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All courses in this Calendar will be offered in 2000-2001 unless a ● appears to the left of the course number. No description will appear after the title if the course is not given in the current year, descriptions can usually be found in preceding Calendars.

The letters which form part of course numbers have the following significance:

- A – fall term
- B – winter term
- D – fall term and winter term
- C – summer session courses starting in May
- L – summer session courses starting in June
- T – summer session courses starting in July
- E – winter term and summer session
- G – summer session and fall term
- H – fall term, winter term and summer session
- J – winter term, summer session and fall term
- K – summer session, fall term and winter term
- N – winter term and fall term

1 Agricultural and Biosystems Engineering

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Website: <http://www.macdonald.mcgill.ca/agreng>

Chair — G.S.V. Raghavan

1.1 Staff

Emeritus Professor

R.S. Broughton; B.S.A., B.A.Sc.(Tor.), S.M.(M.I.T.), Ph.D.(McG.), LL.D.(Dal.)

Professors

S. Barrington; B.Sc.(Agr. Eng.), Ph.D.(McG.)

R. Kok; B.E.Sc., Ph.D.(W.Ont.)

C.A. Madramootoo; B.Sc.(Agr. Eng.), M.Sc., Ph.D.(McG.)

E. McKyes; B.Eng., M.Eng., Ph.D.(McG.)

S.O. Prasher; B.Tech, M.Tech.(Punj.), Ph.D.(Br.Col.)

G.S.V. Raghavan; B.Eng.(B'lore), M.Sc.(Guelph), Ph.D.(Colo.St.)

Associate Professors

E.R. Norris; B.S.A.(Tor.), M.Sc.(Guelph), Ph.D.(Mich. St.)

J. Sheppard; B.Sc.(Eng.)(Guelph), M.E.Sc.(W.Ont.), Ph.D.(McG.)

Assistant Professors

S. Babarutsi; B.Sc.(Agr.Eng.), M.Eng., Ph.D.(McG.)
(Special Category, Part-time)

J.A. Landry; B.Sc.(Agr.Eng.), Ph.D.(McG.)

M.O. Ngadi; B.Eng.(Agr.Eng.), M.A.Sc., Ph.D.(Dal.Tech.)

Brace Centre for Water Resources Management

Assistant Professor

R.B. Bonnell; B.Sc.(Geo.), B.Sc.(Agr.Eng.), M.Sc., Ph.D.(McG.)

Auxiliary Professors

N.B. McLaughlin, J. Millette, B. Paterson, A. Shady, G. Sunahara, C. Vigneault;

Research Associates

P. Enright, Y. Garipey, V. Orsat

1.2 Programs Offered

The Department offers facilities for research in the areas of biosystems engineering, agricultural structures, plant and animal environment, hydrology, irrigation, drainage, farm water supply for people and livestock, water quality, waste management, environmental pollution from agrochemicals, bio-remediation of industrial contaminated sites, agricultural machinery, soil-machine mechanics, computers in agriculture, artificial intelligence, machine vision, control systems, expert systems, precision agriculture, post-harvest technology, food processing and fermentation engineering leading to the degrees of Master of Science and Doctor of Philosophy.

The interdisciplinary nature of agricultural and biosystems engineering often requires candidates for higher degrees to work in association with, or attend courses given by a number of other departments at both the McGill University Macdonald Campus and Downtown Campus.

1.3 Admission Requirements

Candidates for M.Sc. and Ph.D. degrees should indicate in some detail their fields of special interest when making application for admission. An equivalent cumulative grade point average of 3.0/4.0 is required at the Bachelor's level. Experience after the undergraduate degree is an additional asset.

1.4 Application Procedures

Applications for Admission and all supporting documents must be sent directly to:

Student Affairs Office (Graduate Studies)
Macdonald Campus of McGill University
21,111 Lakeshore
Sainte-Anne-de-Bellevue, QC H9X 3V9
Canada

Telephone: (514) 398-7925

Fax: (514) 398-7968

E-mail: GRAD@macdonald.mcgill.ca

Applications will be considered upon receipt of a signed and completed application form, \$60 application fee, all official transcripts, two signed original letters of reference on official letterhead of originating institution, and (if required) proof of competency in oral and written English by appropriate exams.

Deadlines – For **international students**, complete applications with supporting documents must reach the Student Affairs Office (Graduate Studies) at Macdonald Campus at least **eight months** prior to the intended start of program. May 1 for January (winter); September 1 for May (summer); January 1 for September (fall). For **domestic students**, complete applications with supporting documents must reach the office no later than **three months** in advance of intended start of program.

Application Fee (non-refundable) – A fee of \$60 Canadian must accompany each application (including McGill students), *otherwise it cannot be considered*. This sum must be remitted using one of the following methods:

1. **Certified** personal cheque in Cdn.\$ drawn on a Canadian bank;
2. **Certified** personal cheque in U.S.\$ drawn on a U.S. bank;
3. Canadian Money order in Cdn.\$;
4. U.S. Money Order in U.S.\$;
5. Bank draft in Cdn.\$ drawn on a Canadian bank;
6. Bank draft in U.S.\$ drawn on a U.S. bank; negotiable in Canada
7. Credit card (by completing the appropriate section of the application form).

Transcripts – Two official copies of all transcripts are required for admission. Transcripts written in a language other than English or French must be accompanied by a certified translation. An explanation of the grading system used by the applicant's university is essential. It is the applicant's responsibility to arrange for transcripts to be sent. **DOCUMENTS SUBMITTED WILL NOT BE RETURNED.**

It is desirable to submit a list of the titles of courses taken in the major subject, since transcripts often give code numbers only. Applicants must be graduates of a university of recognized reputation and hold a Bachelor's degree equivalent to a McGill Honours degree in a subject closely related to the one selected for graduate work. This implies that about one-third of all undergraduate courses should have been devoted to the subject itself and another third to cognate subjects.

The minimum cumulative grade point average (CGPA) is 3.0/4.0 (second-class upper) or 3.2/4.0 during the last two full-time years of university study. High grades are expected in courses considered by the academic unit to be preparatory to the graduate program.

Letters of Recommendation – Two letters of recommendation on letterhead or bearing the university seal and with original signatures from two instructors familiar with the applicant's work, preferably in the applicant's area of specialization, are required. It is the applicant's responsibility to arrange for these letters to be sent.

Competency in English – Non-Canadian applicants whose mother tongue is not English and who have not completed an undergraduate degree using the English language are required to submit documented proof of competency in oral and written English, by appropriate exams, e.g. TOEFL (minimum score 550) or IELTS (minimum 6.5). The MCHS is not considered equivalent.

Results must be submitted as part of the application. The University code is 0935 (McGill University, Montreal); department code is 31 (graduate schools), Biological Sciences - Agriculture.

Graduate Record Exam (GRE) – The GRE is not required, but it is highly recommended.

Financial aid is very limited and highly competitive. It is suggested that students give serious consideration to their financial planning before submitting an application.

