**FACULTIES OF THE
UNIVERSITY OF PRETORIA**

HUMANITIES
NATURAL AND AGRICULTURAL SCIENCES
LAW
THEOLOGY
ECONOMIC AND MANAGEMENT SCIENCES
VETERINARY SCIENCE
EDUCATION
HEALTH SCIENCES
ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

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PART II

POSTGRADUATE SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT

FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

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AS ON 30 SEPTEMBER 2014

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Potgieter, M., BSc(Hons)(Stellenbosch) MSc(Unisa) PhD(Illinois)

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Meyer, F.H., BScAgric(Hons) MSc(Agric) PhD(Pretoria) ..... Senior Lecturer
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Briers, N. BSc(Stellenbosch) MSc DTI(Pretoria) .....Senior Lecturer
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Department of Animal and Wildlife Sciences

Webb, E.C., MSc(Agric) PhD(Pretoria) PrSciNat(Anim) SASAS.....Professor (Head)
Bothma, J. du P., MSc(Pretoria) PhD(Texas A&M)
PrSciNat(Environ).....Emeritus Professor
Casey, N.H., MSc(Agric)(Natal) DSc(Agric)(Pretoria)
PrSciNat(Anim) MRSSA SASAS.....Emeritus Professor
Donkin, E.F., BSc(Agric)(Natal) MPhil(London) PhD(Medunsa)
PrSciNat(Anim)…….. .....Emeritus Professor
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PhD(Natal) PrSciNat(Anim) SASAS.....Emeritus Professor
Robinson, P.H., BSc(Manitoba) MSc(Guelph) PhD(Cornell Univ).....Extraordinary Professor
Schönfeldt, H.C., BSc(Home Econ & Dietetics) M(Home Econ)
PhD(Pretoria) R Nutri(UK) (SA) PriSciNat(Fd Sci).....Extraordinary Professor
Erasmus, L..J., MSc(Agric) PhD(Pretoria) PrSciNat(Anim)
SASAS PAS(USA)…….....Associate Professor
Somers, M.J., MSc(Wildlife Management)(Pretoria)
PhD(Stellenbosch).....Associate Professor
Van Marle-Köster, E., BSc(Agric)(Pretoria) BSc(Agric)(Hons)
MSc(Agric)(Free State) PhD(Pretoria) Dipl. Development
Studies(Unisa) PrSciNat(Anim) SASAS…….. .....Associate Professor
Van Niekerk, W.A., MSc(Agric) PhD(Pretoria)
PrSciNat(Anim) SASAS .....Associate Professor
Strydom, P.E., MSc(Agric)(Pretoria) PhD(Free State).....Extraordinary Lecturer
Hassen, A., MSc(Agric)(Tanz) PhD(Pretoria) SASAS .....Senior Lecturer
Lehoenya, K.C., BSc(Agric)(Hons) MSc(Agric) PhD(Free State)
SASAS PrSciNat(Anim) .....Senior Lecturer
Meyer, J.A., MSc(Agric) PhD(Pretoria) SASAS.....Senior Lecturer
Visser, C., BSc(Agric) BSc(Agric)(Hons) MSc(Agric)(Pretoria)
PhD(Pretoria) SASAS PrSciNat(Anim).....Senior Lecturer
Coertze, R.J., BSc(Agric)(Hons)(Pretoria).....Lecturer
Jansen van Rensburg, C., MSc(Agric) PhD(Pretoria)
PrSciNat(Anim) SASAS .....Lecturer
Keith, M., MSc PhD(Pretoria) .....Lecturer
Pretorius, Y., MSc(KwaZulu-Natal) PhD(Wageningen).....Lecturer
Basson, A., BSc(Agric) MSc(Agric)(Pretoria).....Junior Lecturer
O'Neill, A., BSc(Agric) MSc(Agric)(Pretoria).....Junior Lecturer

University of Pretoria Natural Hazard Centre, Africa

Kijko, A., PhD(Polish Acad. Sci.) Dr Habil(Krakow) .....Director and Professor
Smit, A., MSc(Pretoria) .....Control Tech. Assist.

Department of Biochemistry

Meyer, D., BSc(Hons) MSc(RAU) PhD(California) ..... Professor (Head)
Swai, H., BSc(Dar es Salaam) MSc PhD(London) ..... Extraordinary Professor
Louw, A.I., MSc(Agric) DSc(Agric)(Pretoria) M.Akad.SA PrSciNat .... Emeritus Professor
Neitz, A.W.H., MSc(Agric) DSc(Agric)(Pretoria) ..... Emeritus Professor
Burton, S.G., MSc PhD(Rhodes)..... Professor
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Schubert, W-D., BSc(Hons) MSc(Cape Town) Dr.rer.nat.(FU Berlin) Professor
Verschoor, J.A., MSc(Agric) DSc(Agric)(Pretoria) ..... Professor
Apostolides, Z., MSc(Agric) DSc(Agric)(Pretoria) PrSciNat ..... Associate Professor
Birkholtz., L-M., MSc PhD(Pretoria) ..... Associate Professor (Chair: SARchi Chair in Sustainable Malaria Control)
Reva, O., MSc PhD(Ukraine) ..... Associate Professor
Beukes, M., BSc(Hons)(Western Cape) MSc PhD(Natal)..... Senior Lecturer
Gaspar, A.R.M., BSc(Hons) MSc PhD(Pretoria)..... Associate Professor
Motshwene, P.G., BSc(Hons) MSc(Cape Town), PhD(Cambridge)... Senior Lecturer
Niemand, J., MSc PhD(Pretoria) ..... Lecturer

Centre for Bioinformatics and Computational Biology

Joubert, F., BSc(Hons) MSc PhD(Pretoria) ..... Professor/Director

Centre for Environmental Economics and Policy in Africa

Hassan, R.M., BSc(Hons) MSc(Agric)(Sudan)
MSc PhD(Iowa State) ..... Professor/Director

Centre for Environmental Studies

Ferguson, J.W.H., BSc(Hons) MSc(Pretoria) PhD(Witwatersrand).... Professor/Director

Centre for Science, Mathematics and Technology Education

Hattingh, A., BSc HED BEd(Hons) MEd PhD(Pretoria) ..... Director and Associate Professor
Ndlalane, T.C., BA UED(Unizul) BEd(Natal)
MEd Science Edu(Leeds) PhD(Pretoria)..... Senior Lecturer

Department of Chemistry

Rohwer, E.R., BSc(Hons) MSc(Stellenbosch) PhD(RAU)
PrSciNat ..... Professor (Head)
Cukrowski, I., MSc PhD(UMCS, Lublin, Poland)
DSc(CU, Torun, Poland)..... Professor
Lotz, S., BSc(Hons) MSc(Stellenbosch) PhD(RAU) PrSciNat..... Professor
Van Rooyen, P.H., BSc(Hons) MSc PhD(RAU)..... Professor
Potgieter, M., BSc(Hons)(Stellenbosch) MSc(Unisa)
PhD(Illinois) ..... Associate Professor
Schoeman, W.J., BCom(Unisa) MSc DSc(Pretoria)
Dip Management (National Education) ..... Associate Professor
Bauermeister, S., BSc(Hons) MSc PhD(Pretoria)..... Senior Lecturer
Castleman, B.B., BSc(Hons) MMed(Witwatersrand) ..... Senior Lecturer
Forbes, P.B.C., BSc(Hons)(Natal) MSc(Cape Town) PhD(Pretoria) .. Senior Lecturer
Landman, M., BSc(Hons) MSc PhD(Pretoria) ..... Senior Lecturer

Laurens, J.B., BSc(Hons) MSc(Pretoria) MSc(Surrey,UK)
PhD(Pretoria) PrSciNat.....Senior Lecturer
Nkwelo, M.M., BSc(Hons) MSc(Fort Hare) PhD(Witwatersrand) .....Senior Lecturer
Pilcher, L.A., BSc(Hons) MSc(Rhodes) PhD(Cantab) .....Senior Lecturer
Rademeyer, M., BSc(Hons) MSc PhD(RAU).....Senior Lecturer
Riley, D.L., BSc(Hons) PhD (Witwatersrand).....Senior Lecturer
Van der Merwe, E.M., BSc(Hons) MSc PhD(Pretoria).....Senior Lecturer
Venter, E.M.M., MSc(Pretoria) PhD(RAU) PrSciNat.....Senior Lecturer
Bezuidenhout, D.I., BSc(Hons) MSc PhD(Pretoria).....Lecturer
Botha, A.C., HED BSc(Hons)(Pretoria) .....Lecturer
De Beer, N.J., BSc(Hons)(Witwatersrand) HED(Unisa).....Lecturer
Dikobe, D.G., BSc(Hons) MSc(Free State) .....Lecturer
Molefe, M.D., BSc(Hons) MSc(Fort Hare) .....Lecturer
October, N., BSc(Hons) MSc(Western Cape) PhD(Cape Town) .....Lecturer
Ramatsetse, P.B., BSc(Hons) MSc PhD(University of the North).....Lecturer
Swart, A.C., BSc(Hons) HED(Unisa).....Lecturer
Mavuso, W.W., BSc(Hons) Sunderland PhD(Cape Town) .....Instructor

Department of Consumer Science
Erasmus, A.C., BSc(Home Econ)(Hons)
M(HomeEcon) PhD(Pretoria).....Professor (Head)
Du Rand, G.E., BHome Econ Ed BHome Econ(Hons)(Stellenbosch)
MSc(Home Econ) PhD(Pretoria).....Senior Lecturer
Donoghue, S., B Home Econ(Hons) M(Home Econ)
PhD(Pretoria) .....Senior Lecturer
Viljoen, A.T., Dipl Hosp Dietetics(Free State)
MDietetics PhD(Pretoria) .....Senior Lecturer
Jacobs, B.M., Dipl in Tertiary Education(Pretoria)
B Home Econ(Hons) MConsSc(Pretoria).....Lecturer
Marx-Pienaar, J.M.M., B ConsSc MConsSc(Pretoria) .....Lecturer
Muthambi, A., B ConsSc MConsSc(Pretoria).....Lecturer
Smith, M., B ConsSc(Cloth Mgt)(Stellenbosch) MConsSc(Pretoria) ..Lecturer
Sonnenberg, N., BHome Econ(Hons) MConsSc(Pretoria).....Lecturer
Van der Spuy, H.H., BSc(Hons)(Dietetics)(Stellenbosch)
MConsSc PhD(Pretoria) .....Lecturer
Makopo, M., BA(Vista) UEDipl (University of the North)
BConsSc MConsSc(Pretoria).....Junior Lecturer

Forestry and Agricultural Biotechnology Institute
Wingfield, M.J., BSc(Hons)(Natal) MSc(Stellenbosch)
PhD(Minnesota).....Professor and Director

Department of Food Science
Buys, E.M., BSc(Hons)(Potchefstroom) MSc(Pretoria)
PhD(Witwatersrand) .....Professor (Head)
Minnaar, A., BSc(Agric)(Hons) PhD(Pretoria).....Professor
Taylor, J.R.N., BSc(Hons)(CNAA) Post-Grad.Cert.Ed.(Nottingham)
PhD(Trent) DSc(Pretoria) .....Professor
Beta, T., MSc(Texas A&M University, College Station, Texas).....Extraordinary Professor
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De Kock, H.L., BSc(Home Ec)(Hons) MSc(Agric) PhD(Pretoria) .....Associate Professor

Duodu, K.G., BSc(Ghana) MInstAgrar PhD(Pretoria)..... Associate Professor
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Emmambux, M.N., BSc(Hons)(Mauritius) MSc PhD(Pretoria)..... Senior Lecturer

Department of Genetics

Bloomer, P., BSc(Hons)(Potchefstroom) PhD(Pretoria)..... Professor (Head)
Wingfield, B.D., BSc(Natal) BSc(Med)(Hons)(Cape Town) MSc(Minnesota) PhD(Stellenbosch)..... Professor and Deputy Dean
Huismans, H., BSc(Hons) MSc(Stellenbosch) DSc(Pretoria)..... Senior Research Fellow; Director, IRT Animal Zoonotic Diseases
Cowan, D.A., BSc MSc PhD (Waikato)..... Professor; Director: IRT Genomics
Greeff, J.M., BSc(Pretoria) BSc(Hons)(Rhodes) PhD(Pretoria)..... Professor
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Honey, E.M., MBChB(Pretoria) MMed(Paed)(Stellenbosch)..... Senior Lecturer
Maritz-Olivier, C., BSc(Hons) MSc PhD(Pretoria)..... Senior Lecturer
Naidoo, S., BSc(Hons)(Natal) MSc(Stellenbosch) PhD(Pretoria)..... Senior Lecturer
Van Staden, V., BSc(Hons) PhD(Pretoria)..... Senior Lecturer
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Department of Geography, Geoinformatics and Meteorology

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PhD(Sri Venkataswara Univ, India)..... Extraordinary Professor
Coetzee, S., BSc(Hons) HED MSc PhD(Pretoria) PGP(PLATO)..... Associate Professor
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PhD(Johannesburg)..... Extraordinary Senior Lecturer
Wessels, K., BSc(Hons) MSc(Pretoria) PhD(Maryland UMD)
Postdoc (NASA) ..... Extraordinary Senior Lecturer
Botai, O.J., BSc(Hons)(Moi) MSc Eng(Chalmers)
MSc(Rhodes) PhD(Pretoria) ..... Senior Lecturer
Darkey, D., BSc(Bophuthatswana) MSc(RAU)
DAdmin(Durban-Westville) ..... Senior Lecturer
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Haussmann, N.S., BSc MSc(Amsterdam) PhD(Stellenbosch)..... Senior Lecturer
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Cooper, A., BSc(Hons)(Rhodes) MSc(Pretoria) ..... Extraordinary Lecturer
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Kruger, A.C., BSc(Pretoria) MSc(Cape Town) PhD(Stellenbosch) .... Extraordinary Lecturer
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Wright, C.Y., B Soc Sc M Soc Sc(Natal) PhD(Otago, New Zealand) . Extraordinary Lecturer
Davis, N., BA(Hons)(Pretoria) MA(Sussex) PhD(Western Cape) ..... Lecturer
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TED(Pretoria) BSc(Hons)(Pretoria)…. ..... Lecturer
Loubser, M.J., BScHons MSc(Pretoria)..... Lecturer
Tsela, P.L., BSc(Hons) MSc(Hons)(Pretoria) ..... Junior Lecturer

Department of Geology

Götz, A., Dr.rer.nat.(Darmstadt, Germany)..... Professor (Head)
De Wit, M.C.J., MSc(Pretoria) MSc(Reading) PhD(Cape Town) ..... Honorary Professor
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Van Rooy, J.L., MSc PhD(Pretoria) PrSciNat MSAIIG MGVSA..... Associate Professor
Molyneux, T.G., MSc PhD(Pretoria) ..... Extraordinary Lecturer
Van der Merwe, R., MSc PhD(RAU) ..... Extraordinary Lecturer
Roberts, R.J., MSc PhD(Witwatersrand) ..... Senior Lecturer
Dippenaar, M.A., BSc(Hons) MSc(Pretoria) PrSciNat ..... Lecturer
Lenhardt, N., MSc PhD (Darmstadt)..... Lecturer
Mavimbela, P.K., BSc(Hons)(Pretoria) ..... Junior Lecturer
Tibane, L.V., BSc(Hons)(Pretoria)..... Junior Lecturer
Van Wyk, Y., MSc(Pretoria) ..... Junior Lecturer

Institute of Applied Materials

Focke, W.W., BEng(Chem)(Pretoria) PhD(MIT) ..... Professor (Director)
Rand, B., BSc MSc(Durham) PhD(Newcastle upon Tyne) ..... Professor (Chair: SARchi Chair in Carbon Technology and Materials)
Manyala, N.I., BSc(Hons) MSc(Witwatersrand) PhD(Louisiana State)..... Senior Lecturer (Deputy Chair: SARchi Chair in Carbon Technology and Materials)

Department of Insurance and Actuarial Science

Venter, M., BSc(Hons)(Johannesburg) BCom(Hons)(Cape Town) MBA(Witwatersrand) PGHCE(Pretoria) FASSA..... Senior Lecturer (Head)
Beyers, F.J.C., BSc(Hons) MSc PhD(Pretoria)..... Senior Lecturer
Gouws, E., BSc(Hons)(Pretoria) FIA FASSA ..... Senior Lecturer
Riekert, M., BSc(Pretoria) PGDip Actuarial Science(Cape Town) FFA FASSA..... Lecturer
Pretorius, S., MSc(Pretoria) ..... Junior Lecturer

Mammal Research Institute

Millar, R.P., MSc(London) PhD(Liverpool) RFCPath FRSE FRSSA .. Professor (Director)
Best, P.B., MA PhD(Cantab)..... Extraordinary Professor
Clutton-Brock FRS, T.H., MA PhD ScD(Cantab)..... Extraordinary Professor
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Lindsey, P.A., BA(Oxford) MSc PhD(Pretoria)..... Extraordinary Lecturer

Department of Mathematics and Applied Mathematics

Anguelov, R., MSc(Sofia) PhD(Unisa)..... Professor (Head)
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Janse van Rensburg, N.F., BSc(Pretoria) BSc(Hons)(Unisa) MSc DSc(Pretoria) HED ..... Emeritus Professor
Pretorius, L.M., MSc DSc(Pretoria) ..... Emeritus Professor
Rosinger, E.E., MSc Dr Sc(Bucharest) ..... Emeritus Professor
Swart, J., BSc(Hons) MSc(Potchefstroom) DrPhil(Zürich) ..... Emeritus Professor
Banda, M.K., BSc(Malawi) MSc(London) MSc(Kaiserslautern) PhD(Darmstadt, Germany) ..... Professor
Harding, A.F., MSc DSc(Pretoria) HNED ..... Professor
Lubuma, J.M-S., MSc PhD(Louvain, Belgium) FAAS FASSAF FSAAWK ..... Professor (Chair SARChi
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Sango, M., MSc(Donetsk State Univ, Ukraine) PhD(Univ of Valenciennes, France)..... Professor

Abbas, M., MSc, MPhil(Bahauddin Zakariya)
PhD(Nat Coll Bus Admin and Ec, Pakistan) ..... Associate Professor
Jordaan, K.H., BSc(Hons)(Witwatersrand) MSc(Pretoria)
PhD(Witwatersrand) HED ..... Associate Professor
Maré, E., MSc(Witwatersrand) PhD(Free State) ..... Associate Professor
Van den Berg, J.E., MSc(KwaZulu-Natal, Dbn)
PhD(KwaZulu-Natal, Pmb) ..... Associate Professor
Chapwanya, M., MSc PhD(Limerick, Ireland) ..... Senior Lecturer
Djoko Kamdem, J., BSc(Hons) MSc(Cameroon) PhD(Cape Town) ... Senior Lecturer
Garba, S.M., MSc PhD(Putra, Malaysia) ..... Senior Lecturer
Le Roux, C., MSc(Cape Town) PhD(Pretoria) ..... Senior Lecturer
Maepa, S.M., BSc(Hons)(University of the North) MSc(Lancaster)
PhD(Pretoria) STD(Setotolwane College of Educ.) ..... Senior Lecturer
Möller, M.P., BSc(Hons)(Comp. Science) BSc(Hons)(Maths)
MSc(Pretoria) ..... Senior Lecturer
Mureithi, E.W., MSc(Kenyatta Univ) PhD(New South Wales) ..... Senior Lecturer
Ntumba, P.P., MSc PhD(Cape Town)
LPA(Institut Pedagogique Kinshasa) ..... Senior Lecturer
Van der Walt, J.H., MSc PhD(Pretoria) ..... Senior Lecturer
Van Zyl, A.J., MSc PhD(Pretoria) ..... Senior Lecturer
Appadu, A.R., BSc(Hons) PhD(Mauritius) ..... Lecturer
Dinga, Y.V., BSc HED(Fort Hare) BSc(Hons)(Rhodes)
MSc(Western Cape) ..... Lecturer
Jooste, A.S., BSc(Hons) MSc PhD(Pretoria) ..... Lecturer
Kellerman, R., BSc(Hons)(RAU) MSc(Johannesburg)
PhD(Witwatersrand) ..... Lecturer
Kufakunesu, R., BSc(Hons) MSc DPhil(Zimbabwe) ..... Lecturer
Mabula, M.D., MSc(Witwatersrand) PhD(Cape Town) ..... Lecturer
Marais, M.S., MSc PhD(Stellenbosch) ..... Lecturer
Mostert, L., BSc(Hons) MSc(Potchefstroom) ..... Lecturer
Moubandjo, D.V., BSc(Hons)(USTM) PhD(Stellenbosch) ..... Lecturer
Van der Hoff, Q., BA(Hons)(Pretoria) MSc(Southern Mississippi)
DTech(TUT) ..... Lecturer
Verwey, A., BSc(Hons) MSc(Pretoria) ..... Lecturer
Yani, B.M., BSc(Hons) MSc(Pretoria) ..... Lecturer
Basson, M., BSc(Hons), MSc PhD(Pretoria) ..... Junior Lecturer
Wiggins, H.Z., BSc(Hons) MSc(Cape Town) ..... Junior Lecturer

Department of Microbiology and Plant Pathology

Venter, S.N., MSc PhD(Pretoria) ..... Associate Professor (Head)
Ashton, P.J., BSc(Hons) MSc PhD(Rhodes) ..... Extraordinary Professor
Brözel, V.S., MSc PhD(Pretoria) ..... Extraordinary Professor
Kfir, R., MSc (Weizmann Institute) DSc(Pretoria)..... Extraordinary Professor
Paweska, J.T., BVSc DVSc Dr hab ..... Extraordinary Professor
Rupprecht, C.E., BA(Rutgers Univ) MSc(Wisconsin)
VMD(Pennsylvania) PhD(Wisconsin) ..... Extraordinary Professor
Pietersen, G., MSc(Pretoria) PhD(Witwatersrand) ..... Extraordinary Professor
Coutinho, T.A., BSc(Hons) MSc PhD(Natal) ..... Professor
Nel, L.H., MSc(Free State) PhD(Pretoria) ..... Professor
Korsten, L., BSc(Hons)(Stellenbosch) MSc PhD(Pretoria) ..... Professor
Roux, J., MSc PhD(Free State) ..... Professor

Theron, J., BSc(Hons) MSc PhD(Pretoria) ..... Professor
Aveling, T.A.S., MSc PhD(Natal) ..... Associate Professor
Labuschagne, N., MSc(Agric) DSc(Agric)(Pretoria) PrSciNat ..... Associate Professor
Markotter, W., BSc(Hons) MSc PhD(Pretoria) ..... Associate Professor
Steenkamp, E.T., BSc(Hons) MSc (Free State) PhD(Pretoria) ..... Associate Professor
Moleleki, L.N., BSc(Hons) MSc(KwaZulu-Natal)
PhD(Univ of Dundee, UK) ..... Senior Lecturer
Thantsha, M., BSc(Hons)(Univ of the North) MSc PhD(Pretoria) ..... Senior Lecturer
Van der Waals, J.E., MSc(Agric) PhD(Pretoria) ..... Senior Lecturer
Anelich, L., MSc(Pretoria) PhD(Free State) ..... Extraordinary Lecturer
Maree, F.F., MSc, PhD(Pretoria) ..... Extraordinary Lecturer
Weyer, W., PhD(Pretoria) ..... Extraordinary Lecturer

Department of Physics

Theron, C.C., BSc(Hons)(Port Elizabeth) MSc PhD(Stellenbosch) .... Professor (Head)
Chakraborty, P., MSc PhD(Calcutta, India) ..... Honorary Professor
Grayson, D.J., MSc PhD(Univ Washington)
PhD h.c.(Umea Univ Sweden) ..... Honorary Professor
Gries, W., BSc MSc(Pretoria) PhD(Stellenbosch) ..... Honorary Professor
Russel, F.M., PhD(University College London) ..... Honorary Professor
Van der Merwe, J.H., MSc(Appl Maths)(Stellenbosch)
MSc(Maths)(Pretoria) PhD(Bristol) ..... Honorary Professor
Boeyens, J.C.A, MSc(Free State) DSc(Pretoria) FRSSA ..... Extraordinary Professor
Friedland, E.K.H., MSc DSc(Pretoria) ..... Extraordinary Professor
Alberts, H.W., BSc(Hons) MSc(Potchefstroom) DSc(Pretoria) ..... Emeritus Professor
Auret, F.D., MSc(Physics) MSc(Appl Maths) DSc(Pretoria) ..... Emeritus Professor
Bredell, L.J., MSc DSc(Pretoria) ..... Emeritus Professor
Kunert, H.W., MSc(Poznan) PhD(Warszawa) ..... Emeritus Professor
Malherbe, J.B., MSc DSc(Pretoria) ..... Emeritus Professor
Van Staden, J.C., MSc(Pretoria) Dr Rer Nat(Heidelberg) ..... Emeritus Professor
Van der Berg, N.G., BSc(Port Elizabeth) MSc(Unisa) ..... Emeritus Senior
DSc(Pretoria) ..... Lecturer
Booth, R., MSc(Univ Belfast) PhD(Manchester) ..... Professor
Chetty, N., BSc(Hons)(Natal) MS PhD(Illinois) ..... Professor
Rakitianski, S., MSc(Tashkent) PhD(Joint Institute for Nuclear
Research, Dubna, Russia) ..... Professor
Selyshchev, P., PhD(Inst. For Nuclear Research,
Taras Shevchenko Kyiv University) ..... Professor
Zoubos, K., MSc(Stony Brook Univ, NY) PhD(Univ Patras, Greece) . Professor
Duvenhage, R. deV., BSc(Hons) MSc PhD(Pretoria) ..... Associate Professor
Manyala, N.I., BSc(Hons) MSc(Witwatersrand)
PhD(Louisiana State Univ) ..... Associate Professor
Meyer, W.E., MSc PhD(Pretoria) ..... Associate Professor
Diale, M., BSc(Ed)(UNIBO) MSc(Medunsa) PhD(Pretoria) ..... Senior Lecturer
Krüger, T.P.J., MSc(NW Univ) PhD(Vrije Univ Amsterdam) ..... Senior Lecturer
Moji, C., BSc(Hons)(University of the North) MSc PhD(Natal) ..... Senior Lecturer
Nel, J.M., BSc(Hons)(Port Elizabeth) MSc(Cape Town)
PhD(Pretoria) ..... Senior Lecturer
Throop, H.B.MSc PhD(Astronomy Univ, Colorado(USA) ..... Senior Lecturer
Hlatshwayo, T.T MSc(Zululand) PhD(Pretoria) ..... Lecturer
Janse van Rensburg, P.J., BSc(Hons)(Pretoria) ..... Lecturer
Langa, D.F. BScHons(Limpopo) MSc(Johannesburg). ..... Lecturer

Legodi, M.J., BSc(Medunsa) MSc(Pretoria) ..... Lecturer
Machatine, A., MSc(Leipzig) ..... Lecturer
Odendaal, R.Q., MSc(Pretoria) ..... Lecturer
Zander, C., MSc PhD(Pretoria) ..... Lecturer
Prinsloo, L.C., MSc HED PhD(Pretoria) ..... First Technical Assistant

Department of Physiology

Joubert, A.M., BSc(Hons) MSc PhD(Pretoria) ..... Professor and Acting Head
Krüger, P.E., MA(PhysEd) DPhil HED(Pretoria) ..... Professor
Pretorius, E., BSc(Hons) MSc(Stellenbosch) PhD DTE(Pretoria) ..... Professor
Van Papendorp, D.H., MBChB(Pretoria) BSc(Hons) MSc PhD(Stellenbosch) M.Akad.SA ..... Emeritus Professor (Temporary part-time lecturer)
Viljoen, M., BSc MSc PhD (Pretoria) PhD(Witwatersrand) Nat Dip(Microbiology) ..... Emeritus Professor
Du Toit, P.J., BSc MSc PhD(Pretoria) ..... Associate Professor
Coetzee, M., BSc(DomSci)(Ed) MSc(Potchefstroom) PhD(Pretoria) .... Senior Lecturer
Punchoo, R., BSc(Hons) MBChB(KwaZulu-Natal) FCPath(Chem)SA(Witwatersrand) ..... Senior Lecturer
Soma, P., MBChB MSc(Pretoria) ..... Senior Lecturer
Theron, A.E., MBChB BSc(Hons) MSc(Pretoria) ..... Senior Lecturer
Wood, P.S., MA(HMS) DPhil(Pretoria) ..... Senior Lecturer
Alummoottil,S., BSc MSc(India) ..... Lecturer
Bipath, P., BSc MSc PhD(Pretoria) ..... Lecturer
Camacho, T.C.T., MA(HMS)(Pretoria) ..... Lecturer
Grobbelaar, C.W., MBChB(KwaZulu-Natal) MSc(Pretoria) ..... Lecturer
Hhlope, Y., BSc MSc(Pretoria) ..... Lecturer
Koorts, A.M., BSc MSc PhD(Pretoria) ..... Lecturer
Phulukdaree, A., BSc(Hons) MSc PhD(KwaZulu-Natal) ..... Lecturer
Nolte, K., MA(HMS) DPhil(Pretoria) ..... Lecturer
Rossouw, F., MA(HMS) DPhil(Pretoria) ..... Lecturer
Stander, B.A., BMedSci(Free State) MSc PhD(Pretoria) ..... Lecturer
Van Rooy, M., BSc MSc(Pretoria) ..... Lecturer
Piorkowski, T., MBChB(Pretoria) ..... Lecturer (Temporary part-time)

Department of Plant Production and Soil Science

Annandale, J.G., MSc(Agric)(Pretoria) PhD(WSU) ..... Professor (Acting Head)
Kruger, R.A., MSc DSc(Pretoria) ..... Honorary Professor
Bristow, K.L., BSc(Hons)(Natal) MSc(Free State) PhD(WSU) ..... Extraordinary Professor
Duke, S.O., MS(Univ Arkansas) PhD(Duke) ..... Extraordinary Professor
Everson, C.S., BSc(Hons) MSc PhD (KwaZulu-Natal) ..... Extraordinary Professor
Haverkort, A.J., MSc(Wageningen) PhD(Reading) ..... Extraordinary Professor
Reinhardt, C.F., BSc(Hons)(Free State) BSc(Agric)(Hons) MSc(Agric) PhD(Pretoria) ..... Extraordinary Professor
Singels, A., BSc(Agric)(Hons) MSc(Agric) PhD(Free State) ..... Extraordinary Professor
Stirzaker, R.J., MSc(Agric) PhD(Sydney) ..... Extraordinary Professor
Van Heerden, P.D.R., MSc(Stellenbosch) PhD(Potchefstroom) ..... Extraordinary Professor

Chirwa, P. W. C., BSc(Hons)(Bangor) MSc(Gainesville, Florida) PhD(Nottingham)....Associate Professor
Du Toit, E.S., BSc(Hons) MSc(Agric) PhD(Pretoria)....Associate Professor
Steyn, J.M., BSc(Hons) MSc(Agric)(Free State) PhD(Pretoria) ....Associate Professor
Ghebremariam, T.T., MSc(Agric)(Pretoria)....Extraordinary Lecturer
Surridge-Talbot, A.K.J., BSc(Hons) MSc PhD(Pretoria) ....Extraordinary Lecturer
Vahrmeijer, J.T., BSc(Hons) MSc(Potchefstroom)....Extraordinary Lecturer
Madakadze, I.C., BSc(Agric)(Hons)(Zimbabwe) MSc(Reading) PhD(McGill)....Senior Lecturer
Marais, D., BSc(Agric)(Hons) MSc(Agric) PhD(Pretoria) ....Senior Lecturer
Taylor, N. J., PhD(KwaZulu-Natal) ....Senior Lecturer
Truter, W. F., MSc(Agric) PhD(Pretoria)....Senior Lecturer
Van der Laan, M., BSc(Hons) MSc(Agric) PhD(Pretoria)....Senior Lecturer
Vorster, B.J., MSc PhD(Pretoria) ....Senior Lecturer
De Jager, P.C., BSc(Hons)(Potchefstroom) MSc(Pretoria)....Lecturer
Tesfamariam, E.H., MSc(Agric) PhD(Pretoria) ....Lecturer

Department of Plant Science

Meyer, J.J.M., PhD(Pretoria)....Professor (Head)
Smith, G.F., PhD (J.P.H.Acocks Chair) ....Extraordinary Professor
Van Rooyen, M. W., PhD(Pretoria) HNED ....Extraordinary Professor
Berger, D.K., PhD(Cape Town)....Professor
Van Wyk, A.E., MSc(Potchefstroom) DSc(Pretoria) HED FLS....Professor
Lall, N., PhD(Pretoria)....Associate Professor
Kunert, K.S., PhD (Konstanz, Germany) ....Senior Research Fellow
Crampton, B.G., PhD(Pretoria....Senior Lecturer
Kritzinger, Q., PhD(Pretoria) ....Senior Lecturer
Tshikalange, T.E., MSc PhD(Pretoria) ....Senior Lecturer
Greve, M., MSc(Stellenbosch) PhD(Aarhus Univ, Denmark)....Senior Lecturer
Le Roux, P.C., BSc(Hons)(Pretoria) PhD(Stellenbosch)....Senior Lecturer
Bapela, M.J., MSc(Pretoria) ....Lecturer
Kiviet, A.M., BSc(Hons)(Fort Hare) MSc(Michigan State) HED(Transkei) BEd(Unisa) Med(Michigan State) D. ED(Columbia, USA) ....Lecturer

Postgraduate School of Agriculture and Rural Development

Machethe, C.L., BSc(Agric)(Hons)(Fort Hare) MSc(Agric)(University of the North) M.S. PhD(Michigan State) ...Professor/Director

SADC Centre for Land-related, Regional and Development Law and Policy

Olivier, N.J.J., BA(Law) LLB BA(Hons)(Pretoria) Drs Juris LLD(Leyden) MA(Pretoria) BA(Hons)(Potchefstroom) LLD(Pretoria)....Professor/Director

SAFCOL Forest Science Chair

Chirwa, P. W. C., BSc(Hons)(Bangor) MSc(Gainesville, Florida) PhD(Nottingham)....Director/ Associate Professor
Brink, M., BSc MBA (Stellenbosch) MFor (Oregon, USA) PhD(Stellenbosch)....ExtraordinaryProfessor
Geldenhuys, C., BSc MSc (Stellenbosch) PhD(Cape Town) ....ExtraordinaryProfessor

Käetsch, C., MSc PhD(Göttingen, Germany) ..... ExtraordinaryProfessor
Malan, F., BSc (Hons)MSc PhD(Stellenbosch) ..... ExtraordinaryProfessor

Department of Statistics

Bekker, A., MSc(Johannesburg) PhD(Unisa) ..... Professor (Head)
Chakroborti, S., PhD(Alabama State, USA) ..... Professor (SARchi chair holder)
Crafford, G., MSc PhD(Pretoria) ..... Senior Lecturer
Debusho, L.K., MSc(Addis Ababa) PhD(KwaZulu-Natal)..... Senior Lecturer
Ehlers, R., MSc PhD(Pretoria) ..... Senior Lecturer
Fabris-Rotelli, I.N., MSc PhD(Pretoria)..... Senior Lecturer
Fletcher, L., MSc PhD(Unisa)..... Senior Lecturer
Kanfer, F.H.J., MSc PhD(Potchefstroom)..... Senior Lecturer
Louw, E.M., MSc PhD(Pretoria) ..... Senior Lecturer
Millard, S.M., MCom(Pretoria)..... Senior Lecturer
Strydom, H.F., MSc(Unisa) PhD(Pretoria)..... Senior Lecturer
Swanepoel, A., MSc(Port Elizabeth) ..... Senior Lecturer
Bodenstein, L.E., BCom(Hons) MCom(Pretoria) ..... Lecturer
Corbett, A.D., BCom BSc(Hons)(Pretoria)..... Lecturer
Graham, M.A., MSc PhD(Pretoria)..... Lecturer
Kleyn, J., MCom PhD(Pretoria)..... Lecturer
Loots, M.T., BSc(Hons) MSc(Pretoria) ..... Lecturer
Reyneke, F., BSc(Hons) MSc(Pretoria)..... Lecturer
Van Niekerk, J., BSc(Hons) MSc(Pretoria)..... Lecturer
Van Staden, P.J., MCom PhD(Pretoria) ..... Lecturer

Wingfield M Mondi Chair

Roux, J., PhD(Free State)..... Professor

Department of Zoology and Entomology

Chimimba, C.T., BSc(Malawi) MSc(Western Australia) PhD(Pretoria) FLS FZS(London) PrSciNat.… ..... Professor (Head)
Best, P.B., MA PhD(Cantab)..... Extraordinary Professor
Clutton-Brock, T.H., MA PhD ScD(Cantab) ..... Extraordinary Professor
Crewe, R.M., BSc(Agric) MSc(Agric)(Natal) PhD(Georgia) FRES FRSSA MSAAS PrSciNat..... Extraordinary Professor
Dippenaar-Schoeman, A.S., BSc(Unisa) BSc(Hons) MSc PhD(RAU) ..... Extraordinary Professor
Faulkes, C.G, PhD (University College London)..... Extraordinary Professor
Kfir, R., BSc(Agric) MSc(Agric) PhD(Hebrew University Jerusalem).. Extraordinary Professor
Mansell, M.W., BSc(Hons) PhD(Rhodes)..... Extraordinary Professor
Moritz, R.F.A., Dip PhD(Frankfurt) ..... Extraordinary Professor
Neumann, P., PhD(MLU) ..... Extraordinary Professor
Bastos, A., BSc(Hons) MSc PhD(Pretoria)..... Professor
Bennett, N.C., BSc(Hons)(Bristol) MSc PhD(Cape Town) FZS ..... Professor
Bester, M.N., BSc(Hons) MSc(Stellenbosch) DSc(Pretoria) PrSciNat ..... Professor
Ferguson, J.W.H., BSc(Port Elizabeth) BSc(Hons) MSc(Pretoria) PhD(Witwatersrand)..... Professor
McKechnie, A.E., MSc PhD(Natal)..... Professor
Millar, R.P., MSc(London) PhD(Liverpool) RFCPath FRSE FRSSA .. Professor (Director)

Nicolson, S.W., BSc(Hons)(Auckland) PhD(Cantab) FRES.....Professor
Scholtz, C.H., BSc(Hons) MSc DSc(Pretoria) FRES .....Professor
Van Aarde, R.J., MSc DSc(Pretoria) PrSciNat .....Professor
Krüger, K., MPhil(Wales) PhD(Pretoria) FRES.....Associate Professor
Pirk, C.W.W., MSc(Berlin TU) PhD(Rhodes).....Associate Professor
Robertson, M.P., BSc BSc(Hons) PhD(Rhodes) .....Associate Professor
De Bruyn, P.J.N., BSc(Hons) MSc PhD(Pretoria).....Senior Lecturer
Garnas, J.R., BA(Colorado) MSc(Maine) PhD(Dartmouth).....Senior Lecturer
Sole, C.L., BSc(Hons) MSc PhD(Pretoria) .....Senior Lecturer
Dalerum, F., MSc PhD(Stockholm) .....Extraordinary Lecturer
Dietemann, V., MSc(Paris) PhD(Würzburg) .....Extraordinary Lecturer
Lindsey, P.A., BA(Oxford) MSc PhD(Pretoria).....Extraordinary Lecturer
Visser, D., BScAgric(Hons)MSc(Agric)(Stellenbosch)
PhD(Pretoria) .....Extraordinary Lecturer
Hurley, B., BSc(Hons) MSc PhD(Pretoria) .....Lecturer
Golpalraj, J.B.P., BSc MSc(Madurai Kamaraj Univ) .....Lecturer
Weldon, C.W., BEnvSci(Hons)(Newcastle) PhD(Sydney).....Lecturer

BSc Four-year Programme
Kritzinger, Q., PhD(Pretoria) .....Senior Lecturer /Director
Fouché, I., MA(Pretoria).....Lecturer
Immelman, S., BA(Hons)(Unisa) .....Lecturer
Leso, T., BA(Hons)(Unisa) .....Lecturer
Naidoo, J., BA(Hons)(Unisa).....Lecturer
Thokwane, D., BA(Hons)(Limpopo) MA(Minnesota).....Lecturer

Student Administration
Beresford, M.E., Mrs .....Head: Student Administration

Faculty Manager
Kotze, S.l., MA PhD(Pretoria)

POSTGRADUATE REGULATIONS

The rules for the degrees published here are subject to change and may be amended prior to the commencement of the academic year in 2015.

The General Regulations (G. Regulations) apply to all faculties of the University of Pretoria. It is expected of each student to familiarise himself or herself well with these regulations. Ignorance concerning these regulations will not be accepted as an excuse for any transgression.

Postgraduate qualifications in the Faculty of Natural and Agricultural Sciences

The following postgraduate qualifications are conferred by the Faculty:

Bachelor of Science Honours	[BScHons]
Bachelor of Agriculture Honours*	[BAgricHons]
Master of Agriculture*	[MAgric]
Master of Consumer Science	[MConsumer Science]
Master of Science	[MSc]
Master of Agricultural Science	[MScAgric]
Doctor of Philosophy	[PhD]
Doctor of Science	[DSc]

**(Coordinated in the Postgraduate School of Agriculture and Rural Development. Please consult page 91 for information and Regulations).*

Selection
A selection procedure takes place prior to admission to the following degree programmes in the Faculty of Natural and Agricultural Sciences:

BScHons in Biotegnology: Applications close on 8 November.
BScHons in Chemistry: Applications close on 15 December.
BScHons in Genetics: Applications close on 8 November.
BScHons in Wildlife Management: Applications close on 30 October.
MScAgric in Animal Science (all specialisations): Applications close on 30 October.

Degree with distinction
Weighted averages (GPA), together with other faculty-specific criteria if applicable, are used at UP to calculate averages for the determination of distinctions.

Language of tuition
In conducting its business, the University uses two official languages, namely English and Afrikaans. In formal education the language of tuition is either English or Afrikaans, or both of these languages; provided that there is a demand and that it is academically and economically justifiable. However, it remains the student's responsibility to ascertain on an annual basis in which language a module and any further level of that module is presented. In respect of administrative and other services, a student has the right to choose whether the University should communicate with him or her in English or Afrikaans. Where the University has the capacity, Sepedi is used as an additional language of communication.

Leave of absence
If it is impossible for a registered student at the University of Pretoria to continue with his/her studies/research in a specific year, but he/she intends to continue in the following year, the student must apply in writing to the dean of the relevant faculty for **leave of absence**. The application must include: full names, student number, address, reasons and period for leave of absence, for example the whole year, first semester (January to June) or second semester (July to December), name of supervisor (where applicable), and the student's intentions for the period after his/her leave of absence. However, in accordance with the policy of the University of Pretoria, leave of absence is not granted for more than two years. Any outstanding fees should be paid in full upon the student's return from his/her leave of absence.

DISCLAIMER
The Faculty reserves the right not to offer a particular module or programme if there is insufficient resources to do so, or if an insufficient number of qualifying students present themselves.

BACHELOR OF SCIENCE HONOURS [BScHons]

Also consult the General Regulations.

a. Admission to study
In addition to the requirements of General Regulations an appropriate bachelor's degree is a prerequisite: a candidate with an average of less than 60% in the major subjects in the final year of the bachelor's degree will only be admitted with the approval of the Dean, on the recommendation of the head of department. Additional conditions may be prescribed by the head of department.

b. Duration of study
The duration of study is a minimum of one year for full-time students, and two years in the case of part-time students.

c. Renewal of registration
i) Subject to exceptions approved by the Dean, on the recommendation of the head of department, and in the case of distance education where the Dean formulates the stipulations that will apply, a student may not sit for an examination for the honours degree more than twice in the same module.
ii) A student for an honours degree must complete his or her study, in the case of full-time students, within two years and, in the case of after-hours students, within three years of first registering for the degree and, in the case of distance education students, within the period stipulated by the Dean. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

d. In calculating marks, General Regulation G.12.2 applies.

e. The BScHons degree is awarded with distinction to a candidate who obtains a weighted average of at least 75% in all the prescribed modules and a minimum of 65% in any one module.

f. Apart from the prescribed coursework, a research project is an integral part of the study.

g. The BScHons degree is conferred in the following fields of study:

- Actuarial Science
- Biochemistry
- Bioinformatics
- Biotechnology
- Chemistry
- Engineering and Environmental Geology:
  Option: Engineering Geology
  Option: Hydrogeology
- Entomology
- Environmental Sciences
- Genetics
- Geographical Sciences
  Option: Geography and Environmental Science
- Geoinformatics
- Geology
- Human Physiology *(Please refer to the yearbook of the Faculty of Health Sciences)*
- Mathematical Sciences
- Meteorology
- Microbiology
- Nutrition and Food Science
- Physics

- Plant Science
- Soil Science [Option: Environmental Soil Science]
- Wildlife Management
- Zoology

BACHELOR OF AGRICULTURE MANAGEMENT HONOURS [BAgricHons]

Please refer to the Regulations of the Postgraduate School of Agriculture and Rural Development, page 91.

MASTER OF SCIENCE [MSc]

Also consult the General Regulations.

a. Admission to study

i) In addition to the General Regulations an appropriate BScHons degree is a prerequisite for admission. An average of 60% is required in the honours year of study for admission to the MSc. Additional requirements and conditions may be prescribed by the Dean on the recommendation of the supervisor, head of department and Postgraduate Studies Committee. Admission is approved by the Postgraduate Studies Committee in consultation with the head of department and the supervisor.

ii) Where admission to the MSc degree study does not follow on a BScHons degree, the minimum period of study for the MSc degree is two years.

b. The MSc degree is conferred on the grounds of a dissertation and such additional postgraduate coursework as may be prescribed.

c. The MSc degree is conferred with distinction to candidates who obtain a final average mark of at least 75% and a mark of at least 75% for the dissertation/mini-dissertation from each of the members of the examination panel. Where a member of the examination panel awards a mark of less than 75% for the dissertation/mini-dissertation, that member of the examination panel must offer, in writing, support for his/her decision, or indicate in writing that he/she supports the examination committee's decision to confer the degree with distinction.

d. Duration of study

Duration of study is a minimum of one year uninterrupted full-time study.

e. Renewal of registration

As long as progress is satisfactory, renewal of the registration of a master's student will be accepted for the second year of the study. Registration for a third and subsequent years will only take place when the Student Administration of the Faculty receives a written motivation that is supported by the head of department and Postgraduate Studies Committee.

f. General

Candidates are required to familiarise themselves with the General Regulations regarding the maximum period of registration and the requirements on the submission of a draft article for publication.

MASTER OF AGRICULTURAL SCIENCE [MScAgric]

Also consult the General Regulations.

a. Admission to study

In addition to the requirements of the General Regulations the BScAgric degree is a prerequisite for admission. An average of 60% is required in the final year of the BScAgric degree for admission. Additional requirements and conditions may be prescribed by the Dean on the recommendation of the head of department and the supervisor. Admission is approved by the Postgraduate Studies Committee in consultation with the head of department and the supervisor.

b. Fields of study

The MScAgric degree is conferred in the following fields of study:

- Agronomy
- Agricultural Economics
- Animal Science (Production Management, Production Physiology, Meat Science, Animal Nutrition)
- Entomology
- Extension
- Food Science and Technology
- Genetics
- Horticulture
- Pasture Science
- Plant Pathology
- Soil Science

c. Duration of study

The duration of study is a minimum of two years uninterrupted full-time study (or three years part-time).

d. Residence

On the recommendation of the head of department, the Dean may set specific residential requirements for the MScAgric degree.

e. Renewal of registration

As long as progress is satisfactory, renewal of the registration of a master's student will be accepted for the second year of the study. Registration for a third and subsequent years will only take place when the Student Administration of the Faculty receives a written motivation which is supported by the head of department and Postgraduate Studies Committee.

f. Curriculum

The curriculum for the MScAgric degree consists of the following:

a. A dissertation; and
b. Further study in the major subject/s, augmented by ancillary modules prescribed by the Postgraduate Studies Committee, on the recommendation of the head of department. Such ancillary modules may be taken simultaneously with the major subject/s. Candidates in possession of the BScAgricHons degree may be exempted from additional ancillary modules.

g. Examinations and promotion

i) The examinations in the ancillary modules should be successfully completed prior to, or simultaneously with, the examinations in the major subject/s, unless the Faculty Board decides otherwise.

ii) General Regulation G.12.2 applies to the calculation of marks.
iii) In order to obtain the MScAgric degree, the candidate must pass all prescribed modules, including the examination in the major subject/s, as well as the dissertation.

h. Degree with distinction
The MScAgric degree is conferred with distinction on candidates who obtain a final average mark of at least 75% and a mark of at least 75% for the dissertation/mini-dissertation from each of the members of the examination panel. Where a member of the examination panel awards a mark of less than 75% for the dissertation/mini-dissertation, that member of the examination panel must offer, in writing, support for his/her decision, or indicate in writing that he/she supports the examination committee's decision to confer the degree with distinction.

i. General
Candidates are required to familiarise themselves with the General Regulations regarding the maximum period of registration and the requirements on the submission of a draft article for publication.

MASTER OF CONSUMER SCIENCE [MConsumer Science]

Also consult the General Regulations.

a. Admission to study
For the MConsumer Science degree in Clothing, Interior, Foods and Nutrition, a four-year BConsumer Science degree that is BCom-based, is required. For the MConsumer Science General, other applicable four-year degrees will be considered. A minimum average of 60% in the broad area of specialisation that the student wishes to pursue is required for admission.

b. Duration of study
Students enrolled for a master's degree must complete their studies within two years after first registering fior the degree, except for programmes which requires a longer period and are specified in faculty regulations.

c. Degree with distinction
The degree is conferred with distinction on a student who obtains a final average of at least 75%, as well as at least 75% for the dissertation and provided that all the members of the Examination Commission indicate in writing that the degree be conferred with distinction.

DOCTOR OF PHILOSOPHY [PhD]

Also consult the General Regulations.

a. Admission to study
In addition to the requirements of the General Regulations the MSc, MScAgric, MInstAgrar or other appropriate degree is a prerequisite for admission to PhD studies. Additional requirements and conditions can be specified by the Dean on the recommendation of the head of department and the supervisor.

b. Duration of studies

The doctorate is conferred on a student only if one of the following periods has expired:

i) At least four years after complying with all the requirements for a three-year bachelor's degree.
ii) At least three years after complying with all the requirements for a four-year bachelor's degree.
iii) At least two years after complying with all the requirements for a bachelor's degree of five years or more.
iv) At least two years after complying with all the requirements for a master's degree.
v) With the exception of a shorter period that may be approved by the Dean, at least 12 months since registration for the doctorate at this University has expired.

The head of department may set specific residential requirements for students who are required to live on campus.

c. Renewal of registration

Subject to other faculty regulations, a student for a doctorate must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department or the Postgraduate Committee, may give approval for a limited fixed extension of this period.

d. Curriculum

The curriculum for the PhD degree consists of the following:

i) Theoretical knowledge of the major subject/s and such additional modules as may be prescribed.
ii) A thesis.

e. Examinations and promotion

i) Consult the General Regulations that apply to the calculation of marks.
ii) In order to obtain the PhD degree the candidate must:
- pass the examinations and the prescribed modules, as determined in the study programme;
- pass the thesis; and
- pass the final examination on the thesis and general subject knowledge.

f. Conversion of a master's to doctoral study

The stipulations of G.41 apply as follows:

2. Requirements
(a) Under special circumstances, the dean of a faculty may convert the registration of a candidate for the master's degree to registration for a doctoral degree.
(b) For such conversions, the head of department and the supervisor must be satisfied that the student's completed work is of the standard that would be expected of a doctoral student, that the student is capable of completing a doctoral degree, and that the project is of appropriate standard and scope to constitute a doctoral study.
(c) For such conversions, the head of department and the supervisor must be satisfied that the student has demonstrated that he or she has the potential to fulfil the requirements of a doctoral degree without having completed a master's degree.

3. Process
   (a) Application for conversion may be submitted at any time during the course of study for the master's degree.
   (b) The application for the conversion must include the following documentation:
      (i) A detailed progress report by the candidate of the work completed for the master's project. The report must provide proof that the results obtained thus far are of such a standard and scientific significance that they justify conversion to a doctoral project. The report should include details of presentations made at conferences and of material that has been submitted for publication and/or published.
      (ii) A detailed proposal for the intended doctoral project, written by the candidate, including the objectives of the project.
      (iii) A recommendation by the supervisor with specific comments on the ability of the applicant as a potential doctoral candidate as well as the feasibility of the conversion, especially with regard to the information provided by the candidate in his/her reports (items (i) and (ii)).
      (v) A recommendation by the head of department, if he or she is not the supervisor, in which the ability of the candidate as a potential doctoral candidate is confirmed.
      (vi) If the dean considers it advisable for the faculty, the candidate may be required to present a seminar to the department in support of the application. In this case, the head of department should include a report on this in his or her recommendation.
   (c) The application of the candidate, together with the reports and recommendations, is submitted for consideration to the dean, (who may delegate to the Chairperson of the Faculty Postgraduate Committee) for approval. The decision should be submitted to the Faculty Board for approval.

g. General

Candidates are required to familiarise themselves with the General Regulations regarding the maximum duration of study and the requirements to submit an article/s for publication.

DOCTOR OF SCIENCE [DSc] (Code 03260001)

Also consult the General Regulations.

The degree is conferred on a candidate who, on the basis of distinguished and comprehensive research work, enjoys international recognition.

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COMPOSITION OF THE DIFFERENT PROGRAMMES IN THE FACULTY

1. HONOURS PROGRAMMES IN THE BIOLOGICAL SCIENCES

1.1. BScHons in Biochemistry (Code 03241011)

a. Admission requirements

Organic and Analytical chemistry at 200-level; a final mark of 60% or more in Biochemistry at 300-level and depending on availability of supervisor/s and/or projects within the department.

b. Programme composition

Code	Module name	Credits
Compulsory modules:		
BCM 771	Trends in biochemical research 771	15
BCM 773	Research project and report 773	60
BCM 774	Research methods 774	30
BCM 775	Advanced biochemistry 775	15
MLB 721	Molecular and cellular biology 721	15

Minimum credits required: 135

Note:

- A pass mark is required for all the components of the honours programme and the average mark is calculated proportionally to the credits.
- Additional modules can be prescribed to remedy shortcomings in a candidate's undergraduate training.

1.2. BScHons in Bioinformatics (Code 03241014)

a. Admission requirements

Students must be in possession of a bachelor's degree in bioinformatics, biological sciences, computer science, informatics, mathematics, mathematical statistics or computer engineering. Students with a bachelor's degree in either physics, mathematics, mathematical statistics or electronic engineering may be required to do a special postgraduate bridging year before admission to BScHons in Bioinformatics. Admission is additionally dependent on availability of supervisor/s and/or projects within the department.

b. Programme composition

Code	Module name	Credits
Compulsory modules:		
BIF 701	Bioinformatics theory and applications 701	30
BIF 702	Trends in bioinformatics and literature seminar 702	15
BIF 703	Research project and report 703	60
MLB 721	Molecular and cellular biology 721	15
Elective modules:		
*BIF 704	Introduction to molecular biology for bioinformatics 704	15

*BME 780	Introduction to mathematical statistics for bioinformatics 780	15

Minimum credits required: 135

Note:
Students with degrees in biological sciences should choose BME 780 as an elective. Students from computer science and other related backgrounds should choose BIF 704. Other additional modules may be prescribed for non-degree purposes to address shortcomings in a candidate's undergraduate training.

1.3. BScHons in Biotechnology (Code 02240392)

a. Admission requirements
BSc in Biotechnology or equivalent degree with GTS 351, BCM 356 and MBY 364; an average pass mark of 60% or more at final-year level or permission by the head of department. Preference will be given to applicants with the highest final grade point averages for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the participating departments.

b. Programme composition
BScHons in Biotechnology is a unique interdepartmental programme aimed at enabling students to pursue their interest in molecular biotechnology through relevant research areas offered within fields of biochemistry, plant science, microbiology and plant pathology, plant production, as well as genetics. Students within this programme will be registered and will conduct their studies within the department of their choice. A student's choice of research programme will determine which of the respective departments will mentor their honours degree programme.

Code	Module name	Credits
BTW 701	Biotechnology in the workplace 701	15
MLB 721	Molecular and cellular biology 721	15

The curriculum for the balance of the credits will be determined by the heads of the participating departments.

Please consult Prof P Bloomer, Tel: 012 420 3259, for further details.

Total credits required: 135

Note:
- Additional modules may be prescribed by the head of the department where deemed necessary. Honours students may also be required to complete a biometry or equivalent module, if they have not already done so during their undergraduate training.
- A pass mark is required for all the components of the honours study programme and the final mark is calculated proportionally to the credits of the respective prescribed modules.

1.4. BScHons in Entomology (Code 03241031)

a. Programme composition

Code	Module	Credits
Compulsory modules:		
ZEN 701	Research project 701	70
ZEN 702	Research methods 702	13
ZEN 713	Scientific communication 713	13
Choice of three additional modules, <u>one</u> of which <u>must be</u> ZEN 707 or ZEN 782:		
ZEN 703	Systematics, evolution and biogeography 703	13
ZEN 704	Environmental physiology704	13
ZEN 705	Principles in applied ecology 705	13
ZEN 707	Integrated pest management in Africa 707	13
ZEN 710	Mammal ecology 710	13
ZEN 712	Behavioural ecology 712	13
ZEN 782	Insect-plant interactions 782	13
ZEN 783	Global climate change and biodiversity 783	13
ZEN 784	Contemporary research techniques 784	13

A pass mark is required for all the components of the honours study programme.

Total credits required: 135

1.5. BScHons in Genetics (Code 03241051)

a. Admission requirements

An appropriate BSc degree with a final grade point average (GPA) of at least 60% and including at least four genetics modules at final-year level or permission by the Head of Department. Preference will be given to applicants with the highest final GPAs for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the Department.

b. Programme composition

The honours study programmes serve as the first level of postgraduate training and we therefore aim to introduce our students to the methods of research – from the reading of research papers, through to the conceptualisation, planning, execution and communication of a research project. The study programme includes the following modules:

Code	Module	Credits
Compulsory modules:		
GTK 702	Seminar course 702	15
GTK 703	Research project 703	60
GTK 704	Trends in genetics 704	15
GTK 705	Research methods 705	30
MLB 721	Molecular and cellular biology 721	15

Total credits required: 135

Note:

- Additional modules may be prescribed by the head of the department where deemed necessary. Honours students may also be required to complete a biometry or equivalent module, if they have not already done so during their undergraduate training.
- A pass mark is required for all the components of the honours study programme and the final honours mark is calculated proportionally to the credits of the respective prescribed modules.
- Suitably qualified candidates may also apply for the interdepartmental BScHons in Biotechnology (Code 02240392) with a registration in the Department of Genetics. For more information, please refer to the programme information on page 23.

1.6. BScHons in Microbiology (Code 03240911)

a. Admission requirements

An average pass mark of 60% or more in at least four modules presented by the Department of Microbiology and Plant Pathology at 300-level (one of which must be MBY 364) or permission by the head of department. Note that additional modules may be prescribed by the head of the department where deemed necessary.

b. Programme composition

Code	Module	Credits
Compulsory modules:		
MCP 751	Research methods 751	30
MCP 752	Seminar course 752	15
MCP 753	Trends in microbiology 753	15
MCP 754	Research project and literature study 754	60
MLB 721	Molecular and cellular biology 721	15

Total credits required: 135

1.7 BScHons in Plant Science (Code 03241091)

Suitably qualified candidates may also apply for the interdepartmental BScHons in Biotechnology* degree (Code 02240392) with a supervisor in the Department of Plant Science.

The following modules are compulsory for BScHons (Biotechnology) students registered in the Department of Plant Science:

Code	Module	Credits
BOT 705	Molecular techniques 705	15
BTW 701	Biotechnology in the workplace 701	15
MLB 721	Molecular and cellular biology 721	15

The curriculum for the balance of the credits will be determined by the heads of department of the interdepartmental BScHons (Biotechnology) degree programme (Code 02240392).

*Please consult Prof P Bloomer, Tel: +27 12 420 3259, for further details.

a. Admission requirements

BSc in Plant Science, or a recommendation from the head of the department if the candidate did not major in Plant Science. Preference will be given to applicants with the highest final grade point averages for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the participating departments.

b. Duration

One academic year for full-time students and two consecutive academic years for part-time students. Lectures and practicals are scheduled to accommodate part-time students.

c. Programme composition

The programme consists of compulsory modules and elective modules. Students may register for modules to the maximum of 20 credits presented by another department, which forms part of the elective modules.

The following fields are presented in the BScHons in Plant Science programme:

- Plant Diversity (D)
- Plant Biotechnology/Physiology (PB)
- Plant Ecology (E)
- Option: Medicinal Plant Science (see page 27 for further information)

Apart from the compulsory and elective modules, a project, leading to a research report (60 credits), forms an essential part of the training programme. One seminar (15 credits) must also be written and presented. Field excursions are undertaken.

In addition to the compulsory modules, electives are selected in consultation with the supervisor.

Programme composition for BScHons in Plant Science:

Code	Module	Sem.	Cts	D	E	PB
BOT 705	Molecular techniques 705	1	15			§
BOT 712	Plant nomenclature 712	1	10	**		
BOT 714	Seed ecology 714	2	10		**	
BOT 717	Plant morphology 717	1	10	**		
BOT 718	Introduction to plant biotechnology 718	1	10			**
BOT 719	Primary plant metabolism 719	1	10			**
BOT 730	Plant ecology and conservation 730	1	20		**	
BOT 741	Plant taxonomy 741	2	10	**		
BOT 742	Plant classification 742	2	20	**		
BOT 746	Applications in plant biotechnology 746	2	10			**
BOT 761	Advanced phytomedicine 761	2	10			**
BOT 782	Research report 782	year	60	*	*	*
BOT 783	Seminar 783	1	15	*	*	*

BOT 784	Trends in plant science 784	1	10	*	*	*
BOT 786	Practical plant identification 786	1	10			
BOT 788	Spatial analysis in ecology 788	2	10			
BOT 790	Plant ecology and conservation for wildlife management 790 #	1	10			
BTW 701	Biotechnology in the workplace 701	year	15			§

* Compulsory modules for all students
** Compulsory modules for the discipline of study
§ BOT 705 and BTW 701 are for BScHons (Biotechnology) students. PB students who wish to take one of these modules as an elective need to apply to the programme leader.
# BOT 790 is for BScHons (Wildlife Management) students.

Total credits required: 135

1.8 BScHons [Option: Medicinal Plant Science] (Code 03241090)

a. Admission requirements

BSc in Plant Science or a recommendation from the head of department if the candidate did not major in Plant science. A minimum of 60% in Phytomedicine 365 (BOT 365), which is offered at third-year level in the Department of Plant Science.

The recommended modules at BSc third-year level are as follows:
1. BOT 366 Plant diversity (Department of Plant Science)
2. BOT 356 Plant ecophysiology (Department of Plant Science)
3. BCM 368 Molecular basis for disease (Department of Biochemistry)
4. BCM 357 Biocatalysis and integration of metabolism (Department of Biochemistry)
5. FAR 382 Pharmacology (Department of Pharmacology)
6. CMY 282 Physical chemistry (Department of Chemistry)
7. CMY 284 Organic chemistry (Department of Chemistry)

b. Duration

The honours degree programme for full-time students covers one academic year and for part-time students two consecutive academic years. Lectures and practicals are scheduled to accommodate part-time students.

c. Learning programme

The programme consists of compulsory modules (30 credits) and elective modules (60 credits). Students may register for modules to the maximum of 20 credits presented by another department, which forms part of the elective modules.
Apart from the compulsory and elective modules, a project, leading to a research report (60 credits), forms an essential part of the programme. One seminar (15 credits) must also be written and presented. Field excursions are undertaken. In addition to the compulsory modules, electives are selected in consultation with the supervisor.

Programme composition for BScHons [Option: Medicinal Plant Science]

Code	Module	Sem	Credits
Compulsory modules:			
BOT 748	Phytopharmacology 748	1	10
BOT 749	Pharmacognosy/Phytotherapy 749	2	10
BOT 761	Advanced phytomedicine 761	2	10
BOT 782	Research report 782	year	60
BOT 783	Seminar 783	2	15
Elective modules (to the value of 30 credits)**:**			
BOT 712	Plant nomenclature 712	1	10
BOT 714	Seed ecology 714	2	10
BOT 717	Plant morphology 717	1	10
BOT 718	Introduction to plant biotechnology 718	1	10
BOT 719	Primary plant metabolism 719	1	10
BOT 741	Plant taxonomy 741	2	10
BOT 742	Plant classification 742	2	20
BOT 746	Applications in plant biotechnology 746	2	10
BOT 784	Trends in plant science 784	1	10
BOT 786	Practical plant identification 786	1	10
BOT 788	Spatial analysis in ecology 788	2	10

Total credits required: 135

1.9 BScHons in Zoology (Code 03241021)

Programme composition

Code	Module	Credits
Compulsory modules:		
ZEN 701	Research project 701	70
ZEN 702	Research methods 702	13
ZEN 713	Scientific communication 713	13
Choice of three additional theory modules:		
ZEN 703	Systematics, evolution and biogeography 703	13
ZEN 704	Environmental physiology704	13
ZEN 705	Principles in applied ecology 705	13
ZEN 707	Integrated pest management in Africa 707	13
ZEN 710	Mammal ecology 710	13
ZEN 712	Behavioural ecology 712	13
ZEN 782	Insect-plant interactions 782	13
ZEN 783	Global climate change and biodiversity 783	13
ZEN 784	Contemporary research techniques 784	13

A pass mark is required for all the components of the honours study programme.

Total credits required: 135

2. MASTER'S PROGRAMMES IN THE BIOLOGICAL SCIENCES

2.1 MSc in Biochemistry (Code 03251011)

a. Admission requirements
A BScHons in Biochemistry with an average of 60%, or a recommendation from the head of department and depending on availability of supervisor/s and/or projects within the department.

b. Programme composition

Code	Module	Credits
BCM 890	Project and dissertation 890	180

Total credits required: 180

2.2 MSc in Bioinformatics (Code 03251014)

a. Admission requirements
Students must be in possession of a BScHons degree in Bioinformatics or the equivalent thereof. Admission is additionally dependent on availability of supervisor/s and/or projects within the department.

b. Programme composition

Code	Module	Credits
BIF 803	Bioinformatics research project and report 803	180

Total credits required: 180

2.3 *MSc in Biotechnology (Code 03251052)
**Interdepartmental programme.*

a. Admission requirements
An appropriate BScHons degree, with a final grade point average of at least 60%, or on recommendation by the Head of Department. Preference will be given to applicants with the highest final grade point averages for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the participating departments.

b. Programme composition
Curriculum to be determined by the heads of the participating departments, namely the departments of Biochemistry, Genetics, Microbiology and Plant Pathology, Plant Science, and Plant Production and Soil Science.
Please consult with Prof P Bloomer, Tel: 012 420 3259, for further details.

Note:
Additional modules may be prescribed by the heads of department where deemed necessary.

Total credits required: 180

2.4 MSc in Entomology (Code 03251031)
An MSc degree by virtue of a dissertation.

Programme composition
ENT 890 Dissertation: Entomology 890 (180 credits)

Total credits required: 180

2.5 MSc in Genetics (Code 03251051)

a. Admission requirements
An appropriate BScHons degree, with a final grade point average of at least 60%, or on recommendation by the Head of Department. Preference will be given to applicants with the highest final grade point averages for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the Department.

b. Programme composition
GTK 890 Dissertation: Genetics 890 (180 credits)

*GTK 890 also applies to MSc in Biotechnology (Code 03251052) students registered in the Department of Genetics.

Note:
Additional modules may be prescribed by the head of department where deemed necessary.

Total credits required: 180

2.6 MSc in Microbiology (Code 03250911)

Programme composition
MBY 890 Dissertation: Microbiology 890 (180 credits)

Total credits required: 180

2.7 MSc in Plant Science (Code 03251091)

a. Admission requirements
BScHons in Plant Science or BScHons [Option: Medicinal Plant Science] with an average of 60%, or a recommendation from the head of department.

b. Programme composition
BOT 890 Dissertation: Plant science 890 (180 credits)

Total credits required: 180
*BOT 890 also applies to MSc in Biotechnology (Code 03251052) students registered in the Plant Science department.

2.8 MSc [Option: Medicinal Plant Science] (Code 03251090)

a. Admission requirements
BScHons [Option: Medicinal Plant Science] or a recommendation by the head of department. A minimum of 60% will be necessary in the compulsory modules, BOT 761, BOT 748, and BOT 749, which are offered at honours level in the Department of Plant Science.

b. Programme composition
MPS 890 Dissertation: Medicinal plant science 890 (180 credits)

Total credits required: 180

2.9 MSc in Plant Pathology (Code 03250881)

Programme composition
PPT 890 Dissertation: Plant pathology 890 (180 credits)

Total credits required: 180

2.10 MSc in Zoology (Code 03251021)

Programme composition
ZOO 890 Dissertation: Zoology 890 (180 credits)

Total credits required: 180

3. DOCTORAL PROGRAMMES IN THE BIOLOGICAL SCIENCES

3.1 PhD in Biochemistry (Code 03260012)

a. Admission requirements
An MSc in Biochemistry with an average of 60%, or a recommendation from the head of department and depending on availability of supervisor/s and/or projects within the department.

b. Programme composition
BCM 990 Project and thesis 990 (360 credits)

Total credits required: 360

3.2 PhD in Bioinformatics (Code 03260014)

a. Admission requirements
Students must be in possession of an MSc degree in Bioinformatics or an equivalent thereof. Admission is additionally dependent on availability of supervisor/s and/or projects within the department.

b. Programme composition
BIF 990 Thesis: Bioinformatics (360 credits)

Total credits required: 360

3.3 *PhD in Biotechnology (Code 03262162)
**Interdepartmental programme.*

a. Admission requirements
An appropriate MSc degree, with a final grade point average of at least 60%, or on recommendation by the Head of Department, and contingent upon the availability of supervisors and/or research projects within the participating departments.

b. Programme composition
Curriculum to be determined by the heads of the participating departments. Please consult with Prof P Bloomer, Tel: 012 420 3259, for further details.

Total credits required: 360

3.4 PhD in Entomology (Code 03260121)

Programme composition

ENT 990	Thesis: Entomology 990	(360 credits)

Total credits required: 360

3.5 PhD in Genetics (Code 03260292)

a. Admission requirements
An appropriate MSc degree, with a final grade point average of at least 60%, or on recommendation by the Head of Department, and contingent upon the availability of supervisors and/or research projects within the Department.

b. Programme composition

GTK 990	Thesis: Genetics 990	(360 credits)

*GTK 990 also apply to PhD in Biotechnology (Code 03262162) students registered in the Department of Genetics.

Total credits required: 360

3.6 PhD in Microbiology (Code 03260072)

Programme composition

MBY 990	Thesis: Microbiology 990	(360 credits)

Total credits required: 360

3.7 PhD in Plant Pathology (Code 03260302)

Programme composition

PPT 990	Thesis: Plant pathology 990	(360 credits)

Total credits required: 360

3.8 PhD in Plant Science (Code 03261091)

a. Admission requirements
MSc in Plant Science or MSc [Option: Medicinal Plant Science] 60%, or a recommendation from the head of department.

b. Programme composition
BOT 990 Thesis: Plant science 990 (360 credits)

*BOT 990 also apply to PhD in Biotechnology (Code 03262162) students registered in the Department of Plant Science.

Total credits required: 360

3.9 PhD [Option: Medicinal Plant Science] (Code 03261090)

a. Admission requirements
MSc [Option: Medicinal Plant Science] or an MSc in Plant Science, or a recommendation from the head of department. A minimum of 60% is required in the compulsory modules, BOT 761, BOT 748, and BOT 749, which are offered at honours level in the Department of Plant Science.

b. Programme composition
MPS 990 Thesis: Medicinal plant science 990 (360 credits)

Total credits required: 360

3.10 PhD in Zoology (Code 03261021)

Programme composition
ZOO 990 Thesis: Zoology 990 (360 credits)

Total credits required: 360

4. HONOURS PROGRAMMES IN THE PHYSICAL SCIENCES

4.1 BScHons in Chemistry (Code 02240121)

a. Admission requirements
An appropriate BSc degree with at least 60% for Chemistry at 300-level.

b. Duration of programme
The programme normally extends over one year for full-time students. The curriculum comprises an advanced study of the four major fields of chemistry.

c. Closing date for applications
Prospective students must apply for admission to the head of department before **15 December** and will be notified of the outcome by 15 January. Details of the contents of the different modules can be obtained from the head of department.

d. Pass requirements:
A final mark of 50% for each module. To continue to a second semester, a minimum of 40% is required in each module in the first semester. The registration of students who do not meet this requirement will be terminated at the end of the first semester.

e. Programme composition

Code	Module	Credits
CMY 706	Analytical chemistry A 706	10
CMY 707	Analytical chemistry B 707	10
CMY 708	Organic chemistry A 708	10
CMY 709	Organic chemistry B 709	10
CMY 714	Inorganic chemistry A 714	10
CMY 715	Inorganic chemistry B 715	10
CMY 716	Physical chemistry A 716	10
CMY 717	Physical chemistry B 717	10
CMY 718	Organic/Inorganic project 718	20
CMY 719	Physical/Analytical project 719	20
CMY 730	Practical techniques 730	15

Total credits required: 135

4.2 BScHons in Engineering and Environmental Geology

Please note that within the honours programme in Engineering and Environmental Geology, there are two possible options, namely Engineering Geology and Hydrogeology. Each has a component of core modules and of elective modules, as shown in the tables below.

a. Admission requirements
A BSc degree in Geology or Environmental and Engineering Geology with an average of 60% for all the modules in applied geology at second-year and third-year level. These modules must include soil mechanics, rock mechanics, engineering geology and hydrogeology. In the selection procedure the candidate's complete undergraduate academic record will be considered. The positions available are limited to 15 and candidates who have progressed faster through their undergraduate degree will take preference. Outside applicants and those with unusual degree structures may be admitted after perusal of their academic records and at the discretion of the head of department.

b. Programme composition

Option: Engineering Geology (Code 02240370)

Code	Module name	Credits	Prerequisites
Research component (30 credits required):			
GTX 713	Site investigation project 713	30	GLY 363/GLY 362 or TDH

Core modules (90 credits required):			
GTX 714	Engineering geology of South Africa 714	15	SGM 311 or TDH
GTX 716	Environmental management and risk assessment 716	15	
GTX 721	Construction materials 721	15	
GTX 722	Rock engineering 722	15	GLY 364 or TDH*
GTX 723	Engineering applications 723	15	
GTX 725	Fluid mechanics in geological media 725	15	GLY 363 and GLY 265
Elective modules (15 credits required):			
GTX 715	Environmental geochemistry 715	15	
GTX 726	Rock and soil improvement 726	15	GLY 264 or TDH*

Total credits required: 135

Option: Hydrogeology (Code 02240373)

Code	Module name	Credits	Prerequisites
Research component (30 credits required):			
GTX 713	Site investigation project 713	30	GLY 362/GLY 363 or TDH
Core modules (90 credits required):			
GTX 714	Engineering geology of South Africa 714	15	SGM 311 or TDH
GTX 715	Environmental geochemistry 715	15	
GTX 716	Environmental management and risk assessment 716	15	
GTX 718	Hydrogeological modelling 718	15	GTX 725
GTX 719	Contaminant transport 719	15	GTX 715 or TDH*
GTX 725	Fluid mechanics in geological media 725	15	GLY 363 and GLY 265
Elective modules (15 credits required):			
GTX 722	Rock engineering 722	15	GLY 364 or TDH*
GTX 726	Rock and soil improvement 726	15	GLY 264 or TDH

*TDH = permission by Head of Department

Total credits required: 135

4.3 BScHons in Geographical Sciences
Option: Geography and Environmental Science (Code 02240413)

a. Admission requirements

An appropriate bachelor's degree, with an overall average of 60% for 300- and 400-level modules.

b. Programme composition

Please note that the curriculum may change each year at the discretion of the head of department or the honours coordinator in the Department of Geography, Geoinformatics and Meteorology.

Code	Module name	Credits
Fundamental modules:		
GGY 710	Geographical and environmental principles 710	25
Core modules:		
GGY 702	Research project 702	35
Elective modules (to the value of 75 credits):		
ENV 785	Environmental assessments 785	15
GGY 701	Selected theme 701	15
GGY 718	Applied geomorphology 718	15
GGY 780	Urban geography 780	15
GGY 789	Environmental change 789	15
GGY 793	Aspects of land reform and the environment 793	15
Appropriate modules, other than the above and approved by the honours coordinator or head of department, may be taken. However, a minimum of 45 elective module credits should come from the Department of Geography, Geoinformatics and Meteorology.		

Minimum credits required: 135

4.4 BScHons in Geoinformatics (Code 02240408)

a. Admission requirements

A BSc in Geoinformatics or equivalent BSc degree that meets the prerequisites of the honours modules. Prospective students may be required to do additional modules to enable them to reach the desired level of study. Selection takes place before admission.

b. Programme composition

Code	Module name	Credits
Fundamental modules (compulsory):		
GIS 701	Research methods 701	10
GIS 703	GIS professional practice 703	15
Core modules (compulsory):		
GIS 702	Research project 702	35
GIS 704	Spatial statistics and geodesy 704	15
GIS 705	Advanced geospatial data 705	15
GMA 705	Advanced remote sensing 705	15
Elective modules: (two modules, one of which must be COS 787 or GIS 706)		
COS 787	Spatial databases 787	15
GIS 706	Internet GIS 706	15
GIS 707	Special topics 707	15
Appropriate honours modules may be taken from the Faculty or from the		

School of Information Technology, as approved by the honours coordinator or Head of Department.

Minimum credits required: 135

4.5 BScHons in Geology (Code 02240141)

a. Admission requirements

A BSc degree in Geology with an average of 60% for all the geology modules at third-year level. In the selection procedure the candidate's complete undergraduate academic record will be considered. The positions available are limited to 25 and candidates who have progressed faster through their undergraduate degree will take preference. Outside applicants and those with unusual degree structures may be admitted after perusal of their academic records and at the discretion of the head of department.

b. Programme composition

Code	Core modules	Credits
GLY 702	Volcanology 702	12
GLY 703	Geophysics and basin analysis 703	16
GLY 704	Crustal evolution 704	12
GLY 706	Ore deposits and mining methods 706	16
GLY 707	Mapping camp 707	9
GLY 710	Honours project 710	30
GLY 711	Igneous petrology and geochemistry 711	12
GLY 712	Metamorphic petrology and geochemistry 712	12
GLY 713	Economic geology 713	16

Total credits required: 135

4.6 BScHons in Meteorology (Code 02240070)

a. Admission requirements

A BSc in Meteorology degree
OR
An appropriate bachelor's degree with second-year mathematics and first-year physics.

WKD 155 Atmospheric structure and processes
WKD 164 Climate and weather of Southern Africa
WKD 261 Physical meteorology
GMA 220 Remote sensing
WKD 263 Introduction to dynamical meteorology
WKD 356 Climate and community
WKD 352 Atmospheric vorticity and divergence
WKD 361 Quasi-geostrophic analysis
WKD 366 Fundamentals of weather forecasting
WTW 114 Calculus*
WTW 128 Calculus*
WTW 126 Linear algebra*

WTW 218 Calculus*
WTW 248 Vector Analysis *
PHY 171 First course in physics* or PHY 114 and 124
(*or an equivalent qualification as approved by the head of the department.)

b. Programme composition

The programme consists of 135 credits of which 99 are core credit modules. Three modules of 12 credits each must be taken as elective credits.

Code	Module	Credits
Core modules (120 credits):		
WKD 704	Numerical modelling: Applications 704	12
WKD 706	Dynamic meteorology 706	16
WKD 707	Radar meteorology 707	12
WKD 731	Overview of tropical and mid-latitude meteorology 731	12
WKD 733	Satellite meteorology 733	12
WKD 763	Research project 763	35
Elective modules (36 credits):		
WKD 703	Seasonal climate modelling 703	20
WKD 719	Boundary layer meteorology 719	20
WKD 781	Cloud dynamics 781	20
WKD 734	Mesoscale meteorology 734 Prerequisite: WKD 707 & WKD 733	12
WKD 736	Selected themes 736 *Prerequisites may be required but will be discussed on an individual basis*	12
Appropriate honours modules from the other disciplines in the Department or Faculty may be taken on approval by the Honours coordinator or Head of Department.		

Total credits required: 135

4.7 BScHons in Physics (Code 02240231)

a. Admission requirements

BSc (or equivalent qualification) with a minimum of 60% in physics at third-year level and with permission from the head of department.

b. Programme composition

Code	Module name	Lectures	Credits
FSK 700	Physics 700	220	135

Students registered for the BScHons in Physics degree enrol for Physics 700. The programme comprises of 135 credits and consists of 220 lectures. It also includes a research project (25 credits), which culminates in a seminar presentation. The programme may optionally include advanced experimental work. The curriculum is compiled in consultation with the Head of the Department of Physics, from whom details are available. With permission from the head of department a maximum of 30 credits may be taken from other postgraduate modules from other departments.

The modules listed below may be taken by students in other honours degree programmes. They must, however, first consult with the Head of the Department of Physics about the availability of a particular module in a particular year.

Postgraduate physics modules:

Code	Module name	Lectures	Credits
PHY 701	Mathematical methods 701	30	15
PHY 702	Classical mechanics 702	30	15
PHY 703	Quantum mechanics 703	30	15
PHY 704	Statistical physics 704	30	15
PHY 705	Electrodynamics 705	30	15
PHY 706	Project and seminar 706		25
PHY 708	Many body physics 708	30	15
PHY 710	Numerical physics 710	30	15
PHY 711	Solid state physics 711	30	15
PHY 712	Quantum optics 712	20	10
PHY 713	Electronic materials 713	30	15
PHY 714	Analytical physics 714	30	15
PHY 716	Group theory 716	20	10
PHY 717	Quantum field theory 717	20	10
PHY 718	Experimental physics 718		10
PHY 719	Nuclear physics 719	20	10
PHY 720	Radio astrophysics 720	20	10
PHY 781	Foundations of physics 781	20	10
PHY 782	Current trends in physics 782	20	10

5. MASTER'S PROGRAMMES IN THE PHYSICAL SCIENCES

5.1 MSc in Applied Mineralogy (Code 02250381)

Programme composition
TMN 890 Dissertation: Applied mineralogy 890 (180 credits)

Total credits required: 180

5.2 MSc in Chemistry (Code 02250121)

Programme composition
CHM 890 Dissertation: Chemistry 890 (180 credits)

Total credits required: 180

5.3 MSc in Engineering Geology (Code 02250371)

Programme composition
IGL 890 Dissertation: Engineering geology 890 (180 credits)

Total credits required: 180

5.4 (a) MSc in Engineering and Environmental Geology (Code 02250372)

Programme composition
IGL 890 Dissertation: Engineering geology 890 (180 credits)

Total credits required: 180

(b) MSc in Engineering and Environmental Geology [Option: Hydrogeology] (Code 02250373)

Programme composition
GTX 890 Dissertation: Hydrogeology 890 (180 credits)

Total credits required: 180

5.5 MSc in Exploration Geophysics (Code 02250431)

Programme composition
EGF 890 Dissertation: Exploration geophysics 890 (180 credits)

Total credits required: 180

5.6 MSc in Geography (Code 02250411)

Programme composition
GGF 890 Dissertation: Geography 890 (180 credits)

Total credits required: 240

5.7 MSc in Geoinformatics (Code 02250412)

Programme composition
GIS 890 Dissertation: Geoinformatics 890 (180 credits)

Total credits required: 240

5.8 MSc in Geology (Code 02250141)

Programme composition
GLG 890 Dissertation: Geology 890 (180 credits)

Total credits required: 180

5.9 MSc in Meteorology (Code 02250070)

Programme composition
AWM 890 Dissertation: Meteorology 890 (180 credits)

Total credits required: 240

5.10 MSc in Physics (Code 02250231)

a. Admission requirements
BScHons in Physics (or equivalent qualification) and with permission from the head

of department and depending on availability of supervisor/s and/or projects within the department.

b. Programme composition and credit requirements:
180 credits consisting of:
i) Dissertation (determined by supervisor and head of department)
ii) Theoretical modules (maximum of 60 lectures) may be taken and are determined by the supervisor and head of department. These modules are to supplement the subject of the dissertation of the student.

FSK 890 Dissertation: Physics 890 (180 credits)

Total credits required: 180

6. DOCTORAL PROGRAMMES IN THE PHYSICAL SCIENCES

6.1 PhD in Chemistry (Code 02260451)

Programme composition
CHM 990 Thesis: Chemistry 990 (360 credits)

Total credits required: 360

6.2 (a) PhD in Engineering and Environmental Geology (Code 02260542)

Programme composition
IGL 990 Thesis: Engineering geology 990 (360 credits)

Total credits required: 360

(b) PhD in Engineering and Environmental Geology [Option: Hydrogeology] (Code 02260522)

Programme composition
GTX 990 Thesis: Hydrogeology 990 (360 credits)

Total credits required: 360

6.3 PhD in Exploration Geophysics (Code 02260531)

Programme composition
EGF 990 Thesis: Exploration geophysics 990 (360 credits)

Total credits required: 360

6.4 PhD in Geography (Code 02260511)

Programme composition
GGF 990 Thesis: Geography 990 (360 credits)

Total credits required: 360

6.5 PhD in Geoinformatics (Code 02260512)

Programme composition
GIS 990 Thesis: Geoinformatics 990 (360 credits)

Total credits required: 360

6.6 PhD in Geology (Code 02260521)

Programme composition
GLG 990 Thesis: Geology 990 (360 credits)

Total credits required: 360

6.7 PhD in Meteorology (Code 02260630)

Programme composition
AWM 990 Thesis: Meteorology 990 (360 credits)

Total credits required: 360

6.8 PhD in Physics (Code 02260481)

a. Admission requirements
An MSc in Physics (or equivalent qualification) and with permission from the head of department and depending on availability of supervisor/s and/or projects within the department.

b. Programme composition and credit requirements:
FSK 990 Thesis: Physics 990 (360 credits)

Additional modules may be prescribed by the head of department. The contents of the coursework will be determined by the supervisor and head of department to supplement the subject of the thesis of the student.

Total credits required: 360

7. BSC HONOURS PROGRAMMES IN THE AGRICULTURAL AND FOOD SCIENCES

7.1 BScHons in Agriculture [Option: Crop Science] (Code 03240161)

a. Admission requirements
The admission requirement is a BScAgric (Applied Plant and Soil Sciences) degree or equivalent qualification, or an appropriate BSc degree after consultation with the Head of Department. A South African equivalent aggregate mark of 60% is required for all the modules taken in the final year of undergraduate studies. Students are selected on merit.

b. Duration
One year full-time.

c. Programme composition

Code	Module name	Credits
Compulsory modules (60 credits):		
PGW 701	Research project in crop science 701	30
PGW 702	Scientific communication 702	15
PGW 704	Research methodology 704	15
Elective modules (75 credits):		
Electives can be chosen out of the modules listed or any other 700-module that is presented in the Faculty of Natural and Agricultural Sciences, chosen in consultation with the Head of Department of Plant Production and Soil Science		
AGR 785	Crop production systems I: Field crops 785	15
AGR 786	Crop production systems II: Vegetable crops 786	15
APS 761	Crop physiology 761	15
GDK 773	Plant nutrition, soil biology and soil fertility 773	15
HSC 780	Fruit tree crops 780	30
LKM 750	Environmental biophysics 750	15
PPR 712	Plant production: Herbicides and control 712	15
PPR 713	Agroforestry 713	15
WDE 781	Rangeland management 781	15
WDE 782	Pasture science 782	15

Total credits required: 135

7.2 BScHons in Food Science (Code 03240921)

a. Admission requirements

A BSc in Food Science degree with a pass mark of at least 60%. A candidate with another, applicable academic background can be admitted to the programme on passing a preliminary examination and/or on completion of certain prescribed modules aimed at supplementing lacking background knowledge.

b. Duration

One year full-time.

c. Programme composition

Code	Module name	Credits
Compulsory modules (105 credits)**:**		
FST 700	Research methodology and seminars 700 (year module)	15
FST 712	Sensory evaluation 712	10
FST 713	Product development and quality management 713	25
FST 720	Advanced food science 720	15
FST 763	Research project 763 (year module)	40

Elective modules (30 credits)**:** Each candidate must complete elective modules to a total of 30 credits. We strongly recommend the following two modules as electives, or other modules as approved by the head of department:		
FST 701	Animal food technologies 701	15
FST 702	Advanced plant food science and technologies 702	15

Total credits required: 135

7.3 BScHons in Nutrition and Food Science (Code 03240922)

a. Admission requirements

A BSc in Nutrition and Food Science degree with a pass mark of at least 60%. A candidate with another applicable academic background can be admitted to the programme on passing a preliminary examination and/or on completion of certain prescribed modules aimed at supplementing lacking background knowledge.

b. Duration

One year full-time

c. Composition of the programme

Code	Module name	Credits
FST 700	Research methodology and seminars 700	15
FST 712	Sensory evaluation 712	10
FST 713 **o**r VDS 713	Product development and quality management 713 or Recipe development and standardisation 713	25
VDS 723	Food consumerism and product advice 723	15
VVW 720	Advanced nutrition and food science 720	15
VVW 763	Research project 763	40
VVW 765	Micronutrient malnutrition 765	15

Total credits required: 135

7.4 BScHons in Soil Science [Option: Environmental Soil Science] (Code 03240902)

a. Admission requirements

In addition to the requirements of the General Regulations an appropriate bachelor's degree is a prerequisite. Soil science at an undergraduate level is required, namely: Introductory soil science, Pedology and Soil chemistry. It is at the discretion of the head of department to prescribe any other modules deemed necessary, or to exempt a prospective student from specific requirements.

b. Programme composition

The honours degree is awarded on the basis of formal modules passed. Students registered for the BScHons in Soil Science [Option: Environmental Soil Science] will register for all the soil science modules prescribed at honours level, as well as any other modules deemed necessary by the head of department.

The following core modules are prescribed:

Code	Module name	Credits
AGR 785	Crop production systems (I): Field crops 785	15
GDK 771	Advanced environmental soil chemistry 771	15
GDK 772	Advanced environmental soil physics 772	15
GDK 773	Plant nutrition, soil biology and soil fertility 773	15
GDK 775	Project in environmental soil science 775	30
LKM 750	Environmental biophysics 750	15
PGW 702	Scientific communication 702	15
PGW 704	Research methodology 704	15

Total credits required: 135

7.5 BScHons in Wildlife Management (Code 03241001)

a. Admission requirements

To qualify for admission to the BScHons in Wildlife Management, prospective students must have completed a BSc degree with Animal Science, Ecology, Zoology, Plant Science, or a similar relevant biological major subject; or a BScAgric Animal Sciences and/or Plant Production; a BSc Forestry, a BVSc degree, or a similar degree. The candidate must also furnish proof of having passed a relevant module in statistics, otherwise they must register for one separately. A South African equivalent aggregate mark of 60% is usually required for all the modules taken in the final year of undergraduate studies. Determination, attitude and standard of undergraduate projects, where available, will also be taken into consideration. Students are selected on merit.

b. Closing date for applications

All applications for admission should reach the Client Service Centre, University of Pretoria, Pretoria, 0002 or the Director of the Centre for Wildlife Management by **30 October** of the preceding year.

c. Duration of the programme

The programme extends over one academic year, full-time.

d. Programme composition

The curriculum is compiled in consultation with the Director of the Centre for Wildlife Management from the modules listed below or any other relevant modules. The programme includes lectures/discussions, seminars, a research project (paper), excursions and informal seminars/lectures. A final mark of at least 50% is required in each of the modules listed for this honours degree.

The honours programme comprises a minimum of 135 credits:

Code	Module name	Credits
BOT 786	Practical plant identification 786	10
BOT 788	Spatial analysis in ecology	10
BOT 790	Plant ecology and conservation for wildlife management	10
NLB 780	Wildlife ecology 780	10

NLB 781	Wildlife management principles and techniques 781	5
NLB 782	Wildlife nutrition 782	10
NLB 783	Parasites, diseases and the capture of wildlife animals 783	10
NLB 785	Scientific communication 785	10
NLB 795	Research project 795	50
WDE 701	Range management in wildlife systems 701	10

Total credits required: 135

8. MASTER'S PROGRAMMES IN THE AGRICULTURAL AND FOOD SCIENCES

8.1 MConsumer Science

There are two options available, each requiring a minimum of 180 credits:

Dissertation option: Clothing Management (02253006)
Interior Merchandise Management (02253004)
Food Management (02253008)
General (02253009)

a. Admission requirements

For the MConsumer Science degree with specialisation in Clothing, Interior, Foods and Nutrition, a four-year BConsumer Science degree that is BCom-based is required. A minimum average of 60% in the broad area of specialisation that the student wishes to pursue is required for admission.
For the general MConsumer Science degree other applicable four-year degrees will be considered.

b. Duration of study

A minimum of one year full-time and a maximum of three years part-time study.

c. Programme composition

Dissertation:

Code	Module name	Credits
NMN 814	Research methodology 814	–
VBR 890	Dissertation: Consumer Science 890	180

Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

A basic course in statistics is compulsory when a quantitative approach is used for the research for the dissertation.

Work on the dissertation consists of three parts, namely a research proposal, project execution, and writing the dissertation. It is compulsory to give an oral presentation of the proposal as well as of the research on completion of the degree.

8.2 *MSc [Option: Forest Science] (Code 03251050)
**Interdepartmental programme.*

a. Admission requirements
A prior four-year bachelor's qualification in Forestry or Forest Science, or an equivalent honours degree in a related field.

b. Programme composition
Curriculum to be determined by the heads of department in the biological sciences. Please consult with Prof P Chirwa, Tel: 012 420 3213, for further details.

FOR 890 Forest science 890 (240 credits)
Note:
Additional modules may be prescribed by the head of department where deemed necessary.

Total credits required: 240

8.3 MSc in Food Science (Code 03250921)

Programme composition
The degree is conferred based on a dissertation and other requirements as follows:

FST 890 Dissertation: Food science 890 (180 credits)
Candidates must write a dissertation on their research project in food science and/or food technology and at least a concept research paper for publication in a peer-reviewed scientific journal.

Total credits required: 180

8.4 MSc in Nutrition (Code 03251106)

Programme composition
The degree is conferred based on a dissertation and 60 credits of coursework.

VDG 801 Electives: Nutrition 801 (60 credits)
Modules at the advanced level chosen in consultation with the Director of the Centre for Nutrition and the head of department. See list of modules below.

VDG 890 Dissertation: Nutrition 890 (180 credits)
Candidates must write a dissertation on their research project in Nutrition and at least a concept research paper for publication in a peer-reviewed scientific journal.

List of elective modules – choose modules to the value of 60 credits:

Code	Module name	Credits
DEK 802	Seminar meetings 802	15
DEK 803	Literature studies 803	15
PFS 801	Production physiology 801	15
VDG 880	Contemporary aspects of nutrition 880 *Prerequisite: Consult the head of department*	15

VDG 881	Nutritional assessment and status 881 *Prerequisite: Consult the head of department*	30
VDS 880	Social aspects of foods 880 *Prerequisite: HSK 810 (Theoretical frameworks in cultural studies)*	30
VDS 881	Foods merchandising 881 *Prerequisite*: *Consult the head of department*	30
VDS 883	Consumer aspects of food product design and development 883 *Prerequisite: HSK 812 (Theoretical frameworks in consumer studies)*	30
VGE 801	Monogastric nutrition 801	15
VGE 802	Ruminant nutrition 802	15
VLE 801	Meat science 801	15

Total credits required: 240

8.5 MSc in Soil Science (Code 03250901)

a. Requirements:

A three-year basic Soil Science degree with a BScHons (Soil Science) or equivalent qualification with a minimum average of 60% is required for admission. In addition, a motivation letter reflecting research interest should accompany the application form. Selection of students will be based on academic performance, the motivation letter, available supervisory capacity and research project funding.

Note:

Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

GDK 890 Dissertation: Soil science (180 credits)

Total credits required: 180

8.6 MSc in Wildlife Management (Code 03251001)

a. Admission requirements

An applicable BScHons in Wildlife Management or an equivalent qualification with a minimum weighted average of 60%.

b. Programme composition

NLB 890 Dissertation: Wildlife management 890 (180 credits)

Research project with dissertation. Please contact Prof MJ Somers at the Centre for Wildlife Management on Tel: 012 420 6091 for the available options.

Total credits required: 180

8.7 MScAgric in Agricultural Economics (Code 03250041)

a. Admission requirements

A BScAgric degree with major in agricultural economics and 60% average in the final year.

b. Programme composition

FIRST YEAR:

Code	Module	Credits
Core modules:		
LEK 815	Applied microeconomics 815	15
LEK 810	Applied econometrics 810	15
LEK 811	Production economics 811	15
LEK 882	Institutional economics 882	15

Elective modules:

Choose any two electives according to area of spesialisation Total: 30

Credits for coursework: Total: 90

SECOND YEAR:

Required modules:		
LEK 892	Dissertation: Agricultural economics 892 *(Students should complete a module in research methodology as preparation for the dissertation module.)*	120

Minimum total credits for master's degree over two years: 210

8.8 MScAgric in Agricultural Extension (Code 03251030)

a. Admission requirements

A four-year BScAgric degree in any field of specialisation PLUS completion of the BAgricHons (Extension) or at least 120 credits of relevant Extension modules at postgraduate level (honours level) with an average of 65%.

b. Programme composition

AGV 890 Dissertation: Agrarian extension 890 (180 credits)

Total credits required: 180

8.9 MScAgric in Agronomy (Code 03250454)

a. Requirements:

A four-year Applied Plant Sciences degree or equivalent qualification with a minimum average of 60% is required for admission. In addition, a motivation letter reflecting research interest should accompany the application form. Selection of students will be based on academic performance, the motivation letter, available supervisory capacity and research project funding.

Note:

Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

AGR 890 Dissertation: Agronomy 890 (180 credits)

Total credits required: 180

8.10 MScAgric in Animal Science degrees

8.10.1 MScAgric (Animal Breeding and Genetics) (Code 03250457)

8.10.2 MScAgric (Animal Science) (Animal Nutrition) (Code 03250421)

8.10.3 MScAgric (Animal Science) (Livestock Production and Ecology) (Code 03250441)

8.10.4 MScAgric (Animal Science) (Production Physiology and Product Quality) (Code 03250391)

a. Admission requirements

The minimum admission requirements are a BScAgric degree with specialisation in Animal Science or an equivalent applicable degree, with a minimum weighted average of 60% for modules in the particular field of specialisation in the fourth year of study.

b. Programme composition

The curriculum for the MScAgric degree consists of the following:

i) A dissertation of 180 credits; or

ii) A dissertation of 150 credits and advanced study in the major subject/s, augmented by ancillary modules to the maximum of 30 credits that may be prescribed by the Dean on the recommendation of the head of department. Such ancillary modules may be taken simultaneously with the major subject/s. Candidates in possession of the BScAgricHons degree may be exempted from additional ancillary modules.

VKU 801 Animal Science 801 (150 credits)

Consisting of a dissertation of 150 credits and 30 credits of coursework selected from Animal science modules at 800-level (See list below):

Code	Module name	Credits
GVK 800	Large stock science 800	15
KVK 800	Small stock science 800	15
PVK 800	Poultry science 800	15
PFS 801	Production physiology 801	15
TLR 801	Animal breeding and genetics 801	15
VKD 800	Pig science 800	15
VNE 800	Livestock ecology 800	15
VLE 801	Meat science 801	15
VGE 801	Monogastric nutrition 801	15
VGE 802	Ruminant nutrition 802	15
WLK 800	Wool science 800	15

or

VKU 890: Dissertation: Animal science 890 (180 credits)

Total credits required: 180

8.11 MScAgric in Entomology (Code 03250120)

Programme composition
ENT 890 Dissertation: Entomology 890 (180 credits)

Total credits required: 180

8.12 MScAgric in Food Science and Technology (Code 03250261)

a. Admission requirements
BScAgric or equivalent degree.

b. Programme composition
The degree is conferred based on a dissertation and other requirements as follows:

FST 890 Dissertation: Food science 890 (180 credits)

Candidates must write a dissertation on their research project in Food science and/or Food technology and at least a concept research paper for publication in a peer-reviewed scientific journal.

Total credits required: 180

8.13 MScAgric in Genetics (Code 03250291)

a. Admission requirements
An appropriate BScAgric degree, with a final grade point average of at least 60%, or on recommendation by the Head of Department. Preference will be given to applicants with the highest final grade point averages for their preceding degree and qualifying applicants may be subjected to an entrance evaluation examination. Admission is furthermore contingent on the availability of supervisors and/or research projects within the Department.

b. Programme composition
GTK 890 Dissertation: Genetics 890 (180 credits)

Students registered for the MScAgric programme will be required to complete ancillary modules concurrently with the abovementioned dissertation during their first year of registration. These modules will be selected from the Genetics honours modules (700-level). Candidates in possession of a BScAgricHons may be exempted from these modules.
Note:
Additional modules may be prescribed by the head of department where deemed necessary.

Total credits required: 180

8.14 MScAgric in Horticulture (Code 03250091)

a. Reguirements:
A four-year Applied Plant Science degree or equivalent qualification with a minimum average of 60% is required for admission. In addition, a motivation letter reflecting research interest should accompany the application form. Selection of

students will be based on academic performance, the motivation letter, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

TBK 890 Dissertation: Horticultural science 890 (180 credits)

Total credits required: 180

8.15 MScAgric in Pasture Science (Code 03250455)

a. Requirements

A four-year Applied Plant/Animal Science degree or equivalent qualification with a minimum average of 60% is required for admission. In addition, a motivation letter reflecting research interest should accompany the application form. Selection of students will be based on academic performance, the motivation letter, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

WDE 890 Dissertation: Pasture science 890 (180 credits)

Total credits required: 180

8.16 MScAgric in Plant Pathology (Code 03250301)

Programme composition

PPT 890 Dissertation: Plant pathology 890 (180 credits)

Total credits required: 240 credits

8.17 MScAgric in Soil Science (Code 03250456)

a. Requirements:

A four-year Applied Soil Science degree or equivalent qualification with a minimum average of 60% is required for admission. In addition, a motivation letter reflecting research interest should accompany the application form. Selection of students will be based on academic performance, the motivation letter, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

GDK 890 Dissertation: Soil science 890 (180 credits)

Total credits required: 180

9. DOCTORAL PROGRAMMES IN THE AGRICULTURAL AND FOOD SCIENCES

9.1 PhD in Agrarian Extension (Code 03262002)

Programme composition
The programme consists of:
i) Original research leading to a thesis.
ii) An examination on the thesis.

AGV 990 Thesis: Agrarian extension 990 (360 credits)

Total credits required: 360

9.2 PhD in Agricultural Economics (Code 03260042)

Programme composition
The PhD programme in Agricultural Economics consists of a thesis and an oral examination:

LEK 991 Thesis: Agricultural economics 991 (360 credits)

All students need to follow a preparatory programme for the thesis which is not part of the degree programme. This preparatory programme should at least cover the following modules or their equivalents:

- Any two modules in economic or applied economic theory (eg Microeconomics or Macroeconomics)
- One module in quantitative methods (Econometrics, Applied econometrics, Quantitative methods, or Partial equilibrium modelling)
- One module in the field of specialisation (institutional economics, science and technology policy, food policy, etc)

If these modules or their equivalents have been completed sucessfully and a PhD proposal has been presented succesfully to and approved by the Department's postgraduate committee, the student may proceed to the research phase and the thesis. Students can be exempted from this preparatory programme if equivalent modules are completed at other universities and students could provide evidence that these prerequisites have been met.

For students with an MInstAgrar or similar qualification, additional modules might be recommended in order to ensure that the candidates' quantitative abilities are at the same level as someone entering the programme with an MScAgric.

Total credits required: 360

9.3 PhD in Agronomy (Code 03262164)

a. Requirements:
MScAgric (Agronomy) or applicable research master's qualification with a pass mark of at least 60% for the dissertation component. In addition, a research proposal should accompany the application form. Selection of students will be based on academic performance, the written research proposal, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition
AGR 990 Thesis: Agronomy 990 (360 credits)

Total credits required: 360

9.4 PhD in Animal Science (Code 03260141)

a. Admission requirements
MScAgric with specialisation in Animal Science or an equivalent applicable degree.

b. Programme composition
The curriculum for the PhD degree programme consists of the following:
i) A theoretical knowledge of the major subject/s and such additional modules as may be prescribed (Animal science modules at 800-level).
ii) A thesis.

VKU 990 Thesis: Animal science 990 (360 credits)

Total credits required: 360

9.5 PhD in Consumer Science

a. Admission requirements
MConsumer Science or applicable master's degree with a pass mark of at least 60%.

To proceed with the thesis a student should have fulfilled the requirements for the master's degree:
- Research methodology 814 (NMN 814) or similar module of the same level and scope;
- The student has published at least one article in an accredited/refereed research journal during the two years prior to registration for the PhD degree or can prove that one has been accepted in an accredited/refereed journal.

It must be evident from the master's dissertation or publications based on it, that the candidate is able to undertake research independently.

Note:
It may be required from the student to do additional coursework.

b. Degrees, duration of study and number of credits
The following fields of specialisation and degrees are offered:

- Clothing Management (02263002)
- Development (02263003)
- Food Management (02263004)
- Interior Merchandise Management (02263001)

The programme extends over a minimum of two years of study.

Total credits required: 360

9.6 *PhD [Option: Forest Science] (Code 03262160)
*Interdepartmental programme.

Programme composition
Curriculum to be determined by the heads of department in the biological sciences. Please consult with Prof P Chirwa, Tel: 012 420 3213, for further details.

FOR 990 Forest science 990 (360 credits)

Total credits required: 360

9.7 PhD in Food Science (Code 03260272)

Programme composition
The degree is awarded based on a thesis and other requirements as follows:

FST 990 Thesis: Food science 990 (360 credits)
Candidates must write a thesis on their research project in Food Science and have at least a research paper accepted for publication in a peer-reviewed scientific journal.

Total credits required: 360

9.8 PhD in Horticultural Science (Code 03262167)

a. Requirements
MScAgric (Horticultural Science) or applicable research master's qualification with a pass mark of at least 60% for the dissertation component. In addition, a research proposal should accompany the application form. Selection of students will be based on academic performance, the written research proposal, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition
TBK 990 Thesis: Horticultural science 990 (360 credits)

Total credits required: 360

9.9 PhD in Nutrition (Code 03261006)
Candidates must write a thesis on their research project in Nutrition and have at least a research paper accepted for publication in a peer-reviewed scientific journal.

Programme composition
VDG 990 Thesis: Nutrition 990 (480 credits)

Total credits required: 480

9.10 PhD in Pasture Science (Code 03262165)

a. Requirements

MScAgric (Animal/Pasture Science) or applicable research master's qualification with a pass mark of at least 60% for the dissertation component. In addition, a research proposal should accompany the application form. Selection of students will be based on academic performance, the written research proposal, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

WDE 990 Thesis: Pasture science 990 (360 credits)

Total credits required: 360

9.11 PhD in Soil Science (Code 03262166)

a. Requirements:

MScAgric (Soil Science) or applicable research master's qualification with a pass mark of at least 60% for the dissertation component. In addition, a research proposal should accompany the application form. Selection of students will be based on academic performance, the written research proposal, available supervisory capacity and research project funding.

Note:
Depending on the academic background of the student and the chosen area of study, it may be required of the student to do additional coursework.

b. Programme composition

GDK 990 Thesis: Soil science (360 credits)

Total credits required: 360

9.12 PhD in Wildlife Management (Code 03261001)

a. Admission requirements

MSc in Wildlife Management or an equivalent applicable degree.

b. Programme composition

Research project with thesis only

NLB 990 Thesis: Wildlife management 990 (360 credits)

Total credits required: 360

10. HONOURS PROGRAMMES IN THE MATHEMATICAL SCIENCES

10.1 BScHons in Actuarial Science (Code 02240275)

a. Admission requirements

i) A relevant bachelor's degree with Mathematical Statistics and Actuarial Science at 300 level.
ii) An average of 60% for all modules at third-year level.
iii) Exemption recommendations for at least five of the A100- and A200-level subjects of the Actuarial Society of South Africa.
iv) IAS 361 Insurance and actuarial applications, which is a prerequisite for the core module IAS 712 Liabilities.
v) Students from other accredited institutions must comply with the same requirements based on equivalent modules at their institutions. In addition, students from other accredited institutions might also be required to pass an entrance evaluation.
vi) Student numbers are limited. Selection is based on performance in the prior degree, on condition that the minimum requirements are met as set out in (i) to (iv) above.
vii) Historical performance during prior studies will also be considered in selecting students. Specific attention will be given to modules repeated and duration of study.
viii) Any additional entrance requirements as specified by the head of department in consultation with the departmental postgraduate selection committee.

b. Duration of study

A student for an honours degree must complete his or her study, in the case of full-time students, within two years and, in the case of part-time students, within three years of first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

To qualify for this degree, the candidate must successfully complete a total of at least 135 credits, made up from modules from the curriculum in collaboration with, and subject to, the approval of the Head of the Department of Insurance and Actuarial Science.

Code	Module name	Credits
Core modules:		
AKM 705	Actuarial mathematics 705	18
BNG 700	Investments 700	27
IAS 712	Liabilities 712	30
Elective modules:		
FNI 700 or	Finance and investment 700 or	30

LEW 700	Life assurance 700	
IAS 722	Actuarial communication 722	10
At least one of FNI 700 or LEW 700 must be selected in order for a candidate to qualify for the degree.		
Research project:		
NPN 780	Research project 780	30

Total credits required: 135

10.2 BScHons in Applied Mathematics (Code 02240171)

Stream 1: Applied analysis
Stream 2: Differential equations and modelling

a. Admission requirements

A BSc in Mathematics, Applied Mathematics or equivalent degree with at least a 60% average in the final year Mathematics or Applied Mathematics subjects. The final year should include at least four of the following third-year level modules or equivalent: partial differential equations, dynamical systems (ordinary differential equations), real analysis, complex analysis, numerical analysis and continuum mechanics. In the selection procedure the candidate's complete undergraduate academic record will be considered.

b. Duration

The minimum duration is one year of full-time study or two years of part-time study. A student must complete his or her study for an honours degree, in the case of full-time students, within two years from the first examination to the final examination and in the case of part-time students, within three years from the first examination to the final examination. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of seven honours modules of 15 credits each as well as the mandatory project (30 credits). It is required that students select the stream and elective modules according to the prerequisites of the modules.

Code	Module name	Credits
Research:		
WTW 795	Project 795	30
Core module:		
WTW 776	Partial differential equations of mathematical physics 776	15

Elective modules (according to stream):		
Stream 1: Applied Analysis		
WTW 710	Functional analysis 710	15
WTW 734	Measure theory and probability 734	15
Four electives from below. The selection must contain at least one of WTW 787 or WTW 764 and at least one of WTW 733 or WTW 763:		
WTW 733	Numerical analysis 733	15
WTW 750	Mathematical optimisation 750	15
WTW 763	Finite element method 763	15
WTW 764	Stochastic calculus 764	15
WTW 772	Mathematical methods and models 772	15
WTW 787	Continuum mechanics 787	15
Stream 2: Differential equations and modelling		
WTW 733	Numerical analysis 733	15
WTW 735	Main principles of analysis in applications 735	15
WTW 750	Mathematical optimisation 750	15
WTW 763	Finite element method 763	15
WTW 772	Mathematical methods and models 772	15
WTW 787	Continuum mechanics 787	15

Total credits required: 135

10.3 BScHons in Financial Engineering (Code 02240274)

a. Admission requirements

An appropriate bachelor's degree with a minimum of 60% for all modules on third-year level. In the selection procedure the candidate's complete undergraduate academic record will be considered. In particular, it is required that the candidate has completed Calculus, Differential equations and Linear algebra on second-year level (each with a mark of at least 60%).

b. Duration

The minimum duration is one year of full-time study or two years of part-time study. A student must complete his or her study for an honours degree, in the case of full-time students, within two years from the first examination to the final examination and in the case of part-time students, within three years from the first examination to the final examination. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of a number of compulsory and elective honours modules of 15-16 credits each (totalling at least 100 credits), as well as the mandatory research project (30 credits).

Code	Module name	Credits
Research:		
WTW 792	Project 792	30
Core modules:		
BAN 780	Industrial analysis 780 [1,2]	16
WTW 732	Mathematical models of financial engineering 732[3]	15
WTW 750	Mathematical optimisation 750	15
WTW 762	Mathematical models of financial engineering 762[3]	15
Elective modules:		
ISE 780	Systems engineering 780[2]	16
LMO 710	Linear models 710	15
LMO 720	Linear models 720	15
MVA 710	Multivariate analysis 710	15
MVA 720	Multivariate analysis 720	15
TRA 720	Analysis of time series 720	15
WTW 712	Modern portfolio theory 712[3]	15
WTW 733	Numerical analysis 733	15
WTW 735	Main principles of analysis in applications 735	15
WTW 763	Finite element method 763	15

The Postgraduate Coordinator has to approve the final programme composition for this programme.

[1] Students who have included Statistics, Mathematical Statistics or Industrial Engineering in their undergraduate degree programme, will not be allowed to take this module. Additional modules from the list of electives should be included in the programme composition.

[2] Lectures for these modules are scheduled in "blocks" – consult the relevant departments at the Faculty of Engineering, Built Environment and Information Technology.

[3] WTW 732 and WTW 762 will be presented weekly as well as some extra "block" lectures.

Total credits required: At least 130

10.4 BScHons in Mathematical Statistics (Code 02240191)

a. Admission requirements

i) A relevant bachelor's degree with Mathematical Statistics on the 300-level is required.

ii) For BScHons in Mathematical Statistics, an average mark of 65% or more
- in Mathematical statistics on the 300-level or
- in an equivalent statistical module(s) at an accredited institution is required.

iii) In addition to passing of the core modules, WST 312 is also required as prerequisite for BScHons and BComHons in Mathematical Statistics.

iv) Students from other accredited institutions must comply with the same requirements based on equivalent modules at their institutions. In addition, students from other accredited institutions must also pass an entrance evaluation.

v) Student numbers are limited to a maximum of 40, collectively over all honours programmes in the Department of Statistics. Selection is based on performance in the prior degree, conditional on ii and iii above.
vi) Historical performance during prior studies will also be considered in selecting students. Specific attention will be given to modules repeated and duration of study.
vii) Any additional entrance requirements as specified by the head of department in consultation with the departmental postgraduate selection committee.

b. Duration of programme

The minimum duration is one year of full-time study or two years of part-time study. A student must complete his or her study for an honours degree, in the case of full-time students, within two years from the first examination to the final examination and in the case of part-time students, within three years from the first examination to the final examination. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

Details of compilation of curriculum are available from the Head of the Department of Statistics as well as from the departmental postgraduate brochure.
A candidate must compile his/her curriculum in consultation with the head of department or his representative. It is also possible to include postgraduate modules from other departments. Refer to the Departmental website for further information.

Code	Module name	Credits
Compulsory modules		
LMO 710	Linear models 710	15
MVA 710	Multivariate analysis 710	15
WST 795	Research report: Mathematical statistics 795	30
Elective modules (Choose any five)		
EKT 720	Introduction to statistical learning 720	15
LMO 720	Linear models 720	15
MVA 720	Multivariate analysis 720	15
PNP 720	Parametric stochastic processes 720	15
SFT 720	Sampling techniques 720	15
SPC 780	Statistical process control 780	15
TRA 720	Analysis of time series 720	15
VMT 710	Distribution-free methods 710	15

Total credits required: 135

10.5 BScHons in Mathematics (Code 02240181)

a. Admission requirements

An appropriate BSc degree with a minimum of 60% for all Mathematics/Applied mathematics modules on third-year level. In the selection procedure the candidate's complete undergraduate academic record will be considered. In particular, it is required that the candidate has completed Real analysis and Algebra on third-year level (each with a mark of at least 60%).

b. Duration

The minimum duration is one year of full-time study or two years of part-time study. A student must complete his or her study for an honours degree, in the case of full-time students, within two years from the first examination to the final examination and in the case of part-time students, within three years from the first examination to the final examination. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of seven honours modules of 15 credits each (five compulsory and two elective modules) as well as the mandatory research project (30 credits).

Code	Module name	Credits
Research:		
WTW 795	Project 795	30
Core modules:		
WTW 710	Functional analysis 710	15
WTW 724	Axiomatic set theory and mathematical logic 724	15
WTW 731	Algebra 731	15
WTW 734	Measure theory and probability 734	15
WTW 772	Mathematical methods and models 772	15
WTW 776	Partial differential equations of mathematical physics 776	15
WTW 790	Topology 790	15
Elective modules:		
WTW 733	Numerical analysis 733	15
WTW 763	Finite element method 763	15
WTW 764	Stochastic calculus 764	15
WTW 772	Mathematical methods and models 772	15
WTW 776	Partial differential equations of mathematical physics 776	15
WTW 727	Special topics 727	15

Total credits required: 135

10.6 BScHons in Mathematics of Finance (Code 02240272)

a. Admission requirements

An appropriate BSc degree with a minimum of 60% for all Mathematics/Applied mathematics modules at third-year level. In the selection procedure the candidate's complete undergraduate academic record will be considered. In particular, it is required that the candidate has completed Real analysis at third-year level and Linear algebra on second-year level (each with a mark of at least 60%).

b. Duration

The minimum duration is one year of full-time study or two years of part-time study. A student must complete his or her study for an honours degree, in the case of full-time students, within two years from the first examination to the final examination and in the case of part-time students, within three years from the first examination to the final examination. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

c. Promotion

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of seven honours modules of 15 credits each (six compulsory and one elective) as well as the mandatory research project (30 credits).

Code	Module name	Credits
Research:		
WTW 792 or WTW 795	Project 792 or Project 795	30 30
Core modules:		
WTW 710	Functional analysis 710	15
WTW 732	Mathematical models of financial engineering 732[*1]	15
WTW 733	Numerical analysis 733	15
WTW 734	Measure theory and probability 734	15
WTW 762	Mathematical models of financial engineering 762[*1]	15
WTW 764	Stochastic calculus 764	15
Elective modules:		
LMO 710	Linear models 710	15
LMO 720	Linear models 720	15
MVA 710	Multivariate analysis 710	15
MVA 720	Multivariate analysis 720	15
WTW 750	Mathematical optimisation 750	15
WTW 763	Finite element method 763	15
WTW 772	Mathematical methods and models 772	15

WTW 776	Partial differential equations of mathematical physics 776	15

[1] WTW 732 and WTW 762 are presented as weekly lectures together with some extra block lectures.

Total credits required: 135

11. MASTER'S PROGRAMMES IN THE MATHEMATICAL SCIENCES

11.1 MSc in Actuarial Science (Code 02250395)

a. Admission requirements

A BScHons degree in Actuarial Science with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The minimum duration for this degree is one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within two years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme consists of a dissertation (180 credits). Additional modules (as approved by the postgraduate coordinator) may be required depending on the candidate's background and the scope of the study.

Further details are available from the Head of the Department of Insurance and Actuarial Science as well as in the departmental brochure.

AKW 890 Dissertation: Actuarial science 890 (180 credits)

Total credits required: 180

11.2 MSc in Applied Mathematics (Code 02250171)

a. Admission requirements

An appropriate BScHons degree with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. In particular, it is strongly recommended that the following modules be included at honours level: Measure

and integration theory, Functional analysis, Partial differential equations and Numerical analysis.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The mimimum duration for this degree is one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of two master's coursework modules of 30 credits each (the choice of modules to be decided by the Head of Department in consultation with the postgraduate coordinator) as well as a dissertation (120 credits).
Full details of the compilation of the curriculum are available in the departmental postgraduate brochure at: www.up.ac.za/maths/postgrad

TWS 890 Dissertation: Applied mathematics 890 (120 credits)

Total credits required: 180

11.3 MSc in Applied Statistics (Code 02250401)

a. Admission requirements

i) A relevant honours degree in Mathematical Statistics is required.
ii) For MSc (Applied Statistics) an average mark of 65% or more in the BScHons in Mathematical Statistics
iii) Students from other accredited institutions must comply with the same requirements based on equivalent models at their institutions. In addition, students from other accredited institutions must also pass an entrance evaluation.
iv) Student numbers are limited to a maximum of 20, collectively over all master's programmes in the Department of Statistics.
v) Admission is also subject to the availability of a suitable supervisor for the study.
vi) Historical performance during prior studies will also be considered in selecting students. Specific attention will be given to modules repeated and duration of study.
vii) The research proposal of applicants should be in line with the research focus of the department.
viii) Any further additional entrance requirements as specified by the head of department in consultation with the departmental postgraduate selection committee.
ix) The head of department, in consultation with the departmental postgraduate selection committee, reserves the right to prescribe additional modules.

b. Duration

As long as progress is satisfactory, renewal of registration of a master's student will be accepted for a second year of study in the case of a full-time student. Renewal of registration for a third and subsequent years for a full-time student will only take place when Student Administration of the Faculty receives a written motivation (the required form can be obtained from the Head of Department) that is supported by the Head of Department and Postgraduate Studies Committee. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period. Subject to exceptions approved by the dean, on recommendation of the head of department, a student may not enter for the master's examination in the same module more than twice.

d. Programme composition

Details of compilation of curriculum are available from the Head of the Department of Statistics as well as from the departmental postgraduate brochure.

A candidate must compile his/her curriculum in consultation with the head of department or his representative. Refer to the departmental website for further information.

Code	Module name	Credits
MVA 880	Statistical learning 880	20
STK 880	Capita selecta: Statistics 880	20
TRA 880	Analysis of time series 880	20
TRG 880	Applied regression analysis 880	20
WST 895	Mini-dissertation: Mathematical statistics 895	100

Total credits required: 180

11.4 MSc in Financial Engineering (Code 02250184)

a. Admission requirements

An appropriate BScHons degree in Financial Engineering with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered.
Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The minimum duration for this degree is one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the

progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of any two of WTW 831, WTW 832 or WTW 833 (choice of modules to be decided by the Head of Department in consultation with the postgraduate coordinator) as well as a dissertation (120 credits).

Code		Module name	Credits
Coursework:			
Any two of	WTW 831	Mathematical and computational finance 831	30
	WTW 832	Advanced methods of financial engineering 832	30
	WTW 833	Quantitative risk management 833	30
Dissertation:			
	WTW 894	Dissertation: Financial engineering 894	120

Total credits required: 180

11.5 MSc in Mathematical Statistics (Code 02250191)

a. Admission requirements

i) A relevant honours degree in Mathematical Statistics is required.
ii) For MSc (Mathematical Statistics) an average mark of 65% or more in the BScHons in Mathematical Statistics.
iii) Students from other accredited institutions must comply with the same requirements based on equivalent models at their institutions. In addition, students from other accredited institutions must also pass an entrance evaluation.
iv) Student numbers are limited to a maximum of 20, collectively over all master's programmes in the Department of Statistics.
v) Admission is also subject to the availability of a suitable supervisor for the study.
vi) Historical performance during prior studies will also be considered in selecting students. Specific attention will be given to modules repeated and duration of study.
vii) The research proposal of applicants should be in line with the research focus of the department.
viii) Any further additional entrance requirements as specified by the head of department in consultation with the departmental postgraduate selection committee.
ix) The head of department, in consultation with the departmental postgraduate selection committee reserves the right to prescribe additional modules.

b. Duration

As long as progress is satisfactory, renewal of registration of a master's student will be accepted for a second year of study in the case of a full-time student. Renewal of registration for a third and subsequent years for a full-time student will only take place when Student Administration of the Faculty receives a written motivation (the required form can be obtained from the Head of Department) that is supported by

the Head of Department and Postgraduate Studies Committee. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period. Subject to exceptions approved by the dean, on recommendation of the head of department, a student may not enter for the master's examination in the same module more than twice.

d. Programme composition

Details of compilation of curriculum are available from the Head of the Department of Statistics as well as from the departmental postgraduate brochure.

A candidate must compile his/her curriculum in consultation with the head of department or his representative. Refer to the Departmental website for further information.

Code	Module name	Credits
MVA 880	Statistical learning 880	20
STK 880	Capita selecta: Statistics 880	20
TRA 880	Analysis of time series 880	20
TRG 880	Applied regression analysis 880	20
WST 895	Mini-dissertation: Mathematical statistics 895	100

Total credits required: 180

11.6 MSc in Mathematics (Code 02250181)

a. Admission requirements

An appropriate BScHons degree with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. In particular, it is strongly recommended that the following modules be included on honours level: Measure and integration theory, Functional analysis, Topology and Algebra.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The minimum duration for this degree is one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme consists of two master's coursework modules of 30 credits each (choice of modules to be decided by the Head of Department in consultation with the postgraduate coordinator) as well as a dissertation (120 credits).
Full details of the compilation of the curriculum are available in the departmental postgraduate brochure at: www.up.ac.za/maths/postgrad

WIS 890 Dissertation: Mathematics 890 (120 credits)

Total credits required: 180

11.7 MSc in Mathematics Education (Code 02250183)

a. Admission requirements

An appropriate BScHons degree with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. In particular, it is strongly recommended that the following modules be included at honours level: Measure and integration theory and Functional analysis.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The minimum duration for this degree is one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme consists of one 30-credit master's coursework module in the Department of Mathematics and Applied Mathematics (choice of module to be decided by the Head of Department in consultation with the postgraduate coordinator), master's coursework modules with a total credit value of no less than 30 in the Faculty of Education (choice of modules to be decided by the Head of Department in consultation with the postgraduate coordinator), as well as a dissertation (120 credits).

Full details of the compilation of the curriculum are available in the departmental postgraduate brochure at: www.up.ac.za/maths/postgrad

WTW 893 Dissertation: Mathematics education 893 (120 credits)

Total credits required: 180

11.8 MSc in Mathematics of Finance (Code 02250182)

a. Admission requirements

An appropriate BScHons degree with a minimum of 60% for all modules at honours level. In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. In particular, it is required that the following modules be included at honours level: Measure and integration theory, Functional analysis and Financial mathematics/Financial engineering.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The mimimum duration for this degree is normally one year. Subject to other faculty regulations, a student for a master's degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

The programme compilation consists of any two of WTW 831, WTW 881 or WTW 884 (choice of modules to be decided by the Head of Department in consultation with the postgraduate coordinator) as well as a dissertation (120 credits).

Code		Module name	Credits
Coursework:			
Any two of	WTW 831	Mathematical and computational finance 831	30
	WTW 881	Abstract analysis 881	30
	WTW 884	Advanced measure theory 884	30
Dissertation:			
	WTW 892	Dissertation: Mathematics of finance 892	120

Total credits required: 180

12. DOCTORAL PROGRAMMES IN THE MATHEMATICAL SCIENCES

12.1 PhD [Option: Actuarial Science) (Code 02260771)

a. Admission requirements

An appropriate master's degree is required for admission to doctoral study in actuarial science. The programme composition of the master's degree must have included a substantial research component that led to a dissertation reflecting originality either in the content or in the presentation. In the selection procedure the candidate's complete honours and master's academic records will be considered.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

The minimum duration for this degree is two years. Subject to other faculty regulations, a student for a doctoral degree must complete his or her studies within three years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (In accordance with the newly approved General Regulations G.47 and G.51.)

c. Promotion

The progress of all doctoral candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

A candidate must complete a thesis in one of several fields in which research is actively being done in the Department.

The programme consists of a thesis (360 credits). Additional modules (as approved by the postgraduate coordinator) may be required depending on the candidate's background and the scope of the study. The research fields and the names of possible supervisors are available from the department at www.up.ac.za/actuarial.

AKW 990 Thesis: Actuarial Science 990 (360 credits)

Total credits required: 360

12.2 PhD in Mathematical Sciences (Code 02260761)

a. Admission requirements

An appropriate master's degree is required for admission to doctoral study in mathematics and applied mathematics. The programme composition of the master's degree must have included a heavy research component that led to a dissertation reflecting originality either in the content or in the presentation. In the selection procedure the candidate's complete honours and master's academic records will be considered.

Admission is also subject to the availability of a suitable supervisor for the study.

b. Duration

Subject to other faculty regulations, a student for a doctoral degree must complete his or her studies within four years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all doctoral candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

A candidate must complete a thesis in one of several fields in which research is actively being done in the Department. The research fields and the names of possible supervisors are available from the departmental postgraduate brochure at: www.up.ac.za/maths/postgrad

WIS 990	Thesis: Mathematics 990	(360 credits)
or		
TWS 990	Thesis: Applied Mathematics 990	(360 credits)

Total credits required: 360

12.3 PhD in Mathematical Statistics (code 02260611)

a. Admission requirements

i) A relevant Master's degree in Mathematical Statistics or Applied Statistics is required.
For PhD (Mathematical Statistics) and PhD (Applied Statistics) a minimum average mark of 65% or more
- in the MSc (Mathematical Statistics) or MSc (Applied Statistics) or
- in an applicable master's degree at an accredited institution is required.

ii) Students from other accredited institutions will be required to pass an entrance examination.
iii) Student numbers are limited to a maximum of 10, collectively over all doctoral programmes in the Department of Statistics. Selection is based on performance in the prior degree, conditional on ii and iii above.
iv) Admission is also subject to the availability of a suitable supervisor for the study.
v) Additional entrance requirements as specified by the head of the department.

b. Duration

Subject to other faculty regulations, a student for a doctoral degree must complete his or her studies within four years after first registering for the degree. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited fixed extension of this period. (Also see the General Regulations.)

c. Promotion

The progress of all doctoral candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

d. Programme composition

A candidate must complete a thesis in one of several fields in Applied Statistics or Mathematical Statistics in which research is actively being done within the Department. Details are available from the Head of Department of Statistics as well as in the departmental brochure. Refer to the Departmental website for further information.

WST 990	Thesis: Mathematical statistics 990	(360 credits)

Total credits required: 360

Related doctoral degree described elsewhere in this publication:
PhD in Science and Mathematics Education (Code 02260753) on p 84

Please refer to the Centre for Science, Mathematics and Technology Education in this publication (point 20, page 84) and to the postgraduate brochure of the Department of Mathematics and Applied Mathematics at: www.up.ac.za/maths/postgrad

CENTRE FOR ENVIRONMENTAL STUDIES (CFES)
[Environmental Studies programmes]

The Centre for Environmental Studies is a graduate school for multidisciplinary training and research focusing on the environment. Training aims to satisfy the need for environmental professionals for implementing current environmental legislation as well as industry-driven environmental management systems. Training of students takes place in two ways:

a) Research-based master's and PhD studies in Environmental Science
b) Coursework master's specialisation options in Environmental Studies

Admission requirements
For the master's level programmes, candidate learners must be in possession of a four-year degree qualification, or equivalent degree status with appropriate subjects as prescribed for each field of specialisation. Final admission is subject to the approval of the Director of the Centre and the head(s) of the respective co-ordinating department(s). Candidates must demonstrate proficiency in the English language up to the level required by either the TOEFL test (www.ets.org/toefl) or the IELTS language proficiency test (www.ielts.org). Candidates for PhD degrees need to have obtained a master's degree in an appropriate field of expertise. Preference will be given to PhD candidates with publication experience in professional journal(s).

13. SPECIALISATION IN AIR QUALITY MANAGEMENT

Coordinated by the Department of Geography, Geoinformatics and Meteorology.

The extensions to the National Environmental Management Act (NEMA) promulgated after 2005 affect environmental management in South Africa in a profound way. In particular, the Air Quality Act brings South African legislation into line with international trends. The metro councils are charged with the responsibility of implementing the Act at the local level. In addition, companies need appropriate expertise to obtain licenses for their air quality management plans. This focus area serves to provide suitable expertise for the implementation of the above legislation by industry by training graduates specialised for careers in air quality management. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning the legislative requirements with respect to air quality management, modelling of and measurement of air pollution and the interpretation of pollution plumes, the measurement and interpretation of chemical air pollution as well as dust pollution, international agreements and requirements as well as the effects of air pollution on humans.

13.1 (a) MSc [Option: Air Quality Management] (Coursework) (Code 03251038)

a. Admission requirements

Candidates must be in possession of an appropriate four-year degree, or equivalent degree status which includes mathematics and chemistry at first-year level. Admission is subject to the approval of the Director of the Centre and the appropriate head of department outside the Centre.

b. Programme composition

Code	Module name	Credits
Fundamental modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Core modules (60credits):		
AQM 811	Boundary layer meteorology 811	15
AQM 812	Atmospheric chemistry 812	15
AQM 813	Atmospheric thermodynamics 813	15
AQM 814	Air pollution: Society and environment 814	15
Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

13.1 (b) MSc [Option: Air Quality Management] (Research) (Code 03251042)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional modules in related topics may be prescribed for students, depending on their academic background.

ENV 898 Dissertation: Air quality management 898 (180 credits)

Total credits required: 180

13.1 PhD [Option: Air Quality Management] (Code 03260129)

Admission is dependent on the candidate being in possession of an MSc [Option: Air Quality Management], or an equivalent degree with the status thereof, as evaluated by the Director of the Centre and the head(s) of the particular department(s). In addition to further theoretical studies as prescribed by the Director and head(s) of the relevant department, the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department during which the student needs to prove that he/she can publish at

least one research paper in an international peer-reviewed scientific journal. The supervisor will be a suitable academic staff member of the University of Pretoria.

ENV 998 Thesis: Air quality management 998 (360 credits)

Total credits required: 360

14. SPECIALISATION IN ENVIRONMENT AND SOCIETY

Coordinated by the Department of Geography, Geoinformatics and Meteorology.

The purpose of this focus area is to train environmental graduates who specialised in careers in the humanities. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning, all aspects involved in the management of human-environment interactions. This includes social impact assessments, policy formulation, social development and planning, participatory appraisal assessments, demographic pattern and trend interpretations, resource appraisals and management.

14.1 (a) MSc in Environment and Society (Coursework) (Code 03251032)

a. Admission requirements

Before application for admission to the MSc (Environment and Society) degree programme candidates must be in possession of a four-year degree qualification, BScHons, or equivalent degree status which includes appropriate subjects in the humanities, geography or planning. Final admission is subject to the approval of the Director of the Centre and the Head of the Department of Geography, Geoinformatics and Meteorology.

b. Programme composition

Code	Module name	Credits
Fundamental modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Specialisation modules (30 credits):		
ENS 811	Environment and development 811	15
ENS 822	Strategic environmental management 822	15
One module selected from:		
ENS 823	Environment and land reform 823	15
ENS 824	Social modelling and assessment 824	15
OMS 881	Environmental change 881	15
Elective module (15 credits): At least one additional elective module must be selected in consultation with the Director of the Centre and the Head of the Department of Geography, Geoinformatics and Meteorology. Options will be based on the academic background and/or anticipated career of the candidate.		
Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

14.1 (b) MSc in Environment and Society (Research) (Code 03251043)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional courses in related topics may be prescribed for students, depending on their academic background.

ENV 893	Dissertation: Environment and society 891	(180 credits)

Total credits required: 180

14.1 PhD in Environment and Society (Code 03260122)

Admission is dependent on the candidate being in possession of an MSc in Environment and Society, or an equivalent degree with the status thereof, as evaluated by the Director of the Centre and the head(s) of the particular department(s). In addition to further theoretical studies as prescribed by the Director and head(s) of the relevant department(s), the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department during which the student needs to prove that he/she can publish at least one research paper in an international peer-reviewed scientific journal. The supervisor will be a suitable academic staff member of the University of Pretoria.

ENV 991	Thesis: Environment and society 991	(360 credits)

Total credits required: 360

15. SPECIALISATION IN ENVIRONMENTAL ECOLOGY

Coordinated by the Department of Zoology and Entomology.

The purpose of this focus area is to train environmental graduates who specialised in careers in the ecology of the environment, including conservation planning, environmental management and air quality management. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning, all aspects involved in the management of the ecological consequences of human existence. This includes a thorough grounding in ecosystem structure, composition and function, ecosystem services, notions of ecosystem health, the management of declining and small populations, captive propagation, control of invasive species, species and community restoration, conservation education, local communities and conservation, as well as aspects of biogeography and macro-ecology, conservation planning and monitoring, the structure, composition and function of biological communities, population and community variability.

15.1 (a) MSc in Environmental Ecology (Coursework) (Code 03251033)

a. Admission requirements

Before application for admission to the MSc (Environmental Ecology) degree programme, candidates must be in possession of a four-year degree qualification, BScHons, or equivalent degree status (SAQA NQF level 8) which includes appropriate subjects in ecology. Admission is subject to the approval of the Director of the Centre and the appropriate head of department outside the Centre.

b. Programme composition

Code	Module name	Credits
Fundamental modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Specialisation modules (60 credits):		
ZEN 808	Conservation planning and monitoring	15
ZEN 809	Macro-ecology	15
ENV 833	Trees in a multifunctional landscape	15
OMS 882	Environmental change	15
One of the above specialisation modules may be substituted with an elective module subject to the approval of the Director of the Centre. Choice of an elective is based on the academic background and/or anticipated career of the student but is expected to be relevant to either conservation biology or sustainable forestry management.		
Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

15.1 (b) MSc in Environmental Ecology (Research) (Code 03251044)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional courses in related topics may be prescribed for students, depending on their academic background.

ENV 892 Dissertation: Environmental ecology 892 (180 credits)

Total credits required: 180

16. SPECIALISATION IN ENVIRONMENTAL MANAGEMENT

Coordinated by the Department of Zoology and Entomology.

The purpose of this focus area is to train environmental graduates considered generalists for managing the full spectrum of human-environment-economic interactions. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning, all aspects involved in managing social, economic and environmental processes in a sustainable manner. This includes social and environmental impact assessment, policy formulation, social development and planning, eco-system structure, composition and function, ecosystem services, ecosystem health, invasive species, species and community restoration, conservation education, local communities and conservation, economic inefficiency, misallocation, market failure, policy failure, the economics of renewable and non-renewable resources, cost-benefit analysis, valuation of environmental goods and services and environmental accounting.

16.1 (a) MSc [Option: Environmental Management] (Coursework) (Code 03251037)

a. Admission requirements

Candidates must be in possession of a BScHons degree or a degree with equivalent degree status.

b. Programme composition

There are two independent foci of the master's option in Environmental Management

(i) Focus area: Sustainable Development

Code	Module name	Credits
Compulsory core modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Coursework modules (70 credits):		
ENS 811	Environment and development 811	15
ENS 822	Strategic environmental management 822	15
NV 822	International environmental management systems 822	15
One module selected from:		
ENS 824	Social modelling and assessment 824	15
OMS 881	Environmental change 881	15
Research project (90 credits):		
ENV 891	Research project 891	90

Note: For the focus on Sustainable Development, final admission is subject to the approval of the Director of the Centre for Environmental Studies.

(ii) Focus area: Environmental Economics

Code	Module name	Credits
Compulsory core modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Coursework modules (60 credits):		
ENS 811	Environment and development 811	15
LEK 880	Natural resource and environmental economics 880	15
LEK 826	Environmental valuation and policy 826	15
LEK 882	Institutional economics 882	15
Research project (90 credits):		
ENV 891	Research project 891	90

For the focus on Environmental Economics, students without a formal background in economics will be considered. Admission is subject to the approval of the Head of the Department of Agricultural Economics, Extension and Rural Development and the Director of the Centre for Environmental Studies. Additional courses in economics or related topics may be prescribed for students, depending on their academic background.

Total credits required: 180

16.1 (b) MSc [Option: Environmental Management] (Research) (Code 03251045)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional courses in economics or related topics may be prescribed for students, depending on their academic background.

ENV 894 Dissertation: Environmental management 894 (180 credits)

Total credits required: 180

16.2 PhD [Option: Environmental Management] (Code 03260125)

a. Admission requirements

Admission is dependent on the candidate being in possession of an MSc or MAgric in Environmental Management, or an equivalent degree with the status thereof, as evaluated by the Director of the Centre for Environmental Studies, the Director of the Postgraduate School for Agriculture and Rural Development and the head(s) of the particular department(s). In addition to further theoretical studies as prescribed

by the Director and head(s) of the relevant department(s), the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department during which the student needs to prove that he/she can publish at least one research paper in an international peer-reviewed scientific journal. The supervisor will be a suitable academic staff member of the University of Pretoria.

b. Programme composition

ENV 994 Thesis: Environmental management 994 (360 credits)

Total credits required: 360

17. SPECIALISATION IN ENVIRONMENTAL EDUCATION

Coordinated by the Faculty of Education.

The purpose of this focus area is to train environmental graduates who specialised in careers in environmental education. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning, all aspects involved in the transfer of environmental principles by education. This includes the transfer of relevant ethical, social and ecological principles to learners, the roles of the NQF and outcomes-based education for approaches towards environmental education, the roles of facilitation, engagement, meta-learning, creative problem solving, cooperative learning and feedback in the learning task.

17.1 (a) MSc in Environmental Education (Coursework) (Code 03251036)

a. Admission requirements

Before application for admission to the MSc (Environmental Education) degree programme, candidates must be in possession of an appropriate four-year degree qualification, BScHons, or equivalent degree status which includes appropriate educational subjects. Final admission is subject to the approval of the Director of the Centre for Environmental Studies and the Director of the Centre for Science, Mathematics and Technology Education.

b. Programme composition

Code	Module name	Credits
Compulsory core modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Compulsory specialisation modules (45 credits):		
FOE 811	Foundations of environmental education 811	15
FOE 821	Teaching and learning strategies 821	15
SCE 881	Research methods in science education 881	15
Elective module (15 credits):		
At least one additional elective module must be selected in consultation with the Director of the Centre and the Head of the Department Curriculum Studies, Faculty of Education. Choices will be based on the academic background and/or anticipated career of the candidate.		

Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

17.2 (b) MSc in Environmental Education (Research) (Code 03251046)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional courses in related topics may be prescribed for students, depending on their academic background.

ENV 897 Dissertation: Environmental education 898 (180 credits)

Total credits required: 180

18. SPECIALISATION IN FOREST MANAGEMENT AND THE ENVIRONMENT

Coordinated by the Department of Plant Production and Soil Science.

The purpose of this option is to equip graduates with a biological and/or agricultural background to specialise further to obtain skills in environmental management and in sustainable forest resource use and management. On completion of the training, candidates should be conversant with the multifunctional nature of the forest resource base and be equipped to render advice concerning forest resource use and management with an understanding of the environmental consequences associated with exploitative use of natural resources. This includes grounding in forest resource use and management, including yield regulations in natural and commercial forest systems, participatory approaches to natural resource management, ecosystem structure, composition and function, ecosystem services, notions of ecosystem health, control of invasive species and community restoration, understanding of local communities, forestry and rural development, participatory planning and monitoring, the forest harvesting schedules and logistics, non-timber forest products, the science of wood and forest wood products utilisation, understanding of the basic economics of natural resources and social development and planning.

18.1 MSc [Option: Forest Management and the Environment] (Coursework) (Code 03251039)

a. Admission requirements

Candidates must have either a three-year BSc and a BScHons, or a four-year degree qualification in agricultural, forestry or biological sciences. Admission is subject to the approval of the Forestry Chair in consultation with the Director of the Centre for Environmental Studies.

b. Programme composition

Code	Module name	Credits
Core modules (45 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
FOR 831	General introduction to forestry 831	15
Specialisation modules: (15-45 credits) *i) Choose at least one module (15 credits) from the following:*		
ENV 833	Trees in a multifunctional landscape 833	15
FOR 832	Forest resource use planning and management 832	15
FOR 833	Forest engineering 833	15
FOR 834	Wood science and forest products 834	15
FOR 835	Forest ecology and management 835	15
FOR 836	Silviculture 836	15
LEK 831	Forest resource economics and policy 831	15
ii) Choose elective modules to a maximum of 30 credits out of a total of 90 taught module credits from the following:		
ENS 822	Strategic environmental management 822	15
ENS 823	Environment and land reform 823	15
ENV 822	International environmental management systems 822 *(**additional costs involved)*	15
OMS 881	Environmental change 881	15
Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

19. SPECIALISATION IN WATER RESOURCE MANAGEMENT

Coordinated by the Department of Microbiology and Plant Pathology.

The purpose of this focus area is to train environmental graduates who specialised in careers in the sustainable management of water resources. On completion of the training, candidates should be conversant and be able to partake in, or render advice concerning, all aspects involved in water resource management in Southern Africa. This includes principles of quality management, water conservation, water demand management, water supply and sanitation technologies.

19.1 (a) MSc in Water Resource Management (Coursework) (Code 03251035)

a. Admission requirements

Before application for admission to the MSc (Water Resource Management) degree programme, candidates must be in possession of a four-year degree qualification, BScHons, or equivalent degree status which includes appropriate subjects in water management and/or water ecology. Final admission is subject to the approval of the Director of the Centre for Environmental Studies and the Head of the Department of Microbiology and Plant Pathology.

b. Programme composition

Code	Module name	Credits
Core modules (30 credits):		
ENV 810	Environmental paradigms 810	15
ENV 816	Environmental law 816	15
Compulsory specialisation modules (45 credits):		
EWM 810	Water quality management 810	15
EWM 821	Water conservation and demand management 821	15
EWM 822	Water supply and sanitation 822	15
Elective module (15 credits):		
At least one additional elective module must be selected in consultation with the Director of the Centre and the Head of the Department of Microbiology and Plant Pathology. Choice of electives will be based on the academic background and/or anticipated career of the candidate.		
Research project (90 credits):		
ENV 891	Research project 891	90

Total credits required: 180

19.1 (b) MSc in Water Resource Management (Research) (Code 03251047)

Admission is dependent on the candidate being in possession of an appropriate BScHons degree (or equivalent degree with the status thereof) as evaluated by the Director of the Centre and the head(s) of the particular department(s). In the selection procedure the candidate's complete undergraduate and honours academic record will be considered. Admission is also subject to the availability of a suitable supervisor for the study. The study will involve a research dissertation under supervision of an academic staff member(s) of the University of Pretoria, during which the candidate should prove that he/she is able to write a research article for a peer-reviewed scientific journal. Additional courses in related topics may be prescribed for students, depending on their academic background.

ENV 896 Dissertation: Water resource management 896 (180 credits)

Total credits required: 180

19.2 PhD in Water Resource Management (Code 03260126)

a. Admission requirements

Admission is dependent on the candidate being in possession of an MSc in Water Resource Management, or an equivalent degree with the status thereof, as evaluated by the Director of the Centre for Environmental Studies and the head(s) of the particular department(s). In addition to further theoretical studies as prescribed by the Director and head(s) of the relevant department(s), the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department during which the student needs to prove that he/she can publish at least one research paper in an international peer-reviewed scientific journal. The supervisor will be a suitable academic staff member of the University of Pretoria.

b. Programme composition
ENV 990 Thesis: Water resource management 990 (360 credits)

Total credits required: 360

Additional possible electives in Environmental studies:
Any module at master's level in either diplomatic studies or political policy studies as approved by the Head of the Department of Political Sciences and the Director of the Centre for Environmental Studies.

20. CENTRE FOR SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION

20.1 MSc in Science Education (Code 02250442)

Students are registered in a discipline department. The MSc (Science Education) is designed for educators who wish to pursue their postgraduate studies in both a scientific discipline and in science education. Science, in this context, is interpreted in its broadest sense, and includes the physical, biological and earth sciences, as well as mathematics and technology.

At the end of this programme the student will be capable of doing research in both scientific and educational disciplines. Candidates achieve an adequate background to pursue further qualifications in either content disciplines or the discipline of Science Education.

a. Admission requirements
Refer to regulation Sc 9.1 in the Regulations: Faculty of Natural and Agricultural Sciences (Undergraduate) as well as the General Regulations applicable to postgraduate degrees.

b. Programme composition
Modules to a maximum of 60 credits may be required by the head of the department concerned. The dissertation will be supervised jointly by the Centre for Science Education and a discipline department.

Where a candidate wishes to register for the MSc programme without a prior BScHons, additional postgraduate coursework (additional to the required 240 credits) is compulsory. Refer to regulation Sc 9.1 (a) of the Regulations: Faculty of Natural and Agricultural Sciences (Undergraduate) as well as the General Regulations applicable to postgraduate degrees.

Total credits required: 240

Related master's degree described elsewhere in this publication:

MSc in Mathematics Education (Code 02250183) on page 69

20.2 PhD in Science and Mathematics Education (Code 02260753)

The programme is designed for science educators at all levels who wish to pursue their postgraduate studies in science education but closely allied with a scientific discipline. Science, in this context, is interpreted in its broadest sense, and includes the physical, biological and earth sciences, as well as mathematics and technology.

At the end of this programme the student will be capable of doing independent research within the values and approaches of the sciences, and their impact and role in the broader social and economic environment with an educational focus.

For admission to the PhD in Science and Mathematics Education, the programme composition of the master's degree must have included a reasonable research component that led to a dissertation.

a. Admission requirements

The status of a master's degree, subject to regulation Sc.10 of the Regulations: Faculty of Natural and Agricultural Sciences (Undergraduate) as well as the General Regulations.

A candidate must demonstrate expertise in education research methodology (including relevant statistical methods) and in current thinking in the field, with the understanding that a candidate who does not satisfy the required level of expertise may be admitted on condition that additional agreed study assignments are completed and/or examinations passed.

b. Programme composition

Science education:

SCE 990 Thesis: Science education 990 (360 credits)

Mathematics education:
Consult the Department of Mathematics and Applied Mathematics.

WTW 993 Thesis: Mathematics education 993 (360 credits)

Total credits required: 360

Refer to regulation Sc. 10 of the Regulations: Faculty of Natural and Agricultural Sciences (Undergraduate) as well as the General Regulations.

PROCEDURES AND POLICIES CONCERNING POSTGRADUATE STUDENT TRAINING

FACULTY GUIDELINES FOR CONSIDERATION OF BTECH AND/OR MTECH STUDENTS TO POSTGRADUATE STUDY

Candidates who hold BTech and/or MTech degrees are required to fulfil the following conditions:

1. Honours level

The candidate must have a BTech degree with a minimum of 60% in the broad area of specialisation that the candidate wishes to pursue for an honours programme. The student will be given conditional acceptance to an honours programme, but in order to align the student's undergraduate training with the outcomes expected of a BSc graduate, the student will be expected to undertake additional coursework at NQF level 7. The head of department concerned will be required to identify specific modules. The programme of study must be recommended by the Postgraduate Studies Committee, Faculty Board and for approval by the Subcommittee of the Senate. Confirmation of candidature will be based on the successful completion of the additional module requirements during the first year of the honours programme.

1.1 Procedure

The candidate must submit an official application form, together with a motivation, matriculation certificate, academic record and a short CV. The CV should include details of relevant work experience and, where applicable, any publications.

The head of department has to identify and prescribe modules as set out in 1 above.

The application is submitted via the Faculty Postgraduate Studies Committee and the Faculty Board, to the Subcommittee of the Senate for approval.

See the guidelines of the Senate of the University of Pretoria as set out below.

2. Master's level

The candidate must have a BTech degree with a minimum of 60% in the broad area of specialisation that he/she wishes to pursue for a master's programme. The student will be given conditional acceptance to a master's programme, but in order to align the student's undergraduate training with the outcomes expected of a BScHons graduate, the student will be expected to undertake additional coursework at NQF levels 7 and 8. Additional coursework will be prescribed by the head of department concerned. A minimum of 70 credits at NQF level 8 will be required. The programme of study must be recommended by the Faculty Postgraduate Studies Committee, Faculty Board and for approval by the Subcommittee of the Senate. Confirmation of candidature will be based on the successfully completion of the additional module requirements during the first year of the master's programme.

2.1 Procedure

The candidate must submit an official application form, together with a motivation, matriculation certificate, academic record and a short CV. The CV should include details of relevant work experience and, where applicable, any publications.

The head of department has to identify and prescribe modules as set out in 1 above.

The application is submitted via the Faculty Postgraduate Studies Committee and the Faculty Board, to the Subcommittee of the Senate for approval.

See the guidelines of the Senate of the University of Pretoria as set out below.

3. <u>Doctoral level</u>

The candidate must have an MTech degree and have obtained at least 60% for the MTech dissertation. Since the PhD is clearly more demanding of a wider (philosophical) scientific background, the selection of candidates for the PhD degree must be stringent, and could include outside evaluation of the dissertation work by nominees selected by the head of department and recommended by the Faculty Postgraduate Studies Committee, evidence of peer-reviewed publication, appropriate work-related experience (ie in a research environment) and, where necessary, formal coursework to address shortcomings in the academic background.

3.1 Procedure

The candidate must submit an official application form, together with a motivation, academic record, a copy of the MTech dissertation and a short CV. The CV should include details of appropriate work experience and list of any publications. The head of department will submit a motivation to support the application. The application is submitted, via the Faculty Postgraduate Studies Committee and the Faculty Board, to the Subcommittee of the Senate for approval.

See the guidelines of the Senate of the University of Pretoria as set out below.

SENATE OF THE UNIVERSITY OF PRETORIA GUIDELINES FOR SENATE DISCRETIONARY ADMISSIONS

G.54 POLICY ON POSTGRADUATE STUDENT CASES AND THE RECOGNITION OF PRIOR LEARNING

As the University has a finite capacity in most undergraduate fields (its limits have already been reached or those admitted are selected from a large number of applicants), the University's policy on the recognition of prior learning only applies to student cases at postgraduate level (including postgraduate diplomas).

Furthermore, as the University's strategic objective is to be an internationally recognised research university, admission to postgraduate study by means of the recognition of a prior learning pathway is the exception rather than the rule.

Senate may –

(a) grant a graduate of another higher education institution (either in the Republic or elsewhere) a status at the University that is equivalent to the status the student had at such other higher education institution.

(b) admit a person, who
(i) has passed examinations at another university or institution (either in the Republic or elsewhere) which Senate deems equivalent to, or higher than the examinations prescribed for a degree at the University, which are set as a prerequisite for admission to a particular postgraduate study programme, or for the admission of such a person as a research student; or
(ii) in another manner has reached a standard of competence Senate considers adequate for the purposes of postgraduate study or research at the University, as a student for a postgraduate degree, diploma or certificate.

The regulation provides two alternative routes with regard to the admission of students at postgraduate level in cases where they do not comply with the prescribed requirements:

1. A first possibility is via the academic route where a student has proven himself/ herself on the basis of academic achievement.

2. The second possibility refers to a standard of competence that would make a student eligible to continue with postgraduate studies.

With regard to the viewpoint set out above candidates may, inter alia, be evaluated according to the following criteria:

Honours studies

1. In cases where only a diploma and not a degree programme was previously offered in a certain field of study, the Dean may, in consultation with the head of the department, consider the admission of such candidates.
2. Should a student have the necessary academic background, but did not graduate in the applicable field of study, he/she may be admitted to the honours degree on the grounds of:
   - the successful completion of an oral/written entrance examination; and
   - a submission to the Senate

   In certain cases one or more external examiners may evaluate such an application.

   or
3. The academic merit of a student who has achieved a standard of competence in another manner can be evaluated by means of:
   - a written motivation by the student which is evaluated by the head of the department;
   - the successful completion of an oral/written entrance examination in which one or more external examiners were involved; and
   - a submission to the Senate.

Master's studies

1. The application of a student who is not in possession of the required honours degree which would admit him/her to study for the master's degree, but has an academically advanced background, may be considered on grounds of:
   - the successful completion of an oral/written entrance examination in which one or more external examiners were involved; and
   - a submission to the Senate.

   or
2. In cases where a standard of competence was reached in another manner, status may be granted by means of:

- a written motivation by the student which was compiled in conjunction with the head of the department and/or study supervisor, and a recommendation;
- the successful completion of an oral/written entrance examination in which one or more external examiners were involved; and
- a submission to the Senate.

Doctoral studies

1. The application of a student who is not in possession of the required master's degree which would admit him/her to doctoral study, but has an academically advanced background, may be considered on the grounds of:
   - the successful completion of an oral/written entrance examination in which one or more external examiners were involved; and
   - a submission to the Senate

   or
2. In cases where a standard of competence was reached in another manner, status may be granted by means of:
   - a written submission compiled in conjunction with the head of the department and/or study supervisor in which the standard of competence is indicated;
   - a report by an external reference(s) motivating the merits of admission to doctoral study;
   - the successful completion of an oral/written entrance examination in which one or more external examiners were involved; and
   - a submission to the Senate.

POSTGRADUATE SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT

INFORMATION AND REGULATIONS FOR 2015

MISSION STATEMENT

To contribute to agricultural and rural development through excellence in teaching and learning, research and community engagement.

The School/Department reserves the right to not present a programme if the required minimum enrolment is not reached.

1. Background

The Postgraduate School of Agriculture and Rural Development was founded in 1991 to address the need for capacity building through teaching, research and community engagement in agricultural and rural development. The School is one of the largest postgraduate facilities in agriculture and rural development education in Southern Africa. Although most of the students enrolled for the School's academic programmes are from Africa, an increasing number of students from other continents enrol for postgraduate studies in the School. The School's graduates are employed in various international and local development agencies, private sector (co-operatives, banks, consultancy firms and agribusiness), higher education institutions (universities and agricultural colleges), public sector (government departments) and community-based organisations.

2. Mission and objectives

The School aims to contribute to agricultural and rural development through excellence in teaching and learning, research and community engagement.

The objectives of the School are to:

- provide teaching and learning, conduct interdisciplinary research, and implement community engagement programmes in the fields of agricultural and rural development;
- facilitate coordination in the presentation of programmes relating to agriculture and rural development to ensure efficiency and effectiveness;
- support policy formulation and implementation, governance and capacity building within the context of agricultural and rural development;
- broaden access to the services of the University of Pretoria to the wider community by implementing community engagement programmes and provision of short courses;
- prepare students for leadership and management roles in agriculture and rural development; and
- maintain and/or establish partnerships with national, regional and international organisations in agriculture and rural development.

3. Regulations for the degrees and diploma offered

The following degrees and diploma are coordinated in the School:

- Bachelor of Agriculture Honours [BAgricHons]
- Master of Agriculture [MAgric]
- Doctor of Philosophy [PhD]
- Advanced University Diploma in Extension and Rural Development

Bachelor of Agriculture Honours [BAgricHons]

a. Admission

In order to be accepted for the BAgricHons studies, a candidate must be in possession of an acceptable bachelor's degree. An average of 60% is required for admission. An entrance examination is necessary, although exemption may be granted under certain circumstances, as determined by the Director of the School. Specified ancillary modules, in addition to the honours modules, may be required,

as determined by the Director of the School in consultation with the head of department(s) in the candidate's proposed field of specialisation.

b. Fields of specialisation

The BAgricHons degree is awarded in the following fields of specialisation:

- Extension
- Rural Development

The coursework extends over a minimum of two semesters.

c. The curriculum consists of a minimum of 135 credits consisting of the following:

- A common core module, namely ARD 780, is included in the curriculum of both programmes. Recognition of equivalent modules already passed may be considered, in which case suitable alternative modules will be prescribed.
- Elective coursework that may be required will be decided upon by the Director of the School and head(s) of the particular department(s).
- Additional required modules as prescribed for the specific fields of specialisation will be jointly determined by the Director of the School and the head(s) of the particular department(s) in question.

d. In order to obtain the degree, the candidate must achieve a minimum of 50% in each of the prescribed modules. An average of 75% in all the prescribed modules must be obtained in order to pass the degree with distinction.

Master of Agriculture [MAgric]

a. Admission

Admission to the master's degree is dependent upon the candidate being in possession of the BInstAgrarHons/BAgricHons degree of the University of Pretoria, or another appropriate degree equivalent to or higher than the status thereof, as evaluated by the Director of the School and the head(s) of the particular department(s).

b. Fields of specialisation

- Animal Production Management
- Extension
- Rural Development

c. The curriculum consists of further study in the field of specialisation and a dissertation or, alternatively a mini-dissertation accompanied by more coursework than that required if the dissertation option is followed. The mini-dissertation will consist of research done by the candidate under supervision of a member of the Faculty staff. (A dissertation comprises at least 120 of the credits required for the degree, whereas a mini-dissertation comprises 100 credits.)

Doctor of Philosophy [PhD]

a. Admission

Admission is dependent upon the candidate being in possession of the MAgric degree, or an equivalent appropriate degree with the status thereof, as evaluated by the Director of the School and the head(s) of the particular department(s).

b. Fields of specialisation

- Environmental Economics
- Agricultural Economics
- Animal Production Management
- Extension
- Plant Production – Agronomy, Horticultural Science, Pasture Science
- Crop Protection
- Rural Development

c. In addition to further theoretical studies as prescribed by the Director and head(s) of the relevant department(s), the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department. The supervisor will be a member of the Faculty staff.

Advanced University Diploma in Extension and Rural Development (Code 03120200)

This diploma is offered on a full-time basis only.

Co-ordinated in the Department of Agricultural Economics, Extension and Rural Development.

a. Admission

In order to be accepted for the Advanced University Diploma in Extension and Rural Development, a candidate must be in possession of

- an appropriate initial university diploma in one of the Agricultural or other appropriate disciplines and have one year relevant extension experience, or
- an appropriate BTech degree or National Diploma plus one year of relevant extension experience, or
- an appropriate Agricultural Diploma or diploma of similar value plus five years of relevant extension experience, or
- a qualification deemed appropriate by the Senate of the University plus approved extension experience (RPL).
- The coursework extends over a minimum of one year. As all modules are not offered at every training venue, it is important to consult the Head of the Department when planning an application.
- The curriculum consists of the following six modules, each worth 20 credits: AGV 412, 413, 415, 426, 428 and 429. Recognition of equivalent modules passed may be considered, in which case suitable alternative modules will be prescribed.

The aim of the extension and rural development programme is to produce diplomats qualified to operate as professional extension and development agents. On completion of the Advanced University Diploma the candidate will be able to design, develop and execute scientifically sound situation-specific and community adapted extension of development programmes, conforming to the principles of participatory development with maximum community involvement and impact.

To enable them to do this they should:

- be aware and knowledgeable of the philosophies and the different concepts and approaches of development and extension as well as its organisation and management;
- have an understanding of the principles of human behaviour with specific reference to decision-making and behaviour change and the theories involved in understanding and facilitating change;
- be knowledgeable of the theory and practical implementation of community development, group dynamics and leadership for the formulation and execution of development plans;
- have an understanding of the principles of communication and be skilful in the identification and use of the most appropriate communication methods and combination thereof;
- be knowledgeable and skilful in the development, execution and evaluation of situation-specific extension programmes.

b. Programme composition

Code	Module name	Credits
AGV 412	Leadership group dynamics 412	20
AGV 413	Communication for sustainable rural development 413	20
AGV 415	Principles and approaches of rural development and extension 415	20
AGV 426	Extension project planning and management 426	20
AGV 428	Extension projects evaluation 428	20
AGV 429	Human and organisational behaviour change and management 429	20

Total credits required: 120 credits

Prospective students are referred to the General Regulations of the University of Pretoria as well as to the Regulations of the Faculty of Natural and Agricultural Sciences.

Further enquiries regarding admission, class fees, accommodation and bursaries may be obtained from:

The Director
Postgraduate School of Agriculture and Rural Development
Faculty of Natural and Agricultural Sciences
University of Pretoria
PRETORIA
0002
Tel:+27 (0)12 420 3280 Fax:+27 (0)12 420 3206
email: PGSARD@up.ac.za

4. Guidelines for acceptance of BTech/MTech students to postgraduate study
Please see page 86 of this publication.

PROGRAMMES OFFERED IN THE DIFFERENT FIELDS OF SPECIALISATION

Please note: All programmes are offered on a full-time basis only.

1. AGRICULTURAL AND ENVIRONMENTAL ECONOMICS

Coordinated in the Department of Agricultural Economics, Extension and Rural Development.

1.1 MSc in Environmental Economics (Code 03251034)

a. Admission requirements

For admission to the MSc in Environmental Economics, candidates must have a four-year degree qualification (BScHons, BScAgric or BScAgric in Agricultural Economics) or equivalent degree status, with appropriate subjects in economics and statistics. Final admission is subject to the approval of the Director of the Centre of Environmental Economics and Policy (CEEPA) and/or the Head of the Department of Agricultural Economics, Extension and Rural Development.

b. Programme composition

Code	Module name	Credits
Required modules:		
LEK 810	Applied econometrics 810	15
LEK 815	Applied microeconomics 815	15
LEK 880	Natural resource and environmental economics 880	15
LEK 826	Environmental valuation and policy 826	15
Two electives from:		
LEK 882	Institutional economics 882	15
LEK 811	Production economics 811	15
LEK 886	Economics of natural resource management 886	15
LEK 814	Quantitative methods for agricultural and environmental policy 814	15
Dissertation:		
LEK 892	Dissertation: Agricultural economics 892 (including module in research methodology)	120

Total credits required: 210

1.2 PhD in Environmental Economics (Code 03260124)

Admission is dependent on the candidate being in possession of an MSc in Environmental Economics, or an equivalent degree with the status thereof, as evaluated by the Director of the Centre and the head(s) of the particular department(s). In addition to further theoretical studies as prescribed by the Director and head(s) of the relevant department(s), the study will involve a doctoral research thesis under guidance of a supervisor selected by the Director and head of department.

Programme composition
ENV 993 Thesis: Environmental economics 993 (360 credits)

All students need to follow a preparatory programme for the thesis which is not part of the degree programme. This preparatory programme should at least cover the following modules or their equivalents:

- Any two modules in economic or applied economic theory (e.g. Microeconomics or Macroeconomics)
- One module in quantitative methods (Econometrics, Applied econometrics, Quantitative methods, or Partial equilibrium modelling
- One module in the field of specialisation (institutional economics, science and technology policy, food policy, etc)

If these modules or their equivalents are successfully completed and a PhD proposal has been successfully presented and approved by the Department's postgraduate committee, the student may proceed to the research phase and the thesis. Students can be exempted from this preparatory programme if equivalent modules are completed at other universities and students could provide evidence that these prerequisites have been met.

Total credits required: 360

1.3 PhD in Agricultural Economics (Code 03260042)

Candidates who followed the MScAgric degree programme can be admitted to the PhD in Agricultural Economics (see page 49 for the the details of this programme).

2. ANIMAL PRODUCTION MANAGEMENT

Coordinated in the Department of Animal and Wildlife Sciences.

2.1 MAgric in Animal Production Management (Code 03252016)

a. Admission requirements:
The minimum admission requirements are a BAgricHons or BScAgric degree in Animal Production or equivalent qualification with a minimum weighted average of 60% in the final year of study.

b. Programme composition
APZ 802 Dissertation: Animal production management 802 (180 credits)
on an appropriate research topic in the field of animal production management.

Total credits required: 180

2.2 PhD in Animal Production Management (Code 02260545)

a. Admission requirements
The minimum admission requirements are an MAgric or MScAgric degree in Animal Production or equivalent qualification.

b. Programme composition

APZ 990 Thesis: Animal production 990 (360 credits)

Total credits required: 360

3. EXTENSION

Coordinated in the Department of Agricultural Economics, Extension and Rural Development.

3.1 BAgricHons in Extension (Code 03240001)

The aim of this degree programme is to produce graduates qualified to operate as professional extension or development agents. On completion of the degree the candidate will be able to design, develop and execute or manage scientifically sound situation-specific and community adapted extension or development programmes, conforming to the principles of participatory development with maximum community involvement and impact.
To enable them to do this they should:

- be aware and knowledgeable of the philosophies and the different concepts and approaches of development and extension as well as its organisation and management;
- have an understanding of the principles of human behaviour with specific reference to decision making and behaviour change and the theories involved in understanding and facilitating change;
- be knowledgeable of the theory and practical implementation of community development, group dynamics and leadership for the formulation and execution of development plans;
- have an understanding of the principles of communication and be skilful in the identification and use of the most appropriate communication methods and combinations thereof;
- be knowledgeable and skilled in the development, execution and evaluation of situation-specific extension programmes.
- The ability to conduct and report a research study under supervision, in a manner that is appropriate to the discipline of the field of study

Programme composition

Code	Module name	Credits
Compulsory modules:		
AGV 712	Leadership and group dynamics 712	15
AGV 713	Communication for sustainable rural development 713	15
AGV 715	Principles and approaches of rural development and extension 715	15
AGV 726	Extension programme planning and management 726	15
AGV 728	Extension programme evaluation and research 728	30
AGV 729	Human and organisational behaviour change and management 729	15
ARD 780	Rural development studies 780	30

A module in Agricultural economics or any other field of specialisation may be included as an elective module, in consultation with the Director of the School and the head(s) of department(s).

Total credits required: 135

3.2 MAgric in Extension (Code: 03252012)

a. Admission requirements

The BAgricHons in Extension – with an average of 60% plus
OR
A Postgraduate Diploma in Extension and Rural Development with an average of 60% in each module and the completion of at least 60 credits at honours level
OR
BInstAgrarHons in Extension with an average of 60% plus. At least 120 credits of relevant extension modules at postgraduate level (honours level) with an average of 60% plus in each module.

b. The degree programme comprises:

(i) the development of a research proposal (AGV 800 Agrarian extension) (20 credits) – these credits will not be included in the total credits required;
(ii) a dissertation in the form of a situation-specific development programme or based on appropriate research in the field of Extension (AGV 890 Dissertation: Agrarian extension) (180 credits).

Total credits required: 180

3.3 PhD in Extension (Code 03262002)

Programme composition

AGV 990	Thesis: Agrarian extension 990	(360 credits)

Total credits required: 360

4. PLANT PRODUCTION

Coordinated in the Department of Plant Production and Soil Science.

Three focus areas are available: Agronomy, Horticultural Science and Pasture Science.

4.1 PhD in Agronomy (Code 03262164)

Programme composition

AGR 900	Agronomy 900	(60 credits)
AGR 990	Thesis: Agronomy 990	(300 credits)

Total credits required: 360

4.2 PhD in Horticultural Science (Code 02260544)

Programme composition

TBK 900	Horticultural science 900	(60 credits)

TBK 990 Thesis: Horticultural science 990 (300 credits)

Total credits required: 360

4.3 PhD in Pasture Science (Code 03262165)

Programme composition

WDE 900 Pasture science 900 (60 credits)
WDE 990 Thesis: Pasture science 990 (300 credits)

Total credits required: 360

5. RURAL DEVELOPMENT

Coordinated in the Department of Agricultural Economics, Extension and Rural Development.

5.1 BAgricHons in Rural Development (Code 03240003)

The aim of this programme is to enable graduates to participate in and lead rural development processes and policy initiatives. It provides a broad-based understanding of rural development, including project planning and analysis and strategic management.

Programme composition

Code	Module name	Credits
AGV 713	Communication for sustainable rural development 713	15
AGV 715	Principles and approaches of rural development and extension 715	15
ARD 780	Rural development studies 780	30
LEK 720	Agribusiness management 720	15
LEK 785	Agricultural project planning and appraisal 785	15
ENV 711	Environmental principles 711	15
ARD 784	Research project 784	30

Total credits required: 135

5.2 MAgric in Rural Development (Code 03252014)

The candidate is required to pass at least 180 credits. A dissertation (115 credits) must be submitted, prepared under the guidance of a member of the academic staff.

Programme composition

Code	Module name	Credits
LEK 884	Advanced rural finance 884	15
LOB 800	Rural developmental management 800	20
Elective modules:		
LEK 834	Measuring and monitoring food security 834	15

LEK 882	Institutional economics 882	15
LEK 833	Food policy 833	15
Any electives that would strengthen the rural development focus.		
Mini-dissertation:		
ARD 891	Mini-dissertation: Rural development 891	115

Total credits required: 180

5.3 PhD in Rural Development (Code 03262023)

Programme composition
ARD 990 Thesis: Rural development 990 (360 credits)

Total credits required: 360

LIST OF MODULES IN THE FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

 # = Concurrent registration
() = Examination admission
dpw = discussions per week
GS = combined (final) mark (semester/year mark plus examination mark) of at least 40%-49%
hpw = hours per week
LP = Lecturer's permission
lpw = lectures per week
ppw = practicals per week
spw = seminars per week
TDH = Permission by head of department
tpw = tutorials per week

AGR 785 Crop production systems (I): Field crops 785
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
Integrated agronomic, climatic, soil, botanical, economic and managerial considerations in crop production systems aimed at maximum economic yield and sustainability. Case studies of specific field crops.

AGR 786 Crop production systems (II): Vegetable crops 786
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Integrating agronomic, climatic, soil, botanical, economic and managerial considerations in crop production systems aimed at maximum economic yield and sustainability. Case studies of specific vegetable crops.

AGV 412 Leadership group dynamics 412
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Community – concept and meaning; Leadership – concept and meaning. Community facilitation and dealing with diversity; hindrances to change. The use of small groups in the community; the use of large groups; group dynamics; group and community goals. The paradigm shift from directing to facilitating; group techniques; participative techniques. Leadership development in communities. Case studies.

AGV 413 Communication for sustainable rural development 413
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw

Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Introduction to the communication process and its importance for sustainable development; the models of communication; critical elements and factors in communication; Communication and perception. Use of non-verbal communication. Persuasion and Credibility. Messages and message treatment; audience and audience identification; channels and methods of communication. Effective listening and feedback. Practical training in communication: Effective speaking; visual aids in communication; managing conflict; report writing. Introduction to Appreciative Inquiry as a communication approach.

AGV 415 Principles and approaches of rural development and extension 415
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
The role, importance and nature of extension and development; ethics in development and extension. International approaches to development and extension; paradigm shifts within extension and development. The Third World: concept, characteristics and change. The subsistence farmer, rural poverty and the deprivation trap. Development practice and theories. Participation; appropriate technology; role players and responsibilities in development.

AGV 421 Communication 421
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
Communication: Definition and clarification of concepts. Theory and elements of communication. Verbal and non-verbal communication. Determinants of interpersonal communication. Abating factors impeding communication. Nature, classification and efficiency of communication channels.

AGV 426 Extension project planning and management 426
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Nature, purpose and principles of a project-based and purposeful approach. Institutional framework for community participation, ownership and empowerment; linking with complementary and support services. Participative need appraisal, problem identification and delimitation; methods and techniques; problem conceptualisation and development of survey instrument; situation surveys and analyses; formulation of objectives; identification and scheduling of methods and activities; work plan or calendar construction, budgeting. Project monitoring tools.

AGV 428 Extension projects evaluation 428
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw

