of igneous petrology including geochemical characterization and use of hand-sample and field criteria.
LH: 3
PR: EASC 3054 and 3420

4054 Metamorphic Petrology examines relationships between metamorphism and tectonics, representation and interpretation of metamorphic mineral assemblages using compositional phase diagrams and petrogenetic grids; equilibrium thermodynamics and thermobarometry; determination of P-T-t paths. Laboratories include use of the electron microprobe to collect data for use in calculations of the conditions of formation of metamorphic assemblages, and various types of software applicable to metamorphic petrology.
LH: 3
PR: EASC 2401, 3055 and 3420

4105 Field Course in Applied Geophysics is a field based course with an emphasis on environmental and mineral exploration applications. It consists of a data collection module normally offered during a special session immediately before the Fall semester, followed by a processing and interpretation module during the first part of the Fall semester. Field techniques used may include ground probing radar, refraction seismology, magnetic surveying, gravimetry, electrical and electro-magnetic methods. For computer based processing, students make use of modern mapping and geophysical software.
AR: attendance required
OR: field-based course
PR: EASC 3170, 3172 and Mathematics 2000

4171 Advanced Seismology examines techniques involved in the acquisition, processing and interpretation of multichannel seismic reflection data. Introduction to elastic properties of rocks. Introduction to advanced processing and interpretation techniques as applied to qualitative and quantitative evaluation of hydrocarbon reservoir characteristics. This course has a laboratory component designed to provide hands-on experience with data processing and interpretation.
LH: 3
PR: EASC 3170 and 4179

4173 Advanced Electrical, Electromagnetic and Potential Fields Methods examines advanced techniques in electrical and electromagnetic exploration methods including advanced IP, airborne EM surveys, EM and IP modelling, and inversion techniques; advanced methods in gravity and magnetic field exploration techniques including 2 ½-D and 3-D modelling and inversion, map processing techniques, and excess mass determination.
LH: 3
PR: EASC 3170, 3172, 4179, and Physics 2820

4179 Digital Signal Processing is an introduction to the theory and basic computational techniques of digital signal processing in geophysics. Topics covered include: sampling, Fourier transformation, design and application of digital filters, deconvolution, spectral analysis, two dimensional signal processing, with emphasis on geophysical applications.
LH: 3
PR: EASC 3170, 3172, 3179, and Physics 2820

4211 Economic Geology provides a detailed look at the methodologies and techniques used in the study of mineral deposits and their applications in case histories. Laboratory exercises involve solving problem sets using the various types of data from selected case studies.
LH: 3
PR: EASC 3054 or 3055; and 3210

4302 Advanced Marine Geology examines the geology and geophysics of ocean basins; discussion of methods of oceanic exploration, the history and development of ocean basins, interrelationships between ocean water, marine organisms, sedimentary and igneous processes.
PR: EASC 1001 or 1002 and completion of any 15 credit hours in core courses at the 3000 and/or 4000 levels (see General Note 5) in Biology, Biochemistry, Chemistry, Earth Sciences, Physics, or Geography.

4310 Earth Science Concepts, Materials and Techniques for Archaeologists - inactive course.

4400 Advanced Techniques in Structural Geology examines modern techniques of structural analysis applied to fold and fault systems including progressive deformation and strain analysis, fold mechanisms, fold morphology and classification, fold sections and profiles, superposed folding, fault geometry and morphology, brittle and ductile shear zones, and construction of balanced cross-sections.
LH: 3
PR: EASC 2401 and 3905 and a minimum of 6 credit hours in Earth

Sciences at the 3000 level

4405 Field Course on the Geology of Newfoundland is a field-based course consisting of in-class lectures and student seminars, and a week-long field trip within the island of Newfoundland. The classroom portion of the course may be offered in an accelerated format. The course provides an introduction to the geological history and tectonic development of Newfoundland. The field portion of the course will normally be offered during a special session either preceding or following any given semester.
OR: lecture and field-based course
PR: 15 credit hours in Earth Sciences at the 3000 and/or 4000 levels including EASC 3420, and permission of the instructor

4420 Tectonics and Crustal Evolution is a lecture and seminar course covering secular change and tectonic evolution in Earth history from the Archean to Mesozoic, featuring examples from the North American geological record. The course will draw on and link concepts from a variety of Earth Science disciplines and provide an overview of the geological evolution of North America in a tectonic context.
CR: the former EASC 4901
OR: seminar
PR: EASC 3420

4502 Advanced Geochemistry focuses primarily on the application of trace, radiogenic and stable isotope geochemistry to constrain the origin, mass balance and chemical fluxes within the Earth's lithosphere and asthenosphere. The course permits students to complete assignments in aspects of geochemistry that reflect their career interests.
LH: 3
PR: EASC 2031 and 2502 and a minimum of 6 credit hours in Earth Sciences at the 3000 level

4503 Mineral Exploration Geochemistry is an examination of the application of geochemistry to mineral exploration, covering: the lithogeochemical characteristics of ore deposits, their host rocks, and element dispersion from them; the principles of sampling and analysis in exploration geochemistry; approaches to the statistical analysis, graphical presentation, and interpretation of survey results; and the design of effective geochemical surveys. Particular emphasis will be placed on case studies relevant to exploration in Newfoundland and Labrador. Laboratory/seminar sessions involve working with exemplary data sets, using computer-based software for statistical analysis and software for searching large databases and viewing the spatial relationships of different types of map data relevant to the mineral exploration industry.
LH: 3
OR: seminar
PR: EASC 3210

4601 Petroleum Origin and Occurrence - inactive course.

4605 Environmental Geoscience Field School is a field-based course normally offered during a special session immediately before the Fall semester followed by laboratory analytical work during the Fall semester. The aim of this course is to investigate anthropogenic impacts on the environment using geochemical, hydrological, and microbial methods. Emphasis is placed on site investigation, sample collection and preparation techniques, instrumental analysis, and data analyses.
AR: attendance required
OR: field-based course
PR: EASC 2502, EASC 3600, Mathematics 1001, and one of Mathematics 2000, Statistics 2550, or the former Statistics 2510

4620 Contaminant Hydrogeology examines the physical and chemical processes controlling groundwater contamination. Methods for numerical modeling of groundwater flow and contaminant transport are discussed. Students gain hands-on experience in using computer software packages to solve practical problems.
LH: 3
PR: EASC 3610 (or the former EASC 4610) or Environmental Science 4479 or permission of instructor

4702 Sedimentary Basins and Hydrocarbon Exploration (same as the former EASC 4602) provides a review of sedimentary basin types and associated petroleum systems including concepts applicable to petroleum generation, migration and accumulation. Regional-scale stratigraphic and structural concepts/models are presented as a framework for hydrocarbon fluid flow and entrapment. Laboratories include description and analysis of data typical of basin- and regional-scale exploration and appraisal of hydrocarbon resources using a variety of integrated, interdisciplinary techniques (geological, geophysical and geochemical).
CR: EASC 4601 and the former EASC 4602
LH: 3
PR: EASC 2401, 2702, 3170 and 3420

4703 Environmental Change and Quaternary Geography (same as Archaeology 4150 and Geography 4150) covers methods of reconstructing Quaternary environments; effects of Quaternary environmental change on landforms, with special reference to North America; development and characteristics of glacial and non-glacial climates.
CR: Archaeology 4150, Geography 4150
LH: 3
PR: 6 credit hours in Earth Sciences or Physical Geography courses at the 3000-level; or permission of the instructor

4704 Reservoir Characterization (same as the former EASC 4603) provides a review of the sedimentary, stratigraphic and structural setting of hydrocarbon reservoirs and the geological controls on reservoir quality. Reservoir types and methods of study are presented to evaluate their key properties for the development and production of hydrocarbons. Laboratories include detailed subsurface correlation and mapping, log analysis, interpretation of reservoir data (e.g. capillary pressure, porosity, permeability and production data).
CR: EASC 4601 and the former EASC 4603
LH: 3
PR: EASC 2401, 2702, 3170 and 3702

4720 Carbonate Depositional Environments and Diagenesis examines carbonate environments and their facies models with examples from modern and ancient settings. Diagenetic environments and diagenetic controls on rock properties, particularly porosity, are examined, as well as their application in the reconstruction of the diagenetic history of a sedimentary basin and in the characterization of hydrocarbon reservoirs. The application of chemostratigraphy to correlation is discussed. The laboratory exercises apply hand specimen, thin section and geochemical methods to investigate carbonates from different depositional settings and a wide spectrum of diagenetic environments covered in lectures
CO: EASC 3811
LH: 3
PR: EASC 2031, 2702, and 3811

4800 Advanced Paleontology (same as Biology 4800) is a field, lecture, laboratory and seminar course dealing with selected topics in general and applied paleontology. Topics include measuring evolution and extinction, population paleontology, functional morphology, paleoecology, statistical methods for paleontological studies, and applications in petroleum, mining, and environmental studies.
CR: Biology 4800
LH: 3
PR: EASC 3811, and Statistics 2550 or the former Statistics 2510 or Mathematics 2000

4902 Early Evolution of the Earth - inactive course.

4903 Global Change is a lecture and seminar course that studies the interaction of the atmosphere, biosphere and lithosphere; topics covered include the evolution of the biosphere, fluid circulation, global geochemical budget, global environmental changes, and chemical evolution of the hydrosphere.
OR: seminar
PR: EASC 1001 or 1002, and Biology 2120 (or Biology 1001 and 1002); and completion of any 15 credit hours in core courses at the 3000 and/or 4000 levels (see General Note 5) in Biology, Biochemistry, Chemistry, Earth Sciences, or Physics; or permission of the instructor.

4905 Field Course in Geological Mapping and Regional Tectonics is a two-week field school designed to allow application of techniques introduced in the third year, and to provide an introduction to the Appalachian geology of western and central Newfoundland. Reports must be submitted for grading during the fall semester.
OR: field based course
PR: EASC 2401, 3055, 3420, and 3905; and permission of the Head of the Department

4912 Planetary Geology is a classroom- and laboratory-based course that provides students with a basic knowledge of the geology of the Moon, Mars, asteroids and the moons of the satellites of the outer solar system; the petrology and geochemistry of meteorites and their importance to understanding the origin of the planets; impact cratering processes and rock products including those on Earth; and instrumentation for planetary exploration. The course combines lectures and laboratory exercises that examine data sets from planetary missions and specimens of extraterrestrial materials. Students learn how geological processes that have shaped Earth also have operated on other planets, moons and asteroids in our solar system.
PR: EASC 2031, 2702, 2905, and 3420

4910-4920 (Excluding 4912) Special Topics in Earth Sciences are lecture and seminar courses given for undergraduates in their fourth or fifth year who wish to gain more specialized knowledge in a particular field of Earth Sciences than is possible through the standard course offerings. The Department will consider suggestions by students for Special Topics courses, but it must be borne in mind that such a course should normally be approved at least three months before the start of the semester in which it is to be taken.
PR: permission of the Head of Department

4950 Technical Report on Geoscience Employment requires the preparation of a publication-quality technical report, about 50 pages in length, based on a study undertaken during geoscience employment. The topic and scope of the study must be approved by the Head of Department

prior to its commencement. Students will present a seminar or seminars on results of the project, and will be closely advised on proper organization and writing of scientific reports. Some directed reading will be required.
PR: completion of 9 credit hours in Earth Sciences at 3000 level, and permission of the Head of Department
UL: can only be used as an "additional course" under point 3. of the regulations for General degrees, and under point 4. of the regulations for Honours degrees. The same study cannot be used as the basis of a dissertation completed for course EASC 499A/B.

499A and 499B Dissertation is an independent study of an approved problem in the Earth Sciences. The subject of study will be decided in consultation with Faculty Advisors and must be approved in advance by the Head of Department. The first semester will normally involve directed reading, supervised field and/or laboratory work, and preparation of a dissertation outline and draft of a first chapter of the thesis. The second semester will be devoted to data synthesis and interpretation, to a seminar presenting the thesis results, and to preparation of a formal written report accompanied by appropriate illustrations, to be submitted for grading one week before the end of classes.
CH: 6
PR: admission to the Honours program
UL: The dissertation cannot be based on the same study used to obtain credit for EASC 4950. May be used as Science credits by students not int the Honours program with permission of the Head of the Department.

11.6 Economics

For course descriptions, see **Faculty of Humanities and Social Sciences** section of the Calendar.

11.7 Geography

For course descriptions, see **Faculty of Humanities and Social Sciences** section of the Calendar.

11.8 Mathematics and Statistics

Students are encouraged to consult the Department regularly for specific planned offerings, semester by semester.

Placement in first-year mathematics courses at the St. John's Campus and online is based upon a student's pre-requisite level of proficiency in mathematics as demonstrated in a manner that is acceptable to the Department of Mathematics and Statistics. This may be through credit and grades earned in recognized high school or undergraduate mathematics courses or scores earned in the University's Mathematics Placement Test (MPT) or recognized standardized examinations such as International Baccalaureate (IB), Advanced Placement (AP), or the College Board's Subject Area Test in Mathematics Level I (SATM1) examinations.

For detailed information regarding mathematics pre-requisites and placement requirements, see the course descriptions below and refer to the mathematics and calculus placement information provided by the Department of Mathematics and Statistics at www.mun.ca/math. Students registering for first year mathematics courses at the Grenfell Campus should consult **Grenfell Campus, Course Descriptions, Mathematics and Statistics** for placement information.

11.8.1 Mathematics Courses

Pure and applied Mathematics courses are designated by MATH. Where the 4 digit course number is the same, students can receive credit for only one course with subject names MATH, AMAT, PMAT, STAT.

1000 Calculus I is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.
CR: the former MATH 1081
LC: 4
PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department
UL: at most 9 credit hours in Mathematics will be given for courses completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151

1001 Calculus II is an introduction to integral calculus, including Riemann sums, techniques of integration and improper integrals. Applications include exponential growth and decay, areas between curves and volumes of solids of revolution.
PR: MATH 1000 or the former MATH 1081

1031 Mathematical Problem Solving - inactive course.

1050 Finite Mathematics I covers topics which include sets, logic, permutations, combinations and elementary probability.
CR: MATH 1052 and MATH 1053
LC: 4
PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F
UL: At most 9 credit hours in Mathematics will be given for courses completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

1051 Finite Mathematics II covers topics which include elementary matrices, linear programming, elementary number theory, mathematical systems, and geometry.
CR: MATH 1052 and MATH 1053
LC: 4
PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F
UL: At most 9 credit hours in Mathematics will be given for courses completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

1090 Algebra and Trigonometry provides students with the essential prerequisite elements for the study of an introductory course in calculus. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.
CR: if previously completed or currently registered for MATH 1000, 1001, 109A/B, the former 1080, or the former 1081
LC: 4
PR: a combination of placement test and high school Mathematics scores acceptable to the Department, or the former MATH 103F
UL: at most 9 credit hours in Mathematics will be given for courses completed from the following list subject to normal credit restrictions: Mathematics 1000, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151

109A and 109B Introductory Algebra and Trigonometry is a two-semester course which provides students with the essential prerequisite elements for the study of an introductory course in calculus, at a slower pace than MATH 1090. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.
CR: if previously completed or currently registered for MATH 1000, 1001, 1090, the former 1080, or the former 1081
LC: 4
PR: a combination of placement test and high school Mathematics scores acceptable to the Department

2000 Calculus III is an introduction to infinite sequences and series, and to the differential and integral calculus of multivariate functions. Topics include tests for the convergence of infinite series, power series, Taylor and Maclaurin series, complex numbers including Euler's formula, partial differentiation, and double integrals in Cartesian and polar coordinates.
PR: MATH 1001

2050 Linear Algebra I includes the topics: Euclidean n-space, vector operations in 2- and 3-space, complex numbers, linear transformations on n-space, matrices, determinants, and systems of linear equations.
PR: A combination of placement test and high school Mathematics scores acceptable to the Department or 3 credit hours in first year Mathematics courses

2051 Linear Algebra II includes the topics: real and complex vector spaces, basis, dimension, change of basis, eigenvectors, inner products, and diagonalization of Hermitian matrices.
PR: MATH 1000 and 2050

2075 Introduction to the History of Mathematics - inactive course.

2090 Mathematics of Finance covers the topics: simple and compound interest and discount, forces of interest and discount, equations of value, annuities and perpetuities, amortization schedules and sinking funds, bonds and other securities, contingent payments.
PR: MATH 1001

2091 Introduction to Actuarial Mathematics - inactive course.

2130 Technical Writing in Mathematics is a project oriented course combining mathematical investigation and technical writing. By using computer programming, graphical and typesetting tools, students will explore mathematical concepts and will produce technical reports of professional quality. The latter will combine elements of writing and graphics to convey technical ideas in a clear and concise manner.
PR: admission to Applied or Pure Mathematics major and MATH 1001 and (Computer Science 1510 or 1001 or 2001; or permission of the Head of Department)

2260 Ordinary Differential Equations I examines direction fields, equations of first order and first degree, higher order linear equations, variation of parameters, methods of undetermined coefficients, Laplace transforms, systems of differential equations. Applications include vibratory motion, satellite and rocket motion, pursuit problems, population models and chemical kinetics.
CR: the former MATH 3260
PR: MATH 2000

2320 Discrete Mathematics covers basic concepts of mathematical reasoning, sets and set operations, functions, relations including equivalence relations and partial orders as illustrated through the notions of congruence and divisibility of integers, mathematical induction, principles of counting, permutations, combinations and the Binomial Theorem.
CR: the former Computer Science 2740 or the former Engineering 3422 or Engineering 4424
PR: MATH 1001 or 2050

2330 Euclidean Geometry is an introduction to Euclidean geometry of the plane. It covers the geometry of triangles and circles, including results such as the Euler line, the nine-point circle and Ceva's theorem. It also includes straight-edge and compass constructions, isometries of the plane, the three reflections theorem, and inversions on circles.
CR: the former MATH 3330
PR: MATH 2051 or 2320

3000 Real Analysis I covers proof techniques, structure of the real numbers, sequences, limits, continuity, uniform continuity, differentiation.
CR: the former MATH 2001
LH: 1.5
PR: MATH 2000

3001 Real Analysis II examines Infinite series of constants, sequences and series of functions, uniform convergence and its consequences, power series, Taylor series, Weierstrass Approximation Theorem.
CR: the former MATH 3201
LH: 1
PR: MATH 3000

3100 Introduction to Dynamical Systems examines flows, stability, phase plane analysis, limit cycles, bifurcations, chaos, attractors, maps, fractals. Applications throughout.
CR: the former AMAT 3190
PR: MATH 2260 (or the former MATH 3260)

3111 Applied Complex Analysis examines mapping by elementary functions, conformal mapping, applications of conformal mapping, Schwartz-Christoffel transformation, Poisson integral formula, poles and zeros, Laplace transforms and stability of systems, analytic continuation.
PR: MATH 3210

3132 Numerical Analysis I includes a discussion of round-off error, the solution of linear systems, iterative methods for nonlinear equations, interpolation and polynomial approximation, least squares approximation, fast Fourier transform, numerical differentiation and integration, and numerical methods for initial value problems.
CR: Computer Science 3731
LH: 1.5
PR: MATH 2000, MATH 2050, and a computing course (Computer Science 1510 is recommended)

3161 Ordinary Differential Equations II examines power series solutions, method of Frobenius, Bessel functions, Legendre polynomials and others from classical Physics, systems of linear first order equations, fundamental matrix solution, existence and uniqueness of solutions, and advanced topics in ordinary differential equations.
PR: MATH 2260 (or the former MATH 3260) and 3202

3202 Vector Calculus deals with functions of several variables, Lagrange multipliers, vector valued functions, directional derivatives, gradient, divergence, curl, transformations, Jacobians, inverse and implicit function theorems, multiple integration including change of variables using polar, cylindrical and spherical co-ordinates, Green's theorem, Stokes' theorem, divergence theorem, line integrals, arc length.
CR: Physics 3810
PR: MATH 2000 and 2050

3210 Introduction to Complex Analysis examines complex numbers, analytic functions of a complex variable, differentiation of complex functions and the Cauchy-Riemann equations, complex integration, Cauchy's theorem, Taylor and Laurent series, residue theory and applications.
PR: MATH 3000

3240 Applied Graph Theory examines algorithms and complexity, definitions and basic properties of graphs, Eulerian and Hamiltonian chains, shortest path problems, graph colouring, planarity, trees, network flows, with emphasis on applications including scheduling problems, tournaments, and facilities design.
CR: the former Computer Science 2741
PR: MATH 2320

3300 Set Theory is an introduction to Mathematical Logic, functions, equivalence relations, equipotence of sets, finite and infinite sets, countable and uncountable sets, Cantor's Theorem, Schroeder-Bernstein Theorem, ordered sets, introduction to cardinal and ordinal numbers, logical paradoxes, the axiom of choice.
PR: MATH 2320

3303 Introductory Geometric Topology covers graphs and the four colour problem, orientable and non-orientable surfaces, triangulation, Euler characteristic, classification and colouring of compact surfaces, basic point-set topology, the fundamental group, including the fundamental groups of surfaces, knots, and the Wirtinger presentation of the knot group.
PR: MATH 2320

3320 Abstract Algebra is an introduction to groups and group homomorphisms including cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, introduction to rings and ring homomorphisms including ideals, prime and maximal ideals, quotient rings, integral domains and fields.
PR: MATH 2320

3321 Applied Algebra - inactive course.

3331 Projective Geometry includes course topics: projective space, the principle of duality, mappings in projective space, conics and quadrics.
PR: MATH 2051

3340 Introductory Combinatorics includes topics: distributions, the binomial and multinomial theorems, Stirling numbers, recurrence relations, generating functions and the inclusion-exclusion principle. Emphasis will be on applications.
PR: MATH 2320

3370 Introductory Number Theory examines perfect numbers and primes, divisibility, Euclidean algorithm, greatest common divisors, primes and the unique factorization theorem, congruences, cryptography (secrecy systems), Euler-Fermat theorems, power residues, primitive roots, arithmetic functions, Diophantine equations, topics above in the setting of the Gaussian integers.
PR: MATH 2320

4000 Lebesgue Integration includes a review of the Riemann integral, functions of bounded variation, null sets and Lebesgue measure, the Cantor set, measurable sets and functions, the Lebesgue integral in R1 and R2, Fatou's lemma, Monotone and Dominated Convergence Theorems, Fubini's Theorem, an introduction to Lebesgue-Stieltjes measure and integration.
CR: the former Pure Mathematics 4400
PR: MATH 3001

4001 Functional Analysis includes metric and normed spaces, completeness, examples of Banach spaces and complete metric spaces, bounded linear operators and their spectra, bounded linear functionals and conjugate spaces, the fundamental theorems for Banach spaces including the Hahn–Banach Theorem, topology including weak and weak* topologies, introduction to Hilbert spaces.
CR: the former Pure Mathematics 4302
PR: MATH 3001

4100 Applied Functional Analysis - inactive course.

4102 Stochastic Methods in Applied Mathematics - inactive course.

4130 Introduction to General Relativity (same as Physics 4220) studies both the mathematical structure and physical content of Einstein's theory of gravity. Topics include the geometric formulation of special relativity, curved spacetimes, metrics, geodesics, causal structure, gravity as spacetime curvature, the weak-field limit, geometry outside a spherical star, Schwarzschild and Kerr black holes, Robertson-Walker cosmologies, gravitational waves, an instruction to tensor calculus, Einstein's equations, and the stress-energy tensor.
CO: MATH 4230
CR: Physics 4220
PR: MATH 3202 and one of Physics 3220 or MATH 4230 or permission of

the Head of Department.

4131 Numerical Linear Algebra - inactive course.

4132 Introduction to Optimization - inactive course.

4133 Numerical Optimization - inactive course.

4140 Introduction to Mathematical Control Theory - inactive course.

4160 Partial Differential Equations I covers two point boundary value problems, Fourier series, Sturm-Liouville theory, canonical forms, classification and solution of linear second order partial differential equations in two independent variables, separation of variable, integral transform methods.
PR: MATH 2260 (or the former MATH 3260) and 3202

4161 Integral Equations - inactive course.

4162 Numerical Methods for Differential Equations covers numerical solution of initial value problems for ordinary differential equations by single and multi-step methods, Runge-Kutta, and predictor-corrector; numerical solution of boundary value problems for ordinary differential equations by shooting methods, finite differences and spectral methods; numerical solution of partial differential equations by the method of lines, finite differences, finite volumes and finite elements.
PR: MATH 3132 and 4160

4170 Partial Differential Equations II covers first order equations, Cauchy problems, Cauchy-Kowalewska theorem, second order equations, canonical forms, wave equations in higher dimensions, method of spherical means, Duhamel's principle, potential equation, Dirichlet and Neuman problem, Green's function and fundamental solution, potential theory, heat equation, Riemann's method of integration, method of plane and Riemann waves for systems of PDEs of the first order.
PR: MATH 4160

4180 Introduction to Fluid Dynamics (same as Physics 4205) covers basic observations, mass conservation, vorticity, stress, hydrostatics, rate of strain, momentum conservation (Navier-Stokes equation), simple viscous and inviscid flows, Reynolds number, boundary layers, Bernoulli's and Kelvin's theorems, potential flows, water waves, thermodynamics.
CR: Physics 4205
PR: Physics 3220 and either MATH 4160 or the former Physics 3821

4190 Mathematical Modelling is intended to develop students' skills in mathematical modelling and competence in oral and written presentations. Case studies in modelling will be analysed. Students will develop a mathematical model and present it in both oral and report form.
PR: MATH 3100, 3161, 4160, and a technical writing course offered by a Science department (MATH 2130 is recommended).

419A and 419B Applied Mathematics Honours Project is a two-semester course that requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Applied Mathematics. In addition to a written project, a one hour presentation will be given by the student at the end of the second semester.
CH: 6
CR: the former AMAT 4199
PR: registration in an Honours or Joint Honours program in Applied Mathematics.

4230 Differential Geometry covers both classical and modern differential geometry. It begins with the classical theory of curves and surfaces, including the Frenet-Serret relations, the fundamental theorem of space curves, curves on surfaces, the metric, the extrinsic curvature operator and Gaussian curvature. The modern section studies differentiable manifolds, tangent vectors as directional derivatives, one-forms and other tensors, the metric tensor, geodesics, connections and parallel transport, Riemann curvature and the Gauss-Codazzi equations.
PR: MATH 3202

4240 Differential and Integral Calculus on Manifolds - inactive course.

4252 Quantum Information and Computing (same as Physics 4852) covers postulates of quantum mechanics, matrix theory, density matrices, qubits, qubit registers, entanglement, quantum gates, superdense coding, quantum teleportation, quantum algorithms, open systems, decoherence, physical realization of quantum computers.
CR: Physics 4852
PR: MATH 2051 or Physics 3820

4280-4290 Special Topics in Pure and Applied Mathematics will have the topics to be studied announced by the Department. Consult the Department for a list of titles and information regarding availability.
PR: permission of the Head of the Department

4300 General Topology is an introduction to point-set topology, centering around the notions of the topological space and the continuous function. Topological properties such as Hausdorff, compactness, connectedness, normality, regularity and path-connectedness are examined, as are Urysohn's metrization theorem and the Tychonoff theorem.
PR: MATH 3300 or both MATH 3000 and 3303

4301 Algebraic Topology - inactive course.

4310 Complex Function Theory examines topology of **C**, analytic functions, Cauchy's theorem with proof, Cauchy integral formula, singularities, argument principle, Rouche's theorem, maximum modulus principle, Schwarz's lemma, harmonic functions, Poisson integral formula, analytic continuation, entire functions, gamma function, Riemann-Zeta function, conformal mapping.
PR: MATH 3210

4320 Ring Theory examines factorization in integral domains, structure of finitely generated modules over a principal ideal domain with application to Abelian groups, nilpotent ideals and idempotents, chain conditions, the Wedderburn-Artin theorem.
PR: MATH 3320

4321 Group Theory examines permutation groups, Sylow theorems, normal series, solvable groups, solvability of polynomials by radicals, introduction to group representations.
PR: MATH 3320

4331 Galois Theory - inactive course.

4340 Combinatorial Analysis continues most of the topics started in 3340 with further work on distributions, recurrence relations and generating functions. Generating functions are used to solve recurrence relations in two variables. Also included is a study of Polya's theorem with applications.
PR: MATH 2000 and 3340

4341 Combinatorial Designs includes the study of finite fields, Latin squares, finite projective planes and balanced incomplete block designs.
PR: MATH 3320 or 3340

4370 Number Theory is continued fractions, an introduction to Diophantine approximations, selected Diophantine equations, the Dirichlet product of arithmetic functions, the quadratic reciprocity law, and factorization in quadratic domains.
PR: MATH 3370

4375 History of Mathematics - inactive course.

439A and 439B Pure Mathematics Honours Project is a two-semester course that requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Pure Mathematics. Although original research by the student will not normally be expected, the student must show an ability and interest to learn and organize material independently. A one-hour presentation will be given by the student at the end of the second semester.
CH: 6
CR: the former MATH 4399
PR: registration in an Honours or Joint Honours program in Pure Mathematics

11.8.2 Statistics Courses

Statistics courses are designated by STAT. Where the 4 digit course number is the same, students can receive credit for only one course with subject names MATH, AMAT, PMAT, STAT.

1510 Statistical Thinking and Concepts examines the basic statistical issues encountered in everyday life, such as data collection (both primary and secondary), ethical issues, planning and conducting statistically-designed experiments, understanding the measurement process, data summarization, measures of central tendency and dispersion, basic concepts of probability, understanding sampling distributions, the central limit theorem based on simulations (without proof), linear regression, concepts of confidence intervals and testing of hypotheses. Statistical software will be used to demonstrate each technique.
CR: cannot receive credit for STAT 1510 if completed with, or subsequent to, STAT 2500, 2550 or the former 2510
LH: one 90 minute lab per week
PR: Mathematics 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department.

2500 Statistics for Business and Arts Students covers descriptive statistics (including histograms, stem-and-leaf plots and box plots), elementary probability, random variables, the binomial distribution, the normal distribution, sampling distribution, estimation and hypothesis testing including both one and two sample tests, paired comparisons, correlation and regression, related applications.
CR: STAT 2550, the former 2510, Psychology 2910, 2925 and the former 2900
LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory, but no prior computing experience is assumed
PR: Mathematics 1000 or 6 credit hours in first year courses in Mathematics or registration in at least semester three of a Bachelor of Nursing program or permission of the Head of Department

2501 Further Statistics for Business and Arts Students covers power calculation and sample size determination, analysis of variance, multiple regression, nonparametric statistics, time series analysis, introduction to sampling techniques.
CR: STAT 2560, Psychology 2911, 2950, and the former 2901
LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory.
PR: STAT 2500 or the former 2510

2550 Statistics for Science Students is an introduction to basic statistics methods with an emphasis on applications to the sciences. Material includes descriptive statistics, elementary probability, binomial distribution, Poisson distribution, normal distribution, sampling distribution, estimation and hypothesis testing (both one and two sample cases), chi-square test, one way analysis of variance, correlation and simple linear regression.
CR: Engineering 4421, STAT 2500, the former STAT 2510, Psychology 2910, Psychology 2925, and the former Psychology 2900
LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory, but no prior computing experience is assumed.
PR: Mathematics 1000 or the former 1081

2560 Further Statistics for Science Students (formerly STAT 2511) covers estimation and hypothesis testing in the two-sample and paired sample cases, one way and two way analysis of variance, simple and multiple linear regression, chi-square tests, non-parametric tests including sign test, Wilcoxon signed rank test and Wilcoxon rank test.
CR: STAT 2501, Psychology 2911, 2950, and the former 2901
LH: one 90 minute lab per week. Statistical computer packages will be used in the laboratory, but no prior computing experienced is assumed.
PR: STAT 1510 or 2500 or 2550 or the former 2510, Mathematics 1000 or the former 1081

3410 Probability and Statistics covers basic probability concepts, combinatorial analysis, conditional probability, independence, random variables, distribution function, mathematical expectation, Chebyshev's inequality, distribution of two random variables, binomial and related distributions, Poisson, gamma, beta, normal, multivariate normal, student t and F distributions, transformations of random variables, convergence in probability, convergence in distribution, delta-method, moment-generating function technique, central limit theorem.
OR: one and a half hour tutorial period weekly
PR: Mathematics 2000

3411 Statistical Inference I examines sampling distributions, order statistics, confidence interval, hypotheses testing, chi-square tests, maximum likelihood estimation, maximum likelihood estimation, Rao-Cramér inequality and efficiency, maximum likelihood tests, sufficiency, completeness and uniqueness, exponential class of distributions, likelihood ratio test and Neyman-Pearson lemma.
OR: one and a half hour tutorial period weekly
PR: STAT 3410

3520 Experimental Design I is an introduction to basic concepts in experimental design, including principles of experimentation; single factor designs such as completely randomized designs; randomized block designs; Latin square designs; Graeco Latin square designs; multiple comparison tests; analysis of covariance; balanced incomplete block designs; factorial designs; fixed, random and mixed effects models.
CR: Psychology 3900 and 3950
PR: Mathematics 2050 and either STAT 3411 or both Mathematics 1001 and one of STAT 2501 or 2560 or the former 2511

3521 Regression covers inferences in linear regression analysis including estimation, confidence and prediction intervals, hypotheses testing and simultaneous inference; matrix approach to regression analysis, multiple linear regression, multicollinearity, model building and selection, polynomial regression, qualitative predictor variables.
PR: Mathematics 2050 and either STAT 3411 or both Mathematics 1001 and one of STAT 2501 or 2560 or the former 2511

3540 Time Series I is an introduction to basic concepts of time series analysis such as stationarity and nonstationarity, components of time series, transformation of nonstationary series using regression, decomposition methods and differencing, autocovariance and autocorrelation functions, moving average (MA), autoregressive (AR), and ARMA representation of stationary time series including stationarity and invertibility conditions; partial autocorrelation function; properties of MA(q), AR(p) and ARMA(p, q) models, model identification, parameter estimation, model diagnostics and selection, forecasting, integrated ARMA process. Applications to real time series.
PR: either STAT 3411 or both Mathematics 1001 and one of STAT 2501 or 2560 or the former 2511

3570 Reliability and Quality Control covers an introduction to reliability, parallel and series systems, standard parametric models, estimation of reliability, quality management systems, introduction to statistical process control, simple quality control tools, process control charts for variables and attributes, process capability, cumulative sum chart, exponentially weighted moving average chart, acceptance sampling plans, measurement system analysis, continuous improvement and six sigma methodology.
PR: either STAT 3411 or both Mathematics 1001 and one of STAT 2501 or 2560 or the former 2511

3585 Computational Statistics is an introduction to modern computational statistics, using a programming language which implements S. Emphasis will be placed on the development of programs for numerical and graphical exploratory data analysis and for implementing specialized statistical procedures.
PR: Mathematics 2000, STAT 2560

4402 Stochastic Processes covers the Poisson process, renewal theory, Markov chains, and some continuous state models including Brownian motion. Applications are considered in queuing, reliability, and inventory theory. Emphasis is on model building and probabilistic reasoning.
CR: Mathematics 4102
PR: STAT 3410

4410 Statistical Inference II covers decision theory, uniformly minimum variance estimators, sufficiency and completeness, likelihood theory and maximum likelihood estimation, other estimation methods including best linear unbiased estimation, estimating equations and Bayesian estimation, hypothesis testing and interval estimation, and applications of statistical inference methods under regression models and analysis of variance models.
PR: Mathematics 2051, STAT 3411

4520 Experimental Design II is an introduction to factorial experiments including mixed effects models, unbalanced data in factorial designs, two level and three level factorial experiments, blocking and confounding in factorial designs, fractional factorial experiments, unreplicated factorial experiments, response surface designs, robust parameter designs, nested and split plot designs.
PR: STAT 3520

4530 Survey Sampling covers basic concepts, simple random sampling, unequal probability sampling and the Horvitz-Thompson principle, sufficiency, design and modelling in sampling, ratio and regression estimators, stratified and cluster sampling, methods for elusive and/or hard-to-detect populations.
PR: STAT 3411

4540 Time Series examines the analysis of time series in the time domain and is an introduction to frequency domain analysis. Topics covered include integrated ARMA processes, seasonal time series models, intervention analysis and outlier detection, transfer function models, time series regression and GARCH models, vector time series models, state space models and the Kalman Filter. Spectral decomposition of a time series is introduced. Emphasis is on applications and examples with a statistical software package.
PR: STAT 3411 and 3540

4550 Non-parametric Statistics covers inferences concerning location based on one sample, paired samples or two samples, inferences concerning scale parameters, goodness-of-fit tests, association analysis, tests for randomness.
PR: one of STAT 3520 or 3521 or STAT 3411

4560 Continuous Multivariate Analysis examines the multivariate normal distribution and its marginal and conditional distributions, distributions of non-singular and singular linear combinations, outline of the Wishart distribution and its application, in particular, to Hotelling's T-squared statistic for the mean vector, connection between likelihood ratio and Hotelling's T-squared statistics, a selection of techniques chosen from among MANOVA, multivariate regression, principal components, factor analysis, discrimination and classification, clustering.
PR: Mathematics 2051, STAT 3410 and one of STAT 3411, 3520, or 3521

4561 Categorical Data Analysis is an analysis of cross-classified categorical data with or without explanatory variables, chi-square test, measures of association, multidimensional contingency tables, hypotheses of partial and conditional independence, log-linear models for Poisson, multinomial and product-multinomial sampling schemes, concept of ordinal categorical models, logit models, likelihood estimation, selection of suitable log-linear and logit models.
PR: STAT 3520 or 3521

4581 Quantitative Methods in Biology - inactive course.

4590 Statistical Analysis of Data I examines the statistical analysis of real life univariate data using computational and statistical methods including descriptive statistics, chi-square tests, non-parametric tests, analysis of variance, linear, logistic and log-linear regressions. Other statistical techniques such as integrated autoregressive moving average modelling and forecasting or quality control methods may be introduced depending on the nature of the data.
LH: one 90 minute lab per week
PR: one of STAT 3520, 3521 or 3540

459A and 459B Statistics Honours Project is a two-semester course that

requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Statistics. In addition to a written project, a presentation will be given by the student at the end of the second semester.
CH: 6
CR: the former STAT 4599
PR: registration in an Honours or Joint Honours program in Statistics

11.9 Ocean Sciences

Ocean Sciences courses are designated by OCSC.

1000 Exploration of the World Ocean is an introductory course covering the major ocean sciences (biology, chemistry, geology, physics) at a level sufficient for science majors but accessible to non-science majors. It explores phenomena occurring from the shoreline to the abyss and from equatorial to polar regions. It also examines principles of marine ecology as well as how the marine environment affects humans and vice versa. The course is offered in a blended format that combines face-to-face lectures and online interactive activities in the form of virtual oceanographic expeditions.
LC: 1.5 hours per week
OR: 1.5 hours per week (online interactive activities)

2000 Introductory Biological Oceanography provides a general understanding of the biological processes that occur in coastal and oceanic environments. It introduces students to the major groups of bacteria, phytoplankton, invertebrates and fish, emphasizing the biotic and abiotic factors controlling primary production and marine biomass. It shows how the physical, chemical, and geological environments interact with biology to define processes and patterns affecting nutrients and life in marine ecosystems.
CR: Biology 3710
PR: OCSC 1000 and a 1000-level course in one of Biology, Chemistry, Earth Sciences or Physics

2001 Introduction to Sustainable Fisheries and Aquaculture introduces students to the breadth of aquaculture and fisheries science and the variety of animal species cultured and harvested. Basic aspects of aquaculture and fisheries and the links between the two are covered, including production systems, capture fisheries, environmental interactions, and the physiology, ecology and reproduction of finfish and shellfish in the context of their culture and harvest.
PR: OCSC 1000 or Biology 1002

2100 Introductory Chemical Oceanography (same as Chemistry 2610) provides an introduction to the fundamental chemical properties of seawater and the processes governing the concentrations of elements and compounds in the oceans. It is an introduction to the sources, distribution, and transformations of chemical constituents of the ocean, and their relation to biological, chemical, geological, and physical processes. Topics include: controls on average concentration of chemicals in the ocean; vertical and horizontal distributions of ocean constituents; air-sea interactions; production, export, and remineralization of organic matter; the ocean carbon cycle; human-induced changes; stable isotopes; and trace elements.
CR: Chemistry 2610
PR: Chemistry 1011 or 1051 which may be taken concurrently or Chemistry 1001

2200 Introductory Geological Oceanography (same as Earth Sciences 2919) is a study of the formation and evolution of oceans, including plate tectonics, mid-ocean ridges (birth place of oceans), subduction zones (where oceans are consumed), sedimentary environments such as estuaries, deltas, beaches and barrier islands, continental shelves, slopes and deep abyssal plains and special topics, including anoxic events, evolution of tides, atmosphere-ocean interactions, formation of banded iron formations, snowball Earth, black and white smokers, and how Earth modulates its climate through atmosphere, hydrosphere, biosphere and lithosphere interactions.
CR: Earth Sciences 2919
PR: Earth Sciences 1000 with a grade of at least 55%

2300 Introductory Physical Oceanography (same as Physics 2300) provides an introduction to general oceanography with a primary focus on physical oceanography. Topics include how oceans form and evolve on a planetary scale. Ocean characteristics studied include: the properties of seawater; elementary dynamics of fluids on the rotating Earth; ocean circulation; wind-forcing in the ocean; tides and waves. Contemporary methods used in oceanographic study are covered including satellite oceanography. Interactions that occur between physical and chemical processes and biological activity are reviewed.
CR: Environmental Science 2371, Physics 2300
PR: 6 credit hours in any first-year courses in Physics

2500 Introduction to Practical Ocean Sciences explores the instruments, techniques and analytical methods commonly used to study marine life and processes, chiefly focusing on the interaction between living organisms and their chemical, physical and geological environment. The course combines ship-based or shore-based sampling and data collection with laboratory investigation in an intensive 2-week long format. It is primarily intended for mid-level undergraduate students majoring in Ocean Sciences. This course will either be offered during a special session following the Winter semester, or in the Spring semester.
AR: attendance is required. Failure to attend may result in a failing grade or withdrawal from the course.
PR: Science 1807; OCSC 1000, and at least three of OCSC 2000 (or Biology 3710), 2100, 2200, 2300

3000 Aquaculture Principles and Practices emphasizes the techniques and methods used to culture finfish and shellfish, with a primary focus on Canadian aquaculture species. Basic aspects of aquaculture will be covered, including the design and maintenance of production systems, culture techniques, and the nutrition, health, physiology and reproduction of finfish and shellfish. The laboratory portion of this course will provide students with practical experience in the maintenance of land-based aquaculture production systems and in the husbandry/culture of aquatic organisms.
LH: 3
PR: OCSC 2001, or OCSC 1000 and Biology 1002

3002 Aquaculture and Fisheries Biotechnology is an introduction to biotechnology and genetics as they are applied to aquaculture and fisheries. Topics covered include genetic variation; genetic structure of fish and shellfish populations; the genetic basis of aquaculture traits; finfish and shellfish genomic research; marker-assisted selection in aquaculture; manipulation of ploidy; genetic engineering in aquaculture; and techniques used to study the responses of aquatic animals to external stressors such as hypoxia, temperature stress, acidification, and pathogens.
PR: Biology 2250 or Biochemistry 2100

3620 Aquatic Microbial Ecology (same as Biology 3620) is a study of the nature, distribution and activities of microorganisms in the freshwater and marine environments. Field and laboratory work illustrate some of the investigative techniques used in this field of study.
CR: Biology 3620 and the former Biology 3603
LH: 3
PR: Science 1807; Biology 2600 and 3050, Statistics 2550 or equivalent

3640 Environmental Physiology of Animals (same as Biology 3640) covers physiological adaptations of animals facilitating their survival in natural environments with emphasis on physiological and biochemical responses of animals to extreme environments. Starting with the fundamental basis of physiological mechanisms, the course explores various aspects and the integration of major physiological processes (metabolism, respiration, osmoregulation) and how these relate to ecological niche.
CR: the former Biology 3403 or the former Biology 4455, Biology 3640
PR: Biology 2060; Biochemistry 3106
UL: may not be used to fulfill the physiology course requirement for a Biology major, honours or joint honours program

4000 Scientific Diving Methods is an in-depth study and application of methods routinely employed for data collection in underwater scientific research. Aspects covered include habitat mapping; installation and use of instrumentation; still and video camera techniques; planning and execution of surveys and experiments in major subtidal habitats; as well as data analysis and interpretation. Participants are trained in accordance with Memorial University of Newfoundland's Guide for Diving Safety and the Canadian Association for Underwater Science (CAUS) standards to meet the criteria for Scientific Diver I rating. This course is normally offered at the Bonne Bay Marine Station in a special 2-week session at the beginning or end of the Spring semester depending on station's availability.
OR: The following documentation must be provided to the course instructor at least four months before the first day of the course. It must be in effect until at least the last day of the course. Submission of this documentation does not guarantee acceptance into the course. Aside from course prerequisites, acceptance will be based on successful completion, before the course begins, of a diving fitness and skills evaluation in a pool environment and demonstration of understanding of the MUN Diving Safety Manual, physics and physiology of diving, and use of recreational dive tables. Nationally recognized scuba diver certification with diver rescue and accident management techniques; diver medical examination by a licensed physician knowledgeable in diving medicine; First Aid (basic), CPR (basic), and DAN oxygen first aid for scuba diving injuries administration cards; DAN membership and insurance or medical insurance covering hyperbaric treatment; diver's log book with at least 12 dives in the last 12 months including one dive in the last six months and four dives in cold (<10°C) water; cold-water scuba diving equipment complete with proper hydrostatic/VIP service tags on diving cylinders and overhaul/service receipts on regulators and buoyancy compensator devices.
PR: Biology 2122 or Biology 3709, Biology 2600 or OCSC 2000 or Environmental Science 2371, Statistics 2550 or equivalent

4100 Marine Pelagic Food Webs examines the structure, function and dynamics of pelagic food webs in the marine environment. The course will focus on the material and energy flows within and among trophic levels and the interactions with major biogeochemical cycles and climate.
PR: Biology 1002 or 2120, and OCSC 2000 or Biology 3710

4122 Advanced Studies in Marine Animal Diversity (same as Biology 4122) provides an in-depth examination of cellular, physiological, behavioural and ecological adaptations in marine animals. Lectures will be combined with discussions of relevant papers from the primary literature on topics of current interest which may relate morphology, ecology, evolution, natural history, species interactions and practical applications. Students will also gain hands-on experience by designing and conducting research projects involving live or preserved animals.
CR: Biology 4122
LC: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
LH: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
PR: Science 1807; Biology 2122 and Biology 2600

4601 Functional Biology of Fish (same as Biology 4601) is an introduction to anatomical physiological and cellular processes in the life cycle of fishes.
CR: Biology 4601
PR: Biology 2060, Biology 2210 or 3202, and Biology 3401 or 3640

11.10 Physics and Physical Oceanography

Physics courses are designated by PHYS.

1020 Introductory Physics I is an algebra-based introduction to Newtonian mechanics. Topics covered include motion in one and two dimensions, Newton's laws, momentum, energy and work, and rotational motion. Previous exposure to physics would be an asset but is not essential.
CO: Mathematics 1090 or 109B
CR: PHYS 1050
LH: 3; six laboratory sessions per semester
OR: tutorial sessions may be held on weeks when no laboratory is scheduled
PR: Level III Advanced Mathematics or Mathematics 1090 or 109B and Science 1807. It is recommended that students have completed at least one of level II and level III high school physics courses

1021 Introductory Physics II is an algebra-based introduction to oscillations, fluids, wave motion, electricity and magnetism, and circuits.
LH: 3; normally there will be six laboratory sessions per semester
OR: tutorial sessions may be held on weeks when no laboratory is scheduled
PR: PHYS 1020 or 1050, Mathematics 1090 or 109B or 1000, Science 1807

1050 General Physics I: Mechanics is a calculus-based introduction to mechanics. The course emphasizes problem solving, beginning with a review of vectors and one-dimensional kinematics. The main part of the course covers motion in two dimensions, forces and Newton's Laws, energy, momentum, rotational motion and torque, and finally oscillations. For details regarding recommendations for students taking PHYS 1050, see Note 4 under Physics and Physical Oceanography.
CO: Mathematics 1000
CR: PHYS 1020
LH: 3
PR: Mathematics 1000 and Science 1807

1051 General Physics II: Oscillations, Waves, Electromagnetism is a calculus-based introduction to oscillations, wave motion, and electromagnetism. Topics include: simple harmonic motion; travelling waves, sound waves, and standing waves; electric fields and potentials; magnetic forces and fields; electric current and resistance; and electromagnetic waves.
CO: Mathematics 1001
LH: 3
PR: PHYS 1050, or 1021, or 1020 (with a minimum grade of 70%), Mathematics 1001, Science 1807

2053 Fluids and Thermodynamics introduces the student to basic concepts in fluid statics and dynamics as well as the fundamental concepts in thermal physics: kinetic theory, the laws of thermodynamics, thermodynamic processes, entropy, and heat engines and refrigerators.
CO: Mathematics 1001 and PHYS 1051 (or PHYS 1021 with a minimum grade of 70%)
LH: 3
PR: Mathematics 1001 and PHYS 1051 (or PHYS 1021 with a minimum grade of 70%), Science 1807

2055 Electricity and Magnetism builds upon the concepts of electric and magnetic forces and fields, Gauss's Law, electric potential and electromagnetic induction introduced in PHYS 1051, expanding them to introduce capacitance, their application in DC and AC circuits, electromagnetic waves, wave optics, and geometric optics.
CO: Mathematics 2000
LH: 3
PR: Mathematics 2000, PHYS 1051, Science 1807

2151 Stellar Astronomy and Astrophysics introduces concepts in modern astronomy including: the celestial sphere, eclipses, parallax, and Kepler's laws; radiation; the Sun; spectroscopy; telescopes, resolution, and detectors; magnitudes, spectral classifications, and the Hertzsprung-Russell diagram; the interstellar medium, star formation, stellar evolution, nucleosynthesis, white dwarfs, neutron stars, pulsars, nebulae, supernovae, black holes, and gamma-ray bursts; galaxies, dark matter, and active galactic nuclei; cosmology, the cosmic microwave background, inflation and dark energy; and the search for extraterrestrial intelligence.
PR: 6 credit hours in Mathematics courses at the first year level

2300 Introductory Physical Oceanography (same as Ocean Sciences 2300) provides an introduction to general oceanography with a primary focus on physical oceanography. Topics include how oceans form and evolve on a planetary scale. Ocean characteristics studied include: the properties of seawater; elementary dynamics of fluids on the rotating Earth; ocean circulation; wind-forcing in the ocean; tides and waves. Contemporary methods used in oceanographic study are covered including satellite oceanography. Interactions that occur between physical and chemical processes and biological activity are reviewed.
CR: Environmental Science 2371, Ocean Sciences 2300
PR: 6 credit hours in any first-year courses in Physics

2750 Modern Physics explores the fundamental ideas that are still driving technological developments. Einstein's theory of special relativity, and the microscopic world described by quantum physics are introduced through crucial historical observations. The course covers the dual nature of light and particles, quantum well and quantum tunneling phenomena, which play a key role in modem electronics. Atomic and nuclei structure, and elementary particles are also described.
CO: Mathematics 1001; PHYS 1051
CR: PHYS 2056
PR: Mathematics 1001; PHYS 1051 (or PHYS 1021 with a minimum grade of 70%)

2820 Computational Mechanics introduces computational methods in the context of Newtonian mechanics. Numerical differentiation and integration, numerical solutions to differential equations and data analysis are applied to projectile motion, N-body systems, oscillations and problems from astrophysics and geophysics. Implementation of numerical methods using computer programming is emphasized.
CO: Mathematics 2000
LH: 2
PR: Mathematics 2000 and PHYS 1051

3000 Physics of Device Materials is an introduction to the physics of materials, particularly group IV and III-V semiconductors, used in common technological devices. It covers fundamental concepts including structures of crystalline solids, quantum mechanics and statistical mechanics of charge carriers, equilibrium charge carrier concentrations, carrier transport and excess carrier phenomena. These concepts are applied to multi-material devices including pn and metal semiconductor junctions, metal-oxide-semiconductor field-effect transistors, photovoltaic devices, light-emitting diodes, and solid-state lasers.
PR: PHYS 1051

3150 Astrophysics I covers macroscopic and microscopic physics related to stellar structure, energy production, and evolution. This includes stellar observables, gravity and other forces, the Virial Theorem, light and matter in stars, stellar spectra and classification, Hertzsprung-Russell diagrams and properties of main sequence dwarf stars, radiation in the stellar atmosphere, structural relationships and stellar models, energy sources and energy transport in stars, star formation and stellar evolution, nucleosynthesis, variable stars, Chandrasekhar's limit, and degenerate remnants.
CR: PHYS 3160
PR: PHYS 2053, 2750 (or 2056), and 2820

3151 Astrophysics II deals with galactic and cosmological scale astrophysics. Topics include: galaxies including Hubble classification, dark matter, and structure of the Milky Way Galaxy; globular and open star clusters; compact objects including compact binary systems, novas and supernovas, pulsars and magnetars, X-ray binaries; black holes, active galactic nuclei, quasars, the Lyman forest, and the Gunn-Peterson trough; and cosmology including the cosmic microwave background, the FLRW metric, the Friedmann equations, cosmological expansion, and dark energy.
CR: PHYS 3160
PR: PHYS 3150 and 3220

3220 Classical Mechanics I covers vector operations, coordinate transformations, derivative of vectors, Newton's laws, differential equations, kinematics and dynamics of a particle, linear and quadratic air resistance, terminal velocity, momentum of a time varying mass, center of mass systems, angular momentum, moment of inertia, energy, work-energy theorem, forces as the gradient of potential energy, time dependent potential energy, curvilinear one-dimensional systems, energy of a multiparticle system, calculus of variations, and Lagrangian Dynamics.
CO: PHYS 2820, Mathematics 2260 and 3202

PR: PHYS 2820, Mathematics 2260 and 3202

3230 Classical Mechanics II covers noninertial frames of reference, Newton's second law in a rotating frame, centrifugal force, Coriolis force, motion of rigid bodies, center of mass, rotation about a fixed axis, rotation about any axis, inertia tensor, Euler's equations with zero torque, coupled oscillators, chaos theory, bifurcation diagrams, state-space orbits, Poincare sections, Hamiltonian dynamics, ignorable coordinate, phase-space orbits, Liouville's theorem, scattering angle, impact parameter, differential scattering cross section, and Rutherford scattering.
CO: Mathematics 3202
PR: PHYS 3220, Mathematics 2260 and 3202

3300 Intermediate Physical Oceanography provides a physics-based introduction to both dynamical and descriptive physical oceanography. Topics include properties of seawater, geostrophy, conservation equations, wind-forced dynamics, large-scale ocean circulation and waves and tides. A survey of analytical, observational, numerical, and laboratory approaches is presented.
PR: PHYS 2053 and Mathematics 2000 or registration in Academic Term 5 of the Ocean and Naval Architectural Engineering program

3340 Principles of Environmental Physics applies basic physical principles to the environment of the Earth with a focus on problem solving and developing physical understanding. Key topics to be covered include the climate system and climate change, energy production and use, and the role of science in guiding public decision-making.
PR: Mathematics 2000 and PHYS 2053

3400 Thermal Physics covers central concepts in thermodynamics and statistical mechanics, including temperature, entropy, the laws of thermodynamics, the Einstein model of solids, paramagnetism, Helmholtz and Gibbs free energies, chemical potential, thermodynamic identities, Boltzmann statistics, the partition function, and quantum statistics.
PR: Mathematics 2000, PHYS 2053 and PHYS 2750 or (2056)

3500 Electromagnetic Fields I examines the laws of electrostatic and magnetostatic fields based on vector calculus and a local formulation. Topics covered include Gauss's law,potentials, energy and work, the multipole expansion, Laplace's equation and boundary conditions, linear dielectrics, electric polarization, electric displacement, capacitance. magnetic fields B and H. vector potentials, Lorentz force, magnetization and Maxwell's equations.
CR: Engineering 5812
PR: PHYS 2055 and Mathematics 3202

3550 Electric Circuits covers circuit elements. Simple resistive circuits. Techniques of circuit analysis. Topology in circuit analysis. Operational amplifiers. Reactive circuit elements. Natural response and step response of RL, RC and RLC circuits. Circuits driven by sinusoidal sources. Mutual inductance. Series and parallel resonance. Laplace transforms in the analysis of frequency response.
CO: Mathematics 2260
CR: Engineering 3821
LC: 6
LH: 6
PR: Mathematics 2050, Mathematics 2260 or (the former Mathematics 3260), PHYS 2055

3551 Analogue Electronics - inactive course.

3600 Optics and Photonics I covers topics in geometrical and physical optics and applications of associated phenomena, principles, and concepts to photonics. Topics include geometrical optics (thin lenses, mirrors, and optical instruments), physical optics (two-beam and multiple-beam interference, Fraunhofer diffraction, reflection, transmission, and polarization), and applications (fibre-optic light guides, modulation of light waves, and optical communication systems).
PR: Mathematics 2000 and PHYS 2055

3750 Quantum Physics I introduces the foundational techniques that are required to understand the physics of atoms and molecules. Beginning with the wave-particle duality of nature, the wave function and the time-independent Schrodinger equation, techniques to calculate wave functions and macroscopic observables in simple one-dimensional models are covered. The three-dimensional hydrogen atom, the simplest real-life system that allows for a quantitative quantum description, is then examined in detail.
CO: Mathematics 2000. PHYS 3220 is recommended.
PR: PHYS 2750 (or 2056 or CHEM 2302). PHYS 3220 is recommended.

3751 Quantum Physics II is an introduction to the physics of elementary particles. After a brief overview of special relativity and non-relativistic quantum mechanics. this course covers relativistic quantum mechanics (KleinGordon and Dirac equations, antiparticles, spin, transition probability, and Feynman diagrams) and particle physics (leptons and quarks, strong and weak interaction, conservation laws, and the standard model of elementary particles).
PR: PHYS 3750

3800 Computational Physics is a project-based course that trains students to become functional in computational methods by writing and compiling computer code (C/Fortran) in a Unix environment to solve problems from different areas of physics. Students complete one or more projects that introduce students to a particular class of numerical methods. Lectures and tutorials cover the theory that underlies the computational methods and background for code development and the application of the required numerical methods.
LH: 2
PR: Computer Science 1510, or 1001, or Engineering 1020 (or other computer programming course as approved by the instructor). PHYS 2820, Mathematics 2260 (or the former Mathematics 3260), and Mathematics 3202

3810 Mathematical Analysis - inactive course.

3820 Mathematical Physics I focuses on applications of mathematical techniques to solve problems in physics. Vectors, vector calculus, matrices and tensors, coordinate systems and transformations, and summation notation are reviewed. Topics in complex numbers, functions and calculus are introduced, including branch cuts, differentiation, integration, Cauchy formula, series, residue theorem, and the gamma function. Other topics include differential equations using series solutions and separation of variables, and Fourier series of real and complex functions.
PR: Mathematics 2260 (or the former Mathematics 3260), and Mathematics 3202

3900 Experimental Physics I develops experimental, analytical, and communications skills through extended experiments in fields of physics including optics, magnetism, fluids, spectroscopy, materials characterization, and modern physics. Students select from a range of experiments that illustrate concepts encountered in previous courses to apply existing knowledge and problem solving skills, while other experiments introduce more advanced techniques and phenomena.
CR: PHYS 4880
LC: 0
LH: 6
PR: at least two of PHYS 2053, 2820, 2055, PHYS 2750 (or 2056), Science 1807

4000 Solid State Physics focuses on the relation between structure and physical properties in crystalline materials. An introduction to crystal structure addresses symmetry and reciprocal space. Phonons and lattice vibrations are linked with thermal properties of solids. Electrons in solids, including energy bands and semiconductors, lead to discussions of transport in solids.
PR: PHYS 3400 and 3750

4200 Classical Mechanics III - inactive course.

4205 Introduction to Fluid Dynamics (same as Mathematics 4180) covers basic observations, mass conservation, vorticity, stress, hydrostatics, rate of strain, momentum conservation (Navier-Stokes equation), simple viscous and inviscid flows, Reynolds number, boundary layers, Bernoulli's and Kelvin's theorems, potential flows, water waves, thermodynamics.
CR: Mathematics 4180
PR: PHYS 3220 and either Mathematics 4160 or the former PHYS 3821 or waiver approved by the instructor

4210 Continuum Mechanics - inactive course.

4220 Introduction to general Relativity (Mathematics 4130) studies both the mathematical structure and physical content of Einstein's theory of gravity. Topics include the geometric formulation of special relativity, curved spacetimes, metrics, geodesics, causal structure, gravity as spacetime curvature, the weak-field limit, geometry outside a spherical star, Schwarzschild and Kerr black holes, Robertson-Walker cosmologies, gravitational waves, an instruction to tensor calculus, Einstein's equations, and the stress-energy tensor.
CO: Mathematics 4230
CR: Mathematics 4130
PR: Mathematics 3202 and one of PHYS 3220, Mathematics 4230 or waiver approved by the instructor

4300 Advanced Physical Oceanography covers dynamical physical oceanography. The equations of motion in oceanography are derived and analysed. Topics include.geostrophy, conservation equations, linear and non-linear wave theory, and open ocean and shelf circulation dynamics.
PR: PHYS 3300 and 3820

4330 Topics in Physical Oceanography - inactive course.

4340 Modelling in Environmental Physics covers the basic principles underlying environmental modelling. Techniques for numerical modelling are introduced with applications to simulation of terrestrial, atmospheric and oceanic environments. Concepts and principles of free and forced dynamical systems are introduced and applied to the analysis and interpretation of simplified climate and environment model simulations. Includes some discussion of dynamics and transition to chaos in environmental systems, uncertainty in their simulations and predictability of future environmental and climate changes.

PR: PHYS 3340 and PHYS 3820 or waiver approved by the instructor

4400 Statistical Mechanics covers ensembles. Classical and quantum statistical mechanics. Statistical mechanics of phase transitions. Advanced topics in statistical mechanics.
CO: PHYS 3750
PR: PHYS 3400 and 3750

4500 Electromagnetic Fields II covers electrodynamics and the applications of Maxwell's equations. Topics covered include electrodynamics (Maxwell's equations and boundary conditions), conservation laws (continuity equation, Poynting's theorem, and momentum conservation), electromagnetic waves {wave properties, reflection and transmission, absorption and dispersion, guided waves), radiation {potential and fields, dipole radiation, and radiation from point charges), and relativistic electrodynamics. Selected topics in electrodynamics and applied electromagnetism may be introduced.
CR: Engineering 6813
PR: PHYS 3500 and 3820

4600 Optics and Photonics II covers principles of lasers, interactions of laser light and matter, and new developments in the fields of optics and photonics. Topics include wave optics, optical resonators, interaction of radiation and atomic systems, principles and techniques of lasers, nonlinear optics and devices, guided-wave optics, and fibre-optic communication. Recent development in the fields, such as photonic crvstal optics, ultrafast optics, and nano-optics will be introduced.
PR: PHYS 3500 and 3600

4700 Atomic and Molecular Physics - inactive course.

4710 Nuclear Physics - inactive course.

4820 Mathematical Physics II covers topics on the common partial differential equations of Mathematical Physics and boundary value problems; Sturm-Liouville theory, introduction to the theory of distributions, Dirac delta function, Laplace and Fourier transforms, Green's functions, Bessel functions, Legendre functions, spherical harmonics, and other topics such as group theory.
PR: PHYS 3820 or all of Mathematics 2051, 2260, 3202, 3210

4850 Quantum Mechanics is a mathematically-based course that covers: the postulates of quantum mechanics; Hermitian operators; x, p and matrix representations of quantum mechanics; the harmonic oscillator; spin and orbital angular momentum and addition of angular momentum; stationary perturbation theory; time dependent perturbation theory.
PR: PHYS 3750 and 3820

4851 Advanced Quantum Mechanics is a continuation of PHYS 4850 that covers: density operators; unitary operators, including symmetry operations and the time-evolution operator; gauge transformations and Berry's phase; quantum mechanical entanglement; systems of identical particles.
PR: PHYS 4820 and 4850

4852 Quantum Information and Computing (same as Mathematics 4252) covers postulates of quantum mechanics, matrix theory, density matrices, qubits, qubit registers, entanglement, quantum gates, superdense coding, quantum teleportation, quantum algorithms, open systems, decoherence, physical realization of quantum computers.
CR: Mathematics 4252
PR: Mathematics 2051 or PHYS 3820

4900 Experimental Physics II builds on the skills developed in Experimental Physics I through advanced and open-ended experiments in fields of physics including optics, magnetism, fluids, spectroscopy, materials characterization, and modern physics.
LC: 0
LH: 6
PR: PHYS 3900, Science 1807

490A/B Honours Physics Thesis is required of the Honours program.

6317 Underwater Acoustics covers basic theory of sound, sound in the ocean environment, wave equation, ray tracing, sonar system operation, transducers, applications.
PR: PHYS 3810 (or the former Mathematics 3220) and 3220, or waiver approved by the instructor

6318 Ocean Climate Modelling covers numerical techniques, finite difference, finite element and spectral methods. Introduction to the climate system. Ocean climate models. Box models. Variability on interdecadal, centennial and geological scales. Zonally averaged models. 3-D ocean modelling. Thermohaline circulation. General circulation models. Climate modelling and global warming.
PR: PHYS 3810 (or Mathematics 3202), PHYS 3300 and the completion of any 15 credit hours in core courses at the 3000 or 4000 level in the Faculty of Science or waiver approved by the instructor

11.11 Psychology

Psychology courses are designated by PSYC.

11.11.1 Non-Restricted Courses

These courses are open to all students who have the appropriate prerequisites. Students who intend to major in Psychology should note the credit restrictions for PSYC 2010, 2100, 2440, 2610, 2810, 2920, and 3640 as taking any of these courses will reduce options in the Majors program

1000 Introduction to Psychology is the first half of a two-semester introduction to Psychology as a biological and social science. Topics may include history, research methodology, behavioural neuroscience, sensation and perception, consciousness, learning, and memory.

1001 Introduction to Psychology is the second half of a two-semester introduction to Psychology as a biological and social science. Topics may include emotion, motivation, stress and health, personality and individuality, psychological disorders and treatment, and social psychology.
PR: PSYC 1000

2010 Biological and Cognitive Development is a survey of principles underlying human development from the prenatal stage to adolescence. Topics covered will include biological, physical, linguistic, sensory, cognitive and intellectual changes.
CR: PSYC 2025, PSYC 3050
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2020 Social and Personality Development (same as the former PSYC 2011) is an examination of relevant research on human socialization and personality development with special emphasis on parenting influences, attachment, imitation, sex role and moral development in childhood and adolescence.
CR: PSYC 2025, the former PSYC 2011
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2030 Adult Development (same as the former PSYC 2012) examines physical and psychological changes from early adulthood until the end of the lifespan. Topics include career choices, love partnerships, parenting and grandparenting, cognitive changes, interpersonal changes, and healthy aging.
CR: the former PSYC 2012
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2100 Attitudes and Social Cognition is an examination of the concepts and principles involved in the interaction between the individual and others. Emphasis will be on the theoretical and empirical concerns of attitude formation and change, social perception, and social cognition.
CR: the former PSYC 2125, PSYC 3100
PR: PSYC 1000 and 1001

2120 Interpersonal and Group Processes - inactive course.

2150 Introduction to Forensic Psychology will provide an in-depth overview of the relationship between psychology and the law. A variety of topics will be discussed and critically evaluated, including the use and misuse of psychology-based investigative methods such as offender and geographic profiling, detection of deception, investigative interviewing, eyewitness testimony, jury decision-making, corrections and treatment, risk assessment, and criminal responsibility.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2151 Health Psychology will explore the history, aims and future of health psychology. Topics covered will consider the contributions of a wide range of psychological theory within the context of psychosocial risk factors for illness, illness prevention, health promotion, and the health care system itself. These theories extend from rather individualistic notions of health and wellness (e.g., personality, attitudes, and behaviour) to concepts associated with characteristics of the broader social environment (e.g., social support, economic challenges, and organizational factors). An overall bio-psycho-social approach to health and wellness is explored.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2240 Survey of Learning - inactive course.

2440 Human Memory and Cognition - inactive course.

2540 Psychology of Gender is an examination of the influence of gender on development and socialization, attitude formation, cognition, personality and mental health.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2560 Intelligence - inactive course.

2610 Personality - inactive course.

2800 Drugs and Behaviour is an examination of the neurophysiology of drug action, the measurable effect of drugs on experimentally controlled behaviour, and a survey of information available on common self-administered drugs and their immediate and long-term effects.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2810 Brain and Behaviour is a broad survey of physiological psychology at an elementary level. Topics will include the following: structure of the nervous system, nerve conduction, sensory and motor systems, behavioural biology of reproduction, aggression, feeding and drinking, sleep and arousal, pleasure and pain, learning and memory.
CR: PSYC 2520, 2825, the former PSYC 3801
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

2920 Research Methods in Psychology for Non-Majors provides an introduction to the design, understanding, and application of psychological research. Topics covered include understanding and applying scientific method, creating and testing hypotheses, constructing reliable and valid experiments, and the proper use of controls. An emphasis will be placed on thinking critically about psychology and common errors of judgment.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major or any Psychology honours or joint honours programs

3430 The Psychology of Thinking - inactive course.

3501 Industrial Psychology - inactive course.

3533 Sexual Behaviour covers the most important aspects of human sexuality with a psychology theory and research framework. The course will examine the biological, behavioural and socio-cultural bases of the human sexual response. Topics include sexual interaction and communication, contraception, sexually transmitted infections, reproduction, sexual orientation, transgender and intersex, variations in sexual behaviour, sex and gender, sexual dysfunction and therapy, and sexual coercion.
PR: PSYC 1000 and 1001
UL: cannot be used towards the Psychology major

3577 Program Evaluation - inactive course.

3640 The Psychology of Abnormal Behaviour covers problems of definition, the history of beliefs about abnormal behaviour and the implication of a behavioural model for the understanding and control of behaviour problems.
CR: PSYC 3650, PSYC 3626
PR: any 2000 level course in Psychology
UL: cannot be used towards the Psychology major

4810 Human Neuropsychology - inactive course.

11.11.2 Majors Courses

These courses are restricted to Majors in Psychology and Behavioural Neuroscience.

2520 Introduction to Behavioural Neuroscience is based on the idea that psychological and neuroscience research efforts are synergistic. Neuroscience research can reveal mechanisms that help explain the mind and behavior, while concepts developed by psychological research often define the topics that neuroscience investigates. The course will survey a broad range of topics that include the fundamentals of neuroanatomy, neurophysiology, and neurodevelopment, as well as higher level functions such as motivation, emotion, sleep, memory, language, and mental illness.
CR: PSYC 2810, 2825, the former PSYC 3801
PR: PSYC 1000 and 1001 and admission to a Major in Psychology or Behavioural Neuroscience; minors may be permitted to take this course if space permits

2910 Research Methods in Psychology I is an introduction to the design and application of psychological research with particular concentration on understanding and applying scientific method, creating and testing hypotheses, constructing reliable and valid experiments, managing and analysing data sets, using statistical software, and scientific writing. Specific topics include descriptive statistics including measures of central tendency, variability and relative standing, inferential statistics such as *t* tests for one and two sample designs, correlation and regression, and non-parametric statistics.
CR: Statistics 2500, 2550, the former 2510, PSYC 2925
LH: one laboratory period weekly
PR: PSYC 1000 and 1001; Mathematics 1000 or two of 1090, 109B, 1050 and 1051 (or equivalent) and admission to a Major in Psychology or Behavioural Neuroscience

2911 Research Methods in Psychology II covers research methods in psychology with a focus on more complex research designs and statistical approaches, within the realm of experimentation and beyond the laboratory. Specific topics include controlling participant variables, using between and repeated measures designs within the context of Analysis of Variance (ANOVA). Particular ANOVA approaches include one-way and factorial designs, within subject design, and two-way mixed designs.
CR: Statistics 2501, 2560, PSYC 2950
LH: one laboratory period weekly
PR: PSYC 2910 and admission to a Major in Psychology or Behavioural Neuroscience

2930 Research and Writing in Psychology is an introduction to the fundamentals of preparing psychology reports, emphasizing organization, correct use of terminology, adherence to appropriate discipline style, concise and accurate description, preparation of abstracts, and integration of numerical data. Topics for reports will be selected each semester by the instructor.
PR: PSYC 1000 and 1001 and admission to a Major in Psychology or Behavioural Neuroscience
UL: may not be used towards the Faculty of Humanities and Social Sciences CRW requirement or the former R/W requirement

3050 Developmental Psychology is an examination of the methods of study and an evaluation of current findings and theoretical issues of importance to an understanding of development. Topics will be drawn from perception, learning, cognition, social learning, memory and language development.
CR: PSYC 2010, PSYC 2025
PR: PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3100 Social Psychology is an examination of the concepts and principles involved in social behaviour. Topics covered will include attitudes, social cognition, interpersonal relations, and group processes.
CR: PSYC 2100, the former PSYC 2125
PR: PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3250 Neurobiology of Learning and Memory examines how organisms adjust their behaviour to regularities in the environment as a result of experience. Experience changes behavior by modifying the nervous system. We will take a multidisciplinary approach, combining information from psychology and neuroscience. to study learning and memory. Students will gain an understanding of sensitization, habituation, and classical and operant conditioning using animal models, with a particular emphasis on the synaptic and molecular changes that occur with learning and memory.
PR: PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3350 Perception is a broad survey of theory and research in sensation and perception.
PR: PSYC 2520, the former 2570, and 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3450 Human Cognition is an introduction to the experimental study of the mental representations and processes involved in human cognition. Topics such as attention, perception and pattern recognition, concepts and the organization of knowledge, language processes, mental imagery, reasoning, problem solving, decision making and skilled performance will be covered with an emphasis on experimental analysis and techniques.
CR: PSYC 2440, PSYC 2425
PR: PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3510 Directed Study provides an opportunity to work with an individual faculty member on a research project. The student will submit a formal written report of the research conducted. Permission of the instructor is required.
PR: PSYC 2911 and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3511 Directed Study provides an opportunity to work with an individual faculty member on a research project. The student will submit a formal written report of the research conducted. Permission of the instructor is required.
PR: PSYC 2911 and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3620 Personality Theory and Research - inactive course.

3650 Abnormal Psychology is an examination of the nature, explanation and treatment of psychological disorders with an emphasis on research methods and current findings.
CR: PSYC 3640, PSYC 3626
PR: PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3750 Animal Behaviour I (same as Biology 3750) is an introduction to the mechanisms, development, function and evolution of behaviour in animals. Topics include the history of ethology and comparative psychology, and

behavioural ecology; methods of animal behaviour study, behaviour of animals in relation to physiology, learning, communication, mating systems, and other areas in Biology and Psychology.
CR: Biology 3750
PR: Biology 1001, 1002 and PSYC 2520, 2911, and 2930 or the former 2570, and admission to a Major in Psychology or Behavioural Neuroscience

3800 Cellular Neuroscience addresses the structure and function of neurons and neural circuits and examines principles of electrochemical neural communication at the macroscopic, microscopic and molecular level. The relevance of this knowledge to understanding brain mechanisms of normal and diseased brain functions will be touched upon. The molecular basis of the formation of some types of memories will be explored.
PR: PSYC 2520, 2911, and 2930 or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience

3820 Research Techniques in Behavioural Neuroscience allows students to increase their understanding of how knowledge is generated in the study of neuroscience and behavior. Students will visit various on-campus laboratories that are engaged in research relevant to these fields. In addition to observations and hands-on tutorials, readings, discussions, and writing assignments will strengthen students' understanding of the techniques used to answer specific research questions in neuroscience and behaviour.
PR: Science 1807; PSYC 2520, 2911, and 2930, or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience

3830 Behavioural Endocrinology explores the behavioural effects of hormones and the question of how hormones act on the brain to influence behaviour. Topics include: basic concepts in neuroendocrinology, reproductive behaviour (sexual and parental), sexual differentiation of the brain and behaviour, aggressive behaviour, and the neuroendocrinology of stress, including the effects of stress on the brain and behaviour.
PR: PSYC 2520, 2911, and 2930 or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience

3900 Design and Analysis III is a course on complex and specialized research design in Psychology. Multifactor research designs that employ both between- and within-subjects independent variables. Advantages and disadvantages of using multifactor research designs to test psychological hypotheses. Hierarchical designs and incomplete factorials. The use of covariates and blocking to increase experimental precision. Problems created by missing data. Single subject designs. How to answer specific psychological questions in the context of complex designs. The design and analysis of non-experimental psychological research. Applications of such techniques as the analysis of variance and multiple linear regression to the data obtained with these research designs, with special attention to problems inherent in psychological research.
CR: PSYC 3950, Statistics 3520
LH: one laboratory period weekly
PR: PSYC 2911 and admission to a Major in Psychology or Behavioural Neuroscience

4050 Selected Topics in Developmental Psychology I is an intensive examination of a specific topic in developmental psychology.
PR: PSYC 3050 and admission to a Major in Psychology or Behavioural Neuroscience

4051 Selected Topics in Developmental Psychology II is an intensive examination of a specific topic in developmental psychology.
PR: PSYC 3050 and admission to a Major in Psychology or Behavioural Neuroscience

4070 Research Experience in Development Psychology allows students to gain research experience in selected areas of developmental psychology.
PR: PSYC 3050 and admission to a Major in Psychology or Behavioural Neuroscience

4150 Selected Topics in Social Psychology I is an intensive examination of a specific topic in social psychology.
PR: PSYC 3100 and admission to a Major in Psychology or Behavioural Neuroscience

4151 Selected Topics in Social Psychology II is an intensive examination of a specific topic in social psychology.
PR: PSYC 3100 and admission to a Major in Psychology or Behavioural Neuroscience

4152 Selected Topics in Applied Social Psychology - inactive course.

4160 Psychology and the Law - inactive course.

4170 Research Experience in Social Psychology will provide research experience in a selection of areas typically studied by social psychologists such as attitudes, prejudice, groups and social cognition. Students will acquire experience with research methods that are used to advance the body of knowledge in social psychology.
PR: PSYC 3100 and admission to a Major in Psychology or Behavioural Neuroscience

4250 Selected Topics in Learning and Motivation I an intensive examination of a specific topic in learning and motivation.
PR: PSYC 3250 and admission to a Major in Psychology or Behavioural Neuroscience

4251 Selected Topics in Learning and Motivation II is an intensive examination of a specific topic in learning and motivation.
PR: PSYC 3250 and admission to a Major in Psychology or Behavioural Neuroscience

4260 Learning Processes and Drug Effects - inactive course.

4270 Research Experience in Learning allows students to gain research experience in selected areas of learning.
PR: Science 1807; PSYC 3250 and admission to a Major in Psychology or Behavioural Neuroscience

4350 Selected Topics in Perception I - inactive course.

4351 Selected Topics in Perception II is an intensive examination of a specific topic in perception.
PR: PSYC 3350 and admission to a Major in Psychology or Behavioural Neuroscience

4370 Research Experience in Perception allows students to gain research experience in selected areas of perception.
PR: PSYC 3350 and admission to a Major in Psychology or Behavioural Neuroscience

4450 Selected Topics in Cognition I (same as the former PSYC 4400) is an intensive examination of a specific topic in cognition.
CR: the former PSYC 4400
PR: PSYC 3450 and admission to a Major in Psychology or Behavioural Neuroscience

4451 Selected Topics in Cognition II (same as the former PSYC 4401) is an intensive examination of a specific topic in cognition.
CR: the former PSYC 4401
PR: PSYC 3450 and admission to a Major in Psychology or Behavioural Neuroscience

4452 Selected Topics in Cognition: Reading - inactive course.

4453 Selected Topics in Cognitive Science (same as the former PSYC 4402) is an intensive examination of a specific topic in cognitive science from a psychological perspective.
CR: the former PSYC 4402
PR: two courses chosen from PSYC 3050, 3250, 3350, 3450, the former 3801 and admission to a Major in Psychology or Behavioural Neuroscience

4461 Psycholinguistics - inactive course.

4462 Human Memory - inactive course.

4470 Research Experience in Cognition allows students to gain research experience in selected areas of cognition.
PR: PSYC 3450 and admission to a Major in Psychology or Behavioural Neuroscience

4500 Selected Topics in Psychology I is an intensive examination of a specific topic in psychology that crosses traditional subdisciplines.
PR: two 3000-level majors courses (other than 3900) and admission to a Major in Psychology or Behavioural Neuroscience

4501 Selected Topics in Psychology II is an intensive examination of a specific topic in psychology that crosses traditional subdisciplines.
PR: two 3000-level majors courses (other than 3900) and admission to a Major in Psychology or Behavioural Neuroscience

4610 Selected Topics in Personality I - inactive course.

4620 Selected Topics in Personality II is an intensive examination of a specific topic in personality.
PR: PSYC 3620 and admission to a Major in Psychology or Behavioural Neuroscience

4650 Selected Topics in Abnormal Behaviour I is an intensive examination of a specific topic in abnormal behaviour.
PR: PSYC 3650 and admission to a Major in Psychology or Behavioural Neuroscience

4651 Selected Topics in Abnormal Behaviour II - inactive course.

4660 Developmental Psychopathology - inactive course.

4661 Family Psychology is a study of the reciprocal relationship between family processes and abnormal behaviour. The course will focus on the role

of family dynamics in the etiology of abnormal behaviour, the impact of psychological disorders on family functioning and the application of family therapy to create therapeutic change.
PR: PSYC 3650, or all of 2520, 2930 or the former 2570, 2911, and 3640, and admission to a Major in Psychology or Behavioural Neuroscience

4662 Clinical Psychology and Theories of Psychotherapy - inactive course.

4670 Research Experience in Abnormal Psychology allows students to gain research experience in selected areas of clinical psychology.
PR: PSYC 3650 and admission to a Major in Psychology or Behavioural Neuroscience

4671 Research Experience in Personality - inactive course.

4701 Animal Behaviour II - inactive course.

4750 Selected Topics in Animal Behaviour I is an intensive examination of a specific topic in animal behaviour.
PR: PSYC 3750 or Biology 3750 and admission to a Major in Psychology or Behavioural Neuroscience

4751 Selected Topics in Animal Behaviour II is an intensive examination of a specific topic in animal behaviour.
PR: PSYC 3750 or Biology 3750 and admission to a Major in Psychology or Behavioural Neuroscience

4770 Research Experience in Animal Behaviour (same as Biology 4770) allows students to gain research experience in selected areas of animal behaviour. This course may be offered in a usual 12-week semester or as a two-week field course.
CR: Biology 4770
LC: either three hours of lecture per week or a two-week field course that embodies equivalent instructional time
PR: Science 1807; PSYC 2520, 2930 or the former 2570, 2911 and PSYC 3750 or BIOL 3750 and admission to a major in Psychology or Behavioural Neuroscience

4850 Selected Topics in Behavioural Neuroscience I is an intensive examination of a specific topic in behavioural neuroscience.
PR: One of PSYC 3800, the former 3801, 3820, or 3250 and admission to a Major in Psychology or Behavioural Neuroscience

4851 Selected Topics in Behavioural Neuroscience II - inactive course.

4870 Research Experience in Behavioural Neuroscience allows students to gain research experience in selected areas of neuroscience.
PR: Science 1807; PSYC 3820 or the former 3801, and admission to a Major in Psychology or Behavioural Neuroscience

4910 Systems in Contemporary Psychology is a study of paradigms and explanations in contemporary psychology in the context of their historical antecedents.
PR: at the St. John's campus, 30 credit hours in Psychology courses required in the majors program and admission to a Major in Psychology or Behavioural Neuroscience or, at the Grenfell campus, 30 credit hours in Psychology courses including Psychology 3950

499A and 499B Honours Dissertation is a linked course, based on independent study of an approved problem in Psychology. The topic will be chosen in consultation with the Faculty Advisor. The first semester will normally involve directed reading in this area, and preparation of a dissertation proposal. The second semester will be devoted to conducting the study, gathering data, data analysis and preparation of a formal written report. The dissertation must be submitted for grading before the end of the tenth week of the semester in which the student is registered for 499B.
CH: 6
PR: admission to the Honours Program

11.11.3 Psychology Work Term Descriptions

The Following Work Terms are a requirement of the Psychology Co-op Program only.

199W Work Term I follows the successful completion of Semester 4. Students are expected to learn, develop and practice the high standards of behaviour and performance normally expected in the work environment. (A detailed description of each job is normally posted during the job competition.) As one component of the Work Term, the student is required to complete a work report. The work report, as a minimum requirement should:
1. analyse an issue/problem related to the student's work environment.
2. demonstrate an understanding of the structure of a professional report, and show reasonable competence in written communication and presentation skills. (Students should consult the evaluation form provided in the placement package.)

Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.
Seminars on professional development, conducted by Co-operative Education, are presented during Semester 4 to introduce and prepare the student for participation in the subsequent work terms. Topics may include among others, work term evaluation, work report writing, career planning, employment seeking skills, resume preparation, self employment, ethics and professional concepts, behavioural requirements in the work place, assertiveness in the work place and industrial safety.

299W Work Term II follows the successful completion of Semester 6. Students are expected to further develop and expand their knowledge and work-related skills and should be able to accept increased responsibility and challenge. In addition, students are expected to demonstrate an ability to deal with increasingly complex work-related concepts and problems. The work report, as a minimum requirement, should:
1. analyse an issue/problem related to the student's work environment and demonstrate an understanding of practical application of concepts relative to the student's academic background
2. demonstrate competence in creating a professional report, and
3. show competence in written communication and presentation skills

Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.

399W Work Term III follows the successful completion of Semester 7. Students should have sufficient academic grounding and work experience to contribute in a positive manner to the problem-solving and management processes needed and practiced in the work environment. Students should become better acquainted with their discipline of study, should observe and appreciate the attitudes, responsibilities, and ethics normally expected of professionals and should exercise greater independence and responsibility in their assigned work functions. The work report should reflect the growing professional development of the student and, as a minimum requirement, will:
1. demonstrate an increased ability to analyse a significant issue/problem related to the student's experience in the work environment
2. demonstrate a high level of competence in producing a professional report, and
3. show a high level of competence in written communication and presentation skills

Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.

11.12 Science

1000 Introduction to Science I is a liberal science course for Humanities and Social Sciences students, which reflects the way scientists think and work through historical, philosophical and social considerations of the environment we live in. Typical course content includes: the concepts of matter, motion and energy; the chemical basis for life and the interdependence of organisms; and the abundance and distribution of the Earth's natural resources.
UL: may not be used to fulfill any of the Science course requirements for the Honours and General Degrees in Science

1001 Introduction to Science II is continuation of Science 1000.
PR: Science 1000
UL: may not be used to fulfill any of the Science course requirements for the Honours and General Degrees in Science

1150 Introduction to Physical and Life Sciences (formerly Science 115A) is an introduction to some concepts in the Physical and Life Sciences. This course is primarily intended for the non-science major (Bachelor of Arts; Bachelor of Education (Primary/Elementary)).
CR: the former Science 115A
LH: 3
PR: Science 1807
UL: not acceptable as a prerequisite for 2000 level courses in Physics, Chemistry, Biology, Geography or Earth Sciences

1151 Introduction to Physical and Life Sciences (formerly Science 115B) is an introduction to some concepts in the Physical and Life Sciences. This course is primarily intended for the non-science major (Bachelor of Arts; Bachelor of Education (Primary/Elementary)).
CR: the former Science 115B
LH: 3
PR: Science 1807
UL: not acceptable as a prerequisite for 2000 level courses in Physics, Chemistry, Biology, Geography or Earth Sciences

1807 Safety in the Scientific Laboratory introduces students to safety practices required for working in science laboratories where hazards are present. Students complete individual online modules in Laboratory Safety and WHIMIS. Normally, it will be taken before the start of the semester in which students take their first science laboratory course with this prerequisite, and it must be completed no later than the first Friday of the semester. Check department lists of courses to see where this is a prerequisite.
CH: 0
OR: only offered online; completion time estimated to be two hours