Acceptance to all programs depends on a staff member agreeing to serve as the student's supervisor and the student obtaining financial support. Normally, a student will not be accepted unless adequate financial support can be provided by the student and/or the student's supervisor. Academic units cannot guarantee financial support via teaching assistantships or other funds.

Qualifying Students – Some applicants whose academic degrees and standing entitle them to serious consideration for admission to graduate studies, but who are considered inadequately prepared in the subject selected may be admitted to a *Qualifying Program* if they have met the Faculty of Graduate Studies and Research minimum CGPA of 3.0/4.0. The course(s) to be taken in a *Qualifying Program* will be prescribed by the academic unit concerned. *Qualifying students* are registered in the Faculty of Graduate Studies and Research, **but not as candidates for a degree**. Only one qualifying year is permitted. **Successful completion of a qualifying program does not guarantee admission to a degree program.**

1.5 Program Requirements

M.Sc.

At least 12 months of full-time study are required for this degree. A student may complete the requirements by obtaining 46 credits under the conditions of the thesis or non-thesis options.

M.Sc. Thesis Option

This option for the M.Sc. degree is oriented towards individuals who intend to develop a career in agricultural and biosystems engineering research. The requirements for this option are:

- 1) completion and final acceptance of a supervised research thesis in one of the areas described above, according to the regulations of the faculty of graduate studies and research. This work is represented by courses M.Sc. Thesis I through VIII, described below and equivalent to four credits each, for a total of 32 credits allotted to thesis work (336-691 to 698).
- 2) 12 credits of postgraduate course work in agricultural and biosystems engineering and other fields to be determined in consultation with the research director. It is required that the candidate include the scientific publication course in this category of credits.
- 3) Participation in graduate seminar during two semesters.

M.Sc., Applied – Non-thesis Option

The non-thesis option is aimed towards individuals already employed in industry or seeking to improve their skills in specific areas (soil and water/structures and environment/waste management/and environment protection/post harvest technology/food process engineering/environmental engineering) in order to enter the engineering profession at a higher level. The requirements for a candidate registering for this option are:

- 1) a minimum of 2 project courses of 6 credits each (336-671 and 672).
- 2) 31 additional credits in graduate courses from the Agricultural and Biosystems Engineering Department or courses from other departments relevant to project topics which must be approved by the academic advisor. Selection of courses in each area can follow the format of the example shown below for the Food Process Engineering area: this option is offered under the regulations of the non-thesis degree in cooperation with the Department of Food Science and Agricultural Chemistry and the Department of Chemical Engineering. The candidate is ex-

pected to obtain 12 of the 31 non-project credits in the cooperating departments. The division of these 12 credits between the two departments should be decided between the candidate and the supervisors of the projects undertaken. In some cases, necessary senior undergraduate courses in the collaborative departments can be taken for credit towards the M.Sc., Applied.

- 3) participation in graduate seminar during two semesters.

Candidates must meet the qualifications of a professional engineer either before or during their M.Sc., Applied program.

Each candidate for this option is expected to establish and maintain contact with his/her academic advisor in the Department of Agricultural and Biosystems Engineering some time before registration in order to clarify objectives, investigate project possibilities and plan a program of study.

M.Sc. in Environmental Engineering

The program consists of a minimum of 45 credits, of which, depending on the student's home department, a minimum of 5 and a maximum of 15 may be allotted to the project. The balance is earned by coursework, of which one to three approved undergraduate (below 500-level) courses are allowed. Candidates must possess a Bachelor's degree in engineering with superior academic achievement (a minimum cumulative grade point average of 3.0 out of a possible 4.0).

To complete the program, students must:

- 1) complete four required core courses;
- 2) complete a minimum of two engineering courses;
- 3) complete a minimum of two non-engineering courses (each course should be chosen from a different department);
- 4) complete a design or research project of 5 to 15 credits;
- 5) complete all the remaining courses (to a total of at least 45 credits) as required in the student's departmental program (these courses must be approved by the student's Academic Advisor); and
- 6) obtain a grade of 65% (or B-) or better in all required and approved courses.

Ph.D.

Candidates for the Ph.D. degree will normally register for the M.Sc. degree in the first instance. In cases where the research work is proceeding very satisfactorily, or where the equivalent of the M.Sc. degree has been completed, candidates may be permitted to proceed directly to the Ph.D. degree.

Courses of study selected for a Ph.D. program will depend on the existing academic qualifications of the candidate and on those needed for effective pursuit of research in the chosen field. Candidates are encouraged to take an additional course of study of their own choice in some field of the humanities, sciences or engineering not directly related to their research. The program will be established by consultation of the candidate with a committee that will include the Research Director and at least one other professor.

A comprehensive examination, Agricultural and Biosystems Engineering 336-701A,B,C, will be taken either late in the first, or early in the second, registration year to qualify to proceed to the completion of the Ph.D. degree.

Participation in graduate seminar during four semesters.

1.6 Courses

- Denotes not offered in 2000-01.

The course credit weight is given in parentheses (#) after the course title.

336-500B ARTIFICIAL INTELLIGENCE FOR BIOSYSTEMS (3) (3 hour lecture, 2 hour lab) Utilization of artificially intelligent constructs in biosystem engineering (design, construction, maintenance, operation, expansion), especially in agroecosystems. Topics include: neural networks rule-based expert systems, databases, control networks, artificial life.

- **336-504B INSTRUMENTATION AND CONTROL.** (3) (3 hours lectures and 2 hours lab)
- **336-506A,B,C ADVANCES IN DRAINAGE AND WATER MANAGEMENT.** (3) (Three weeks intensive course.)
- **336-509A,B HYDROLOGIC SYSTEMS AND MODELLING.** (3) (3 hours lectures)
- 336-512B SOIL CUTTING, TILLAGE AND TRENCHING.** (3) (2 hours lectures and 2 hours lab) Soil mechanics applied to cutting and tillage tools; soil cutting forces for two and three-dimensional implements, soil loosening, sorting, inversion and manipulation; selection of traction machines to match soil cutting and tillage requirements, traction; depth and grade control systems; analysis of drainage machines, wheel trenchers, Chain trenchers and trenchless plows. **Professor McKyes**
- 336-514B DRAIN PIPE AND ENVELOPE MATERIALS.** (3) Plastic, concrete, ceramic and geotextile drainage materials. Production, processing and management sciences. Quality control, testing, inventory management, handling, uses. Granular media for drainage. **Professor Bonnell**
- 336-515A COMPUTER MODELS IN DRAINAGE ENGINEERING.** (3) A review of computer simulation models of designing subsurface drainage systems. Use of CAD systems in design and drafting drainage plans. In depth discussion and applications of DRAINMOD and SWATRE, two microcomputer based models for designing and evaluating drainage water management systems for soils with high water tables, analysis of climatic and parametric uncertainties in the design. **Professor Prasher**
- **336-516A PREPARATION AND APPRAISAL OF DRAINAGE PROJECTS.** (3)
- **336-517A DRAINAGE PROJECT CONTRACTS, INSTALLATION AND MANAGEMENT.** (3)
- **336-518A POLLUTION CONTROL FOR AGRICULTURE.** (3) (3 hours lectures)
- 336-525B VENTILATION OF AGRICULTURAL STRUCTURES.** (3) The analyses of heat and water vapour transfer through the structure of buildings are used to design heating, ventilation and refrigeration systems. Heat conduction, convection and radiation are included in the analysis of heat transfer. Ventilation systems are designed for livestock shelters, produce storages and greenhouses. **Professor Barrington**
- **336-530B ADVANCED FOOD AND FERMENTATION ENGINEERING.** (3) (3 lectures and one 3-hour lab) (Prerequisite 336-325 or equivalent)
- 336-605A FUNCTIONAL ANALYSIS OF AGRICULTURAL MACHINES.** (3) (3 hours lectures) Theoretical analysis of unit operations performed by field machines. Physical and biological properties of the materials affected by the machines. **Professor Norris**
- **336-607B ENGINEERING ASPECTS OF PLANT ENVIRONMENT.** (3) (3 hours lectures)
- 336-608A,B,C SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING.** (3) (2 conferences, either term) Laboratory, field and library studies and reports on special problems related to agricultural and biosystems engineering that are not covered in regular course work. **The Chair and Staff**
- **336-611A,B ADVANCES IN IRRIGATION ENGINEERING.** (3) (3 hours lectures)
- **336-612A SIMULATION AND MODELLING.** (3) (3 hours lectures)
- 336-614B ENGINEERING DECISION ANALYSIS.** (3) (3 hours lectures) Analysis of various kinds of uncertainties, use of expected values of random parameters in decision analysis, decision trees, utility theorem, updating probabilities with Baye's theorem, first and second order methods of analyzing uncertainty. **Professor Prasher**
- **336-616B ADVANCED SOIL AND WATER ENGINEERING.** (3) (3 hours lectures)
- **336-617B SPECIAL DRAINAGE APPLICATIONS.** (3)
- 336-619B,C DRAINAGE AND RECLAMATION OF IRRIGATED LANDS.** (3) Design of drainage systems for control of salinity and water-logging in irrigated arid and semi-arid lands. Field investigations of soil and water salinity components, movement of water and salts. Canal leakage control, interceptor drains and field drains. Groundwater geology considerations. Disposal or reuse of drainage water. **Professors Paterson and Bonnell**
- 336-621A,B ADVANCES IN POST-HARVEST TECHNOLOGY – DRYING.** (3) (3 hours lectures) Heat and moisture transfer with respect to drying of agricultural commodities; techniques of enhancement of heat and mass transfer; drying efficiency and scale-up problems. **Professor Raghavan**
- **336-622A,B ADVANCES IN POST-HARVEST TECHNOLOGY – STORAGE.** (3) (3 hours lectures)
- 336-623A,B,C PROPOSAL PREPARATION.** (3) (3 hours conferences) Critiques of proposals prepared by others. Preparation and defense of draft proposals for funding agencies. **Professor Raghavan and Staff**
- 336-651A,B,C DEPARTMENTAL SEMINAR M.Sc. I.** (1) To give seminars and participate in discussions. **Professor Landry**
- 336-652A,B,C DEPARTMENTAL SEMINAR M.Sc. II.** (1) To give seminars and participate in discussions. **Professor Landry**
- 336-653A,B,C DEPARTMENTAL SEMINAR M.Sc. III.** (1) To give seminars and participate in discussions **Professor Landry**
- 336-671A,B,C PROJECT I.** (6) Prepare project outline, execute and report. This project relates to the M.Sc. (Applied) degree. **Professor Raghavan and Staff**
- 336-672A,B,C PROJECT II.** (6) Prepare project outline, execute and report. This project relates to the M.Sc. (Applied) degree. **Professor Raghavan and Staff**
- 336-691 through 336-698 must be taken in sequence.**
- 336-691A,B,C M.Sc. THESIS I.** (4) Problem definition and literature Review. **The Chair and Staff**
- 336-692A,B,C M.Sc. THESIS II.** (4) Project proposal and presentation. **The Chair and Staff**
- 336-693A,B,C M.Sc. THESIS III.** (4) Methodology development. **The Chair and Staff**
- 336-694A,B,C M.Sc. THESIS IV.** (4) Experimentation I. **The Chair and Staff**
- 336-695A,B,C M.Sc. THESIS V.** (4) Experimentation II. **The Chair and Staff**
- 336-696A,B,C M.Sc. THESIS VI.** (4) Data analysis. **The Chair and Staff**
- 336-697A,B,C M.Sc. THESIS VII.** (4) Draft thesis preparation. **The Chair and Staff**
- 336-698A,B,C M.Sc. THESIS VIII.** (4) Thesis completion and acceptance. **The Chair and Staff**
- 336-699A,B,C SCIENTIFIC PUBLICATION.** (3) (Periodic conferences) Review and critique papers that are published in field of the candidate. Prepare draft paper(s) following the format of leading journals in field of study undertaken. **Professor Raghavan and Staff**
- 336-701A,B,C PH.D. COMPREHENSIVE EXAMINATION.** **The Chair and Staff**
- 336-702A,B SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING II.** (3) (2 conferences, either term) Advanced level laboratory, field and library studies and reports on special problems related to agricultural and biosystems engineering which are not covered in regular course work. Designed for doctoral level students with experience in postgraduate studies. **Professor McKyes and Staff**
- 336-751A,B,C DEPARTMENTAL SEMINAR PH.D. I.** To give seminars and participate in discussions. **Professor Landry**
- 336-752A,B,C DEPARTMENTAL SEMINAR PH.D. II.** To give seminars and participate in discussions. **Professor Landry**

336-753A,B,C. DEPARTMENTAL SEMINAR PH.D. III. To give seminars and participate in discussions **Professor Landry**

336-754A,B,C DEPARTMENTAL SEMINAR PH.D. IV. To give seminars and participate in discussions **Professor Landry**

336-755A,B,C DEPARTMENTAL SEMINAR PH.D. V. To give seminars and participate in discussions **Professor Landry**

● **360-612B MATHEMATICAL METHODS.** (3) (3 hours lectures)

2 Agricultural Economics

Department of Agricultural Economics
Macdonald Campus
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue, QC H9X 3V9
Canada

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Chair — P.J. Thomassin

2.1 Staff

Associate Professors

K.R. Gunjal; B.Sc.(Poona), M.Sc.(New Delhi), Ph.D.(Iowa St.)

J.C. Henning; B.Sc., Ph.D.(Guelph)

P.J. Thomassin; B.Sc.(McG.), M.S., Ph.D.(Hawaii)

Assistant Professors

L.B.B. Baker; S.D.A., D.C.P.(Edin.), D.F.B.O.M.(Aberd.),

M.Sc.(Man.), Ph.D.(McG.)

M. Brown; B.A.(St-Mary's), M.A., Ph.D.(McM.)

Adjunct Professors

Joan Marshall, Peter Goldsmith

2.2 Programs Offered

The Department of Agricultural Economics offers programs leading to the M.Sc. and, with the Faculty of Management, a joint M.Sc./M.B.A. in Agricultural Economics. Students who complete all the degree requirements of the joint program will be awarded two degrees, an M.Sc. and an M.B.A.

It is possible for students to pursue doctoral studies in Agricultural Economics on an *ad hoc* basis, or through the Ph.D. program of the Department of Economics which offers Agricultural Economics as an area of specialization. For specific requirements of that graduate program see the Department of Economics.

2.3 Admission Requirements

M.Sc.

Direct admission to the M.Sc. requires the completion of a B.Sc. in Agricultural Economics or a closely related area, with the equivalent cumulative grade point average of 3.0/4.0 (Second Class-Upper).

The ideal preparation includes courses in agricultural economics, economic theory (intermediate micro and macro), calculus, linear algebra, and statistics. Students with deficiencies in these areas will be required to take additional courses as part of their degree program.

M.Sc./M.B.A.

Students must fulfil the admission requirements for both the M.Sc. degree in Agricultural Economics and the M.B.A. degree in the Faculty of Management.

2.4 Application Procedures

Applications for Admission and all supporting documents must be sent directly to:

Student Affairs Office (Graduate Studies)
Macdonald Campus of McGill University
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1. **Certified** personal cheque in Cdn.\$ drawn on a Canadian bank;
2. **Certified** personal cheque in U.S.\$ drawn on a U.S. bank;
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Transcripts – Two official copies of all transcripts are required for admission. Transcripts written in a language other than English or French must be accompanied by a certified translation. An explanation of the grading system used by the applicant's university is essential. It is the applicant's responsibility to arrange for transcripts to be sent. DOCUMENTS SUBMITTED WILL NOT BE RETURNED.

It is desirable to submit a list of the titles of courses taken in the major subject, since transcripts often give code numbers only. Applicants must be graduates of a university of recognized reputation and hold a Bachelor's degree equivalent to a McGill Honours degree in a subject closely related to the one selected for graduate work. This implies that about one-third of all undergraduate courses should have been devoted to the subject itself and another third to cognate subjects.

The minimum cumulative grade point average (CGPA) is 3.0/4.0 (second-class upper) or 3.2/4.0 during the last two full-time years of university study. High grades are expected in courses considered by the academic unit to be preparatory to the graduate program.

Letters of Recommendation – Two letters of recommendation on letterhead or bearing the university seal and with original signatures from two instructors familiar with the applicant's work, preferably in the applicant's area of specialization, are required. It is the applicant's responsibility to arrange for these letters to be sent.

Competency in English – Non-Canadian applicants whose mother tongue is not English and who have not completed an undergraduate degree using the English language are required to submit documented proof of competency in oral and written English, by appropriate exams, e.g. TOEFL (minimum score 570) or IELTS (minimum 6.5). The MCHE is not considered equivalent. Results must be submitted as part of the application. The University code is 0935 (McGill University, Montreal); department code is 31 (graduate schools), Biological Sciences - Agriculture.

Graduate Record Exam (GRE) – The GRE is not required, but it is highly recommended.

Financial aid is very limited and highly competitive. It is suggested that students give serious consideration to their financial planning before submitting an application.

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2.5 Program Requirements

M.Sc.

A minimum of 19 graduate course credits and the completion of a research thesis (27 credits) are required for the M.Sc. Students may specialize, by way of their research program, in agribusiness, development, finance, marketing and trade, policy, and resource and ecological economics.

Specific requirements are as follows:

1. Economic Theory (Micro and/or Macro) – 2 courses (6 credits)
2. Quantitative Methods – 1 course (3 credits)
3. Three other courses chosen in consultation with the Agricultural Economics Advisor with a minimum of one course in the Department of Agricultural Economics (9 credits).
4. Seminar (334-690) (1 credit)
5. M.Sc. Thesis I, II, III, IV, V (27 credits)

M.Sc./M.B.A.

A minimum of 19 graduate course credits and the completion of a research thesis (26 credits) are required for the M.Sc. degree which includes 5 credits of internship. The M.B.A. component of this joint program requires 45 credits.

The specific course requirements for the M.Sc. degree are:

1. Economic Theory – 1 course (3 credits)
2. Quantitative Methods – 1 course (3 credits)
3. Four other courses chosen in consultation with the Agricultural Economics Advisor with a minimum of one course in the Department of Agricultural Economics (12 credits).
4. Seminar (334-690) (1 credit)
5. Thesis requirement (26 credits).

The course requirements for the M.B.A degree are:

1. First year of the M.B.A. program (three trimesters - 30 credits).
2. 15 additional credits of M.B.A. courses.

(see the Faculty of Management M.B.A. program for additional details).

2.6 Graduate Courses

- Denotes not offered in 2000-01.

The course credit weight is given in parentheses (#) after the course title.

334-611B PRICE ANALYSIS. (3) Topics in advanced microeconomic theory with applications in agricultural economics. **Professor Henning**

- **334-633A ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS.** (3)

- **334-640A AGRICULTURE AND FOOD MARKETING.** (3)

334-642B ECONOMICS OF AGRICULTURAL DEVELOPMENT. (3) This course focuses on the role of agriculture in economic development. Topics covered will be – development theories, economic efficiency, employment, technology adoption and structural change in developing countries. Also, agriculture, food and development policies and implications for long term planning will be discussed. **Professor Gunjal**

334-679A FINANCING: ALTERNATIVE STRATEGIES. (3) An in-depth study of the relationship between financing, asset acquisition, tenure, and property rights and obligations for farm businesses. Emphasis will be placed on the potential for the use of non-debt financial instruments such as Community Based Land Trusts (CBLT) and Community Supported Agriculture (CSA). **Professor Baker**

334-685A,B,C SELECTED TOPICS IN AGRICULTURAL ECONOMICS. (3) This course is designed to permit students to explore agricultural economics topics that are not covered in other courses. Students may be asked to prepare a presentation or lead discussion on the selected topic for the benefit of other students and staff. (Pass/Fail grading) **Staff**

334-690 A,B,C SEMINAR. (1) This course will focus on current research on economic problems of agriculture through presentations by staff, students and special guests. All graduate students are required to register for this course, and make at least one major presentation.

334-691A,B,C M.Sc. THESIS I. (6)

334-692A,B,C M.Sc. THESIS II. (3)

334-693A,B,C M.Sc. THESIS III. (6)

334-694A,B,C M.Sc. THESIS IV. (6)

334-695A,B,C M.Sc. THESIS IV. (6)

3 Anatomy and Cell Biology

Department of Anatomy and Cell Biology
Strathcona Anatomy and Dentistry Building
3640 University Street
Montreal, QC H3A 2B2
Canada

Telephone: (514) 398-6335

Fax: (514) 398-5047

Chair — J.J.M. Bergeron

3.1 Staff

Emeritus Professor

Y. Clermont; B.Sc.(Montr.), M.Sc., Ph.D.(McG.)

Professors

A. Beaudet*; M.Sc., Ph.D., M.D.(Montr.)
G.C. Bennett; B.A., B.Sc.(Sir G.Wms.), M.Sc., Ph.D.(McG.)
J.J.M. Bergeron; B.Sc.(McG.), D.Phil.(Oxon.)
J.R. Brawer; B.S.(Tufts), Ph.D.(Harv.)
M. Burnier*; M.D.,M.Sc.,Ph.D.(Brazil)
L. Hermo; B.A.(Montr.), M.Sc., Ph.D.(McG.)
D. Lawrence*; B.Sc.(Bishop's), M.D., C.M.(McG.)
C.P. Leblond; M.D.(Paris), Ph.D.(Montr.), D.Sc.(Sorbonne)
S.C. Miller; B.Sc.(Sir G.Wms.), M.Sc., Ph.D.(McG.)
R. Murphy*; M.S.(Northeastern), Ph.D.(Rutgers)
D.G. Osmond; B.Sc., M.B., Ch.B., D.Sc.(Brist.), F.R.S.C.
B. Posner*; M.D.(Man.), Ph.D.(Iowa)
C.E. Smith*; D.D.S., Ph.D.(McG.)
E. Wang*; M.A.(N. Mich.), Ph.D.(C.W.R., Clev.)
H. Warshawsky; B.Sc.(Sir G.Wms), M.Sc., Ph.D.(McG.)

Associate Professors

O.W. Blaschuk*; B.Sc.(Winn.), M.Sc.(Man.), Ph.D.(Tor.)
E. Daniels; M.Sc., Ph.D.(Man.)
S. David*; Ph.D.(Man.)
M.F. Lalli; B.S., M.A.(Bowling Green), Ph.D.(McG.)

P. Lasko*; A.B.(Harv.), Ph.D.(M.I.T.)
 M. McKee*; B.Sc.,M.Sc.,Ph.D.(McG.)
 M. Miller*; B.Sc.(Marquette), M.Sc., Ph.D.(Loyola)
 C.R. Morales; D.V.M.(Argentina), Ph.D.(McG.)
 H. Vali*; B.Sc., M.Sc., Ph.D.(Munich)

Assistant Professors

C. Autexier; B.Sc.(C'dia) Ph.D.(McG.)
 D. Baranes; B.Sc.,M.Sc.,Ph.D.(Jerusalem)
 P. Barker*; B.Sc.(S.Fraser), Ph.D.(Alta.)
 M. Greenwood*; B.Sc.,M.Sc.(C'dia), Ph.D.(McG.)
 T. Kennedy*; B.Sc.(McM.), M.Phil., Ph.D.(Col.)
 A. Koromilas*; B.Sc., Ph.D.(Aristotelian U., Greece)
 N. Lamarche-Vane; B.Sc.,Ph.D.(U.Mtl.)
 P. McPherson*; M.Sc.(Man.), Ph.D.(Iowa)
 A. Ribeiro-da-Silva*; M.D., Ph.D.(Oporto)
 W. Sossin*; S.B.(M.I.T.), Ph.D.(Stan.)
 J. Snipes*; Ph.D., M.D.(Vanderbilt)
 S. Stifani*; Ph.D.(Rome), Ph.D.(Alta.)
 D. Walker*; B.Sc.(Geneva), Ph.D.(Salk), Ph.D.(Geneva)
 G. Wild*; B.Sc., Ph.D., M.D., C.M.(McG.)

Adjunct Professor

D. Cyr; B.Sc., M.Sc.(C'dia), Ph.D.(Man.)
 J. Drouin; B.Sc., D.Sc.(Laval)
 S. Inoue; M.Sc., Ph.D.(Hok. U.)
 A. Nantel; B.Sc., M.Sc.(Laval), Ph.D.(Chapel Hill)
 D. Thomas*; B.Sc.(Brist.), M.Sc., Ph.D.(Lond.)

* Denotes cross or joint appointees.

3.2 Programs Offered

Graduate research activities leading to the presentation of the M.Sc. and Ph.D. thesis involve original experimental work in one of the areas being actively investigated by the Department's Research Supervisors. Current research projects include: cell biology of secretion; cell biology of endocytosis; signal transduction of cell receptors for growth factors and hormones; synthesis and migration of glycoproteins; subcomponents of the Golgi apparatus and their function; biogenesis and function of lysosomes; cell turnover in various tissues; control of cell growth and proliferation; molecular biology of extracellular matrix; structure, composition and function of basement membranes and connective tissue microfibrils; cell and microfibrils; cell and molecular biology of spermatogenesis; genetic expression of proteins in the formation of cytoskeletal components of spermatozoa; role of endocytosis and secretion by epididymal cells in sperm maturation; molecular biology of Sertoli cell secretions and their interaction with germ cells; synchronization of sperm production; transferrin, transferrin receptors and iron in germinal cells; differentiation of B lymphocytes in bone marrow in relation to mechanisms of humoral immunity, immunodeficiency states and B cell neoplasias; control mechanisms and cytokines in B lymphopoiesis; in situ organization and stromal cell-interactions of B lineage precursor cells in bone marrow; microenvironmental regulation of hemopoiesis; differentiation and regulation of cells mediating natural tumor immunosurveillance; tumor-cell biology; cell and molecular biology of the formation of dental enamel, dentin and bone; structure of organic matrices and inorganic crystals of dental enamel; role of hormones and their binding sites with calcified tissues; secretion and degradation of the proteins of enamel matrix, hypothalamo-pituitary function and gonadotropin patterns in ovarian follicular development; polycystic ovarian disease; computer assisted modeling of morphometric and kinetic data; cell biology and molecular genetics of ageing; senescence and cell cycle-specific genes and their products.

Research in the Department investigates the dynamics and organization of molecules, organelles, cells and tissues in several major systems of the body. The work makes fundamental contributions to a number of established and emerging multidisciplinary fields: cell and molecular biology, cellular immunology and hematology, reproductive biology, calcified tissue biology, tumor cell biology, developmental biology, neurobiology and ageing.

The Department offers contemporary facilities for the wide range of techniques currently employed in research. Modern methods of cell and molecular biology, immunology and biochemistry are used in conjunction with specialized microscopy in a variety of experimental systems. Techniques used by Department members include labeling with radioisotopes and other tracers, radioautography, immunocytochemistry, histochemistry, cryo immune microscopy, fluorescence microscopy, high resolution electron microscopy, scanning electron microscopy, backscattered electron imaging, confocal microscopy, microinjection, video-microscopy in living cells, X-ray microanalysis, electron diffraction, freeze-fracture replication, computer reconstruction and quantitation, chromatography, subcellular fractionation, recombinant DNA technology, in situ hybridization, tissue grafting, cell and tissue culture, mutant and transgenic mice, hybridomas, and monoclonal antibodies.

The Department has one of the largest electron microscope facilities in Canada. Currently in use are three modern electron microscopes, including a high voltage instrument, the JEOL 2000FX. Combined with some of these microscopes are computer-aided analytical equipment capable of elemental microanalysis, histomorphometry, reconstruction and quantitation. The high voltage microscope is particularly useful for certain analytical electron optical procedures such as electron diffraction, lattice imaging and stereo electron microscopy.

3.3 Admission Requirements

M.Sc. and Ph.D. Programs

1. A B.Sc. degree in life sciences or any of M.D., D.D.S. or D.V.M. degrees from a university of recognized reputation.
2. Evidence of a high academic achievement with a minimum Cumulative Grade Point Average (CGPA) of 3.3 on 4.0.

Admission to a Qualifying Program

Applicants whose academic degree and standing entitle them to serious consideration for admission to graduate studies, but who are considered inadequately prepared in the area chosen may, upon recommendation of the Graduate Student Affairs Committee, and with the permission of the Director of Graduate Studies of the Faculty of Graduate Studies and Research, be admitted to Qualifying Programs. The courses to be taken in qualifying programs will be stipulated by the Graduate Student Affairs Committee. (Note: Only one qualifying program of a maximum of one year is permitted.)

3.4 Application Procedures

Application for admission to the Faculty of Graduate Studies and Research for the degrees of M.Sc. or Ph.D. in Anatomy should be made to the Chair of Graduate Studies, Department of Anatomy and Cell Biology.

Application forms and a brochure giving full details of the Graduate Program are available upon request.

Documents Required

1. Two official copies of complete university-level academic records to date (this also applies to McGill University transcripts). It may be desirable to submit a list of the titles of the courses taken, if transcripts give code numbers only.
 It is the applicant's responsibility to contact the institution(s) which he/she has attended and request that the transcripts be forwarded directly to the Department of Anatomy.
2. Two letters of recommendation.
 It is the applicant's responsibility to arrange that these letters are originals, sent directly to the Department of Anatomy from the persons specified by the applicant.
3. Fee of \$60.00 in Canadian funds for processing the application.

3.5 Program Requirements

The M.Sc. program is a 48-credit program. Students must complete 15 credits in course work and 33 credits of thesis research (504-698 and 504-699).

For the Ph.D. degree, the student must complete a series of courses selected to suit individual requirements. In addition, Ph.D. candidates will write a comprehensive examination after the end of the first year.

For both degrees, the major emphasis is placed on the conduct of original research and the preparation of a thesis.

3.6 Courses

The course credit weight is given in parentheses (#) after the course title.

504-663D HISTOLOGY. (9) The study of the cytology and structure of tissues and organs.

504-690D CELL BIOLOGY. (6) Current developments in molecular cell biology and developmental biology will be presented by course coordinators and staff from primary papers in the scientific literature. These will be researched and critiqued by students through oral and written presentations. Two term papers are required for students taking the course.

504-698D M.Sc. THESIS RESEARCH. (24)

504-699D M.Sc. THESIS SEMINAR. (9)

504-701D Ph.D. COMPREHENSIVE EXAMINATION.

4 Animal Science

Department of Animal Science
Macdonald Campus
21,111 Lakeshore Road
Sainte-Anne-de-Bellevue, QC H9X 3V9
Canada

Telephone: (514) 398-7794
Fax: (514) 398-7964
E-mail: Info@AnimSci.AgrEnv.McGill.CA
Website: <http://www.agrenv.mcgill.ca/animal/animal.htm>

Chair — X. Zhao

4.1 Staff

Emeritus Professor

J.E. Moxley; B.Sc.(Agr.), M.Sc.(McG.), Ph.D.(C'nell)

Professors

R.B. Buckland; B.Sc.(Agr.), M.Sc.(McG.), Ph.D.(Maryland)
E.R. Chavez; Agr.Eng.(Chile), M.Sc. Ph.D.(Calif.)
B.R. Downey; D.V.M.(Tor.), Ph.D.(McG.)
J.F. Hayes; B.Agr.Sc., M.Agr.Sc.(Dub.), Ph.D.(N.C.St.)
U. Kuhnlein; B.Sc.(Fed. Inst. of Tech., Zurich), Ph.D.(Geneva)
K.F. Ng-Kwai-Hang; B.Sc.(Agr.), M.Sc., Ph.D.(McG.)

Associate Professors

R.I. Cue; B.Sc.(Newcastle-upon-Tyne), Ph.D.(Edin.)
P.C. Laguë; B.A.(Montr.), B.S.A.(Laval), M.S., Ph.D.(C'nell)
H. Monardes; Ing. Agr.(Concepcion, Chile), M.Sc., Ph.D.(McG.)
L.E. Phillip; B.Sc.(Agr.), M.Sc.(Agr.)(McG.), Ph.D.(Guelph)
K.M. Wade; B.Sc.(Agr.), M.Sc.(Agr.)(Dublin), Ph.D.(C'nell)
D. Zadworny; B.Sc., Ph.D.(Guelph)
X. Zhao; B.Sc., M.Sc.(Nanjing), Ph.D.(C'nell)

Assistant Professors

R.C. Chian; B.Sc.(Northeast Agric.U., PR China), M.Sc.(Nanjing Agric.U, PR China), Ph.D.(Okayama U., Japan) (PT)
R. Lacroix; B.Sc., M.Sc.(Que.), Ph.D.(McG.) (PT)

Associate Members

Faculty in the School of Dietetics and Human Nutrition

Adjunct Professors

M. Britten, C. Keefer, P. Lacasse, B. Murphy, D. Petitclerc, J.D. Turner

4.2 Programs Offered

The Department provides laboratory facilities for research work leading to the degrees of Master of Science and Doctor of Philosophy in the disciplines of animal breeding (genetics), nutrition, and reproductive physiology, molecular biology, milk biochemistry and information systems. Within these areas advantage may be taken of strong research programs and expertise in molecular biology and milk biochemistry. Students registered in the Department of Animal Science may develop programs in conjunction with other units at McGill, for example the Nutrition and Food Science Centre or the School of Dietetics and Human Nutrition. Each student has an advisory committee composed of the thesis supervisor and at least two other faculty members.

4.3 Admission Requirements

M.Sc. (Thesis)

Candidates are required to have either a Bachelor's degree in Agriculture or a B.Sc. degree in an appropriate, related discipline with an equivalent cumulative grade point average of 3.2/4.0 over the past four full-time semesters of study.

M..Sc. (Applied)

All candidates are required to have a B.Sc. degree or equivalent.

Ph.D.

Candidates are normally required to have an M.Sc. degree in an area related to the chosen field of specialization for the Ph.D. program.

4.4 Application Procedures

Applications for Admission and all supporting documents must be sent directly to:

Student Affairs Office (Graduate Studies)
Macdonald Campus of McGill University
21,111 Lakeshore
Sainte-Anne-de-Bellevue, QC H9X 3V9
Canada

Telephone: (514) 398-7925
Fax: (514) 398-7968
E-mail: GRAD@macdonald.mcgill.ca

Applications will be considered upon receipt of a signed and completed application form, \$60 application fee, all official transcripts, two signed original letters of reference on official letterhead of originating institution, and (if required) proof of competency in oral and written English by appropriate exams.

Deadlines – For **international students**, complete applications with supporting documents must reach the Student Affairs Office (Graduate Studies) at Macdonald Campus at least **eight months** prior to the intended start of program. May 1 for January (winter); September 1 for May (summer); January 1 for September (fall). For **domestic students**, complete applications with supporting documents must reach the office no later than **three months** in advance of intended start of program.

Application Fee (non-refundable) – A fee of \$60 Canadian must accompany each application (including McGill students), *otherwise it cannot be considered*. This sum must be remitted using one of the following methods:

1. **Certified** personal cheque in Cdn.\$ drawn on a Canadian bank;
2. **Certified** personal cheque in U.S.\$ drawn on a U.S. bank;
3. Canadian Money order in Cdn.\$;
4. U.S. Money Order in U.S.\$;
5. Bank draft in Cdn.\$ drawn on a Canadian bank;
6. Bank draft in U.S.\$ drawn on a U.S. bank, negotiable in Canada;

7. Credit card (by completing the appropriate section of the application form).

Transcripts – Two official copies of all transcripts are required for admission. Transcripts written in a language other than English or French must be accompanied by a certified translation. An explanation of the grading system used by the applicant's university is essential. It is the applicant's responsibility to arrange for transcripts to be sent. DOCUMENTS SUBMITTED WILL NOT BE RETURNED.

It is desirable to submit a list of the titles of courses taken in the major subject, since transcripts often give code numbers only. Applicants must be graduates of a university of recognized reputation and hold a Bachelor's degree equivalent to a McGill Honours degree in a subject closely related to the one selected for graduate work. This implies that about one-third of all undergraduate courses should have been devoted to the subject itself and another third to cognate subjects.

The minimum cumulative grade point average (CGPA) is 3.0/4.0 (second-class upper) or 3.2/4.0 during the last two full-time years of university study. High grades are expected in courses considered by the academic unit to be preparatory to the graduate program.

Letters of Recommendation – Two letters of recommendation on letterhead or bearing the university seal and with original signatures from two instructors familiar with the applicant's work, preferably in the applicant's area of specialization, are required. It is the applicant's responsibility to arrange for these letters to be sent.

Competency in English – Non-Canadian applicants whose mother tongue is not English and who have not completed an undergraduate degree using the English language are required to submit documented proof of competency in oral and written English, by appropriate exams, e.g. TOEFL (minimum score 550 or 213 on computerized test) or IELTS (minimum 6.5). The MCHE is not considered equivalent. Results must be submitted as part of the application. The University code is 0935 (McGill University, Montreal); department code is 31 (graduate schools), Biological Sciences - Agriculture.

Graduate Record Exam (GRE) – The GRE is not required, but it is highly recommended.

Financial aid is very limited and highly competitive. It is suggested that students give serious consideration to their financial planning before submitting an application.

Acceptance to all programs depends on a staff member agreeing to serve as the student's supervisor and the student obtaining financial support. Normally, a student will not be accepted unless adequate financial support can be provided by the student and/or the student's supervisor. Academic units cannot guarantee financial support via teaching assistantships or other funds.

Qualifying Students – Some applicants whose academic degrees and standing entitle them to serious consideration for admission to graduate studies, but who are considered inadequately prepared in the subject selected may be admitted to a *Qualifying Program* if they have met the Faculty of Graduate Studies and Research minimum CGPA of 3.0/4.0. The course(s) to be taken in a *Qualifying Program* will be prescribed by the academic unit concerned. *Qualifying students* are registered in the Faculty of Graduate Studies and Research, **but not as candidates for a degree**. Only one qualifying year is permitted. **Successful completion of a qualifying program does not guarantee admission to a degree program.**

4.5 Program Requirements

M.Sc. (Thesis)

Four one-semester courses or the equivalent and two seminar courses at the post-graduate level are required, as a minimum, although a student may be advised to take additional courses as specified by his/her advisory committee. Advanced undergraduate courses may be considered for graduate credit if approved by the student's committee and graduate faculty and passed at the grad-

uate level; generally, this will not constitute more than one of the four required courses.

A minimum of 45 credits and completion of an acceptable thesis is required for the M.Sc. degree; 14 credits are for course work and 31 credits for the thesis (342-680, 681, 682, and 683). Exceptional M.Sc. students may be considered for Ph.D. status after one full year in the Department.

M.Sc. (Applied) in Animal Science (45 credits)

The M.Sc. Applied (non-thesis) degree is oriented to animal scientists already working in industry or government, to undergraduate students inspired by concepts in sustainable and integrated animal agriculture, to project leaders interested in animal resource management and to veterinarians. The program aims to provide graduate training in applied areas of animal production with a view towards integrating technology and management in animal production with allied areas of agricultural resource utilisation.

Required Course (3 credits)

342-501B (3) Advanced Animal Production Systems.

Complementary Courses (27 credits)

9 credits must be in Animal Science at the graduate level

18 credits can be selected from a recommended list where no more than 6 credits can be chosen from undergraduate level courses.

Project Component – Required (15 credits)

342-643 (3) Project I
342-644 (3) Project II
342-645 (3) Project III
342-646 (3) Project IV
342-647 (3) Project V

Ph.D.

Since the Ph.D. is primarily a research degree, the amount of course work required may comprise a smaller portion of the total than is the case for the M.Sc., this will depend on the background of the individual student, and must be approved by the student's advisory committee. This course work must include two seminar courses at the graduate level and the Ph.D. Comprehensive Examination 342-701D.

The thesis must clearly show originality and be a contribution to knowledge.

4.6 Courses

- Denotes not offered in 2000-01.
- Denotes limited enrolment.

The course credit weight is given in parentheses (#) after the course title.

In addition to the courses listed below, students may be required to take one or more courses offered by other departments or faculties.

342-501B ADVANCED ANIMAL PRODUCTION SYSTEMS. (3)

(3 lectures) An advanced course dealing with current world animal production systems (ruminant and monogastric) emphasizing their practices, constraints and relative efficiencies with a view to developing methods of improving productivity. **Professor Chavez**

342-504A POPULATION GENETICS. (3) (3 lectures) A consideration of the problems involved in the improvement of animals and the application of genetics in their solution. **Professor Monardes**

342-551B CARBOHYDRATE AND LIPID METABOLISM. (3) (3 lectures) Comparative aspects of nutrition and metabolism of carbohydrate and lipid from the cellular level through the multi-organ of the whole organism. Main topics will include biothermodynamics, calorimetry, cellular metabolism and functions of carbohydrate and lipid, digestion, absorption and utilization of dietary carbohydrate and lipid. **Staff**

342-552A PROTEIN METABOLISM AND NUTRITION. (3) (3 lectures) Comparative aspects of nutrition and metabolism of amino acids and proteins from the cellular level on through the multisystem operation of the whole organism. Main topics include cellular

metabolism and functions of amino acids and proteins, digestion, absorption and utilization of dietary protein. Comparison between farm animals and humans. **Professors Zhao and Phillip**

342-605B ESTIMATION OF GENETIC PARAMETERS. (3) (3 lectures) (Given in alternate years.) General methods for the estimation of components of variance and co-variance are considered, with specific emphasis given to their application to heritability, repeatability and genetic correlation estimation. **Professor Hayes**

342-606B SELECTION INDEX AND ANIMAL IMPROVEMENT. (3) (3 lectures) Selection index principles and their application to livestock improvement are considered, with emphasis on the estimation of genetic breeding values for single and multi-trait selection. **Staff**

342-607A LINEAR MODELS IN AGRICULTURAL RESEARCH. (3) (3 lectures) The theory and application of linear models to agricultural research is considered. Special emphasis is given to the analysis of experimental and survey data with unequal subclass numbers. **Professor Cue**

★342-611B ADVANCE REPRODUCTIVE PHYSIOLOGY. (3) (2 lectures, 1 seminar) (Given in alternate years.) Discussion of current concepts relating to male and female reproduction, primarily of domestic animals and avian species. Topics include: the regulation of gonadal function and sexual behavior, pregnancy and parturition, and methods of assessing and/or improving reproductive efficiency. **Professors Downey and Laguë**

● **342-620A,B VERTEBRATE CELL CULTURE METHODS.** (3) (3 labs and 1 seminar)

342-622B SELECTED TOPICS IN MOLECULAR BIOLOGY. (3) (1 lecture and 2 seminars) (Prerequisite: 362-500B or permission of instructor) Key examples of applications of molecular biology to the study of animal physiology and animal genetics will be drawn from the current literature and discussed in depth. The course has a dual purpose. It will familiarize students with current events at the forefront of molecular biology and will teach them how to read and critically evaluate research publications. **Professor Kuhnlein**

● **★342-623B TECHNIQUES IN MOLECULAR GENETICS: DNA SEQUENCING.** (3)

● **★342-624B TECHNIQUES IN MOLECULAR GENETICS: DNA FINGERPRINTING.** (3) (Requires previous laboratory experience.)

● **★342-625B TECHNIQUES IN MOLECULAR GENETICS: POLYMERASE CHAIN REACTION.** (3)

342-630A EXPERIMENTAL TECHNIQUES IN ANIMAL SCIENCE: NUTRITION. (3) (1 lecture, 1 lab) Lectures and laboratories dealing with animal experimentation. Emphasis on the design and conduction of animal studies, selection of experimental animals, chemical and biological assays, statistical analysis, interpretation of data and preparation of technical reports. **Professor Chavez and Staff**

● **342-635B VITAMIN AND MINERAL NUTRITION.** (3) (3 lectures)

342-636B TECHNIQUES IN ANALYSIS OF ANIMAL BREEDING RESEARCH DATA. (3) (3 lectures) An advanced graduate course to give training and experience in statistical techniques applied to quantitative genetics and animal breeding. To consider aspects of data handling of large data sets (100,000 observations), checks for consistency and connectedness in data. Considerations in choosing efficient analytical procedures in fitting these models and development of efficient numerical algorithms to apply these procedures. **Professor Cue**

342-643A,B PROJECT I. (3) Review of the literature and design of the project. This project relates to the M.Sc. Applied (non-thesis) degree. **Staff**

342-644A,B PROJECT II. (3) Continuation of the review of the literature and design of project. This project relates to the M.Sc. Applied (non-thesis) degree. **Staff**

342-645A,B PROJECT III. (3) Execution and write-up of project. This project relates to the M.Sc. Applied (non-thesis) degree. **Staff**

342-646A,B PROJECT IV. (3) Continuation of write-up and submission of project. This project relates to the M.Sc. Applied (non-thesis) degree. **Staff**

342-647A,B PROJECT V. (3) Seminar and project presentations. This oral presentation of the project relates to the M.Sc. Applied (non-thesis) degree. **Staff**

342-680A,B ANIMAL SCIENCE M.Sc. THESIS I. (7) Independent research under the direction of a supervisor toward completion of M.Sc. thesis. **Staff**

342-681A,B ANIMAL SCIENCE M.Sc. THESIS II. (7) Independent research under the direction of a supervisor toward completion of M.Sc. thesis. **Staff**

342-682A,B ANIMAL SCIENCE M.Sc. THESIS III. (7) Independent research under the direction of a supervisor toward completion of M.Sc. thesis. **Staff**

342-683A,B ANIMAL SCIENCE M.Sc. THESIS IV. (10) Final submission and approval of M.Sc. thesis. **Staff**

342-691D,N SPECIAL TOPICS IN ANIMAL SCIENCE. (3) Prescribed reading, conference or practical work on a selected topic in the student's area of specialization, not otherwise available in other courses; under staff supervision. An approved course outline must be on file in the Departmental office prior to registration deadline. **Staff**

342-692D,N SPECIAL TOPICS IN ANIMAL SCIENCE. (3) Prescribed reading, conference or practical work on a selected topic in the student's area of specialization, not otherwise available in other courses; under staff supervision. An approved course outline must be on file in the Departmental office prior to registration deadline. **Staff**

342-693D,N SPECIAL TOPICS IN ANIMAL SCIENCE. (3) Prescribed reading, conference or practical work on a selected topic in the student's area of specialization, not otherwise available in other courses; under staff supervision. An approved course outline must be on file in the Departmental office prior to registration deadline. **Staff**

342-695A,B ANIMAL SCIENCE SEMINAR I. (1) (1 hour) One of two seminars to be given by all students in an M.Sc. program. Consists of a review of literature in relation to the student's proposed research and an experimental design of the research to be conducted. **Professor Cue**

342-696A,B ANIMAL SCIENCE SEMINAR II. (1) (1 hour) One of two seminars to be given by all students in an M.Sc. program. Presentation of a current scientific topic which is not related to the student's research. The topic for the presentation should be cleared by the thesis supervisor. **Professor Cue**

342-797A,B ANIMAL SCIENCE SEMINAR III. (1) (1 hour) One of two seminars to be given by all students in a Ph.D. program. Review of literature in relation to the student's proposed research and an experimental design of the research to be conducted. **Professor Cue**

342-798A,B ANIMAL SCIENCE SEMINAR IV. (1 hour) One of two seminars to be given by all students in a Ph.D. program. Presentation of a current scientific topic which is not related to the student's research. The topic for the presentation should be cleared by the thesis supervisor. **Professor Cue**

342-701D DOCTORAL COMPREHENSIVE EXAMINATION. (See Faculty Regulations)

360-610A STATISTICAL METHODS II. (3) (3 hours lectures and 2 hours lab) (Prerequisite: 360-310A or equivalent) Principles of linear models, multiple regression equations and classification models. Introduction to Analysis of Variance and common statistical designs used in agricultural and environmental sciences. Emphasis on balanced and unbalanced designs and data structures; their analysis and tests of statistical significance. **Professor Cue**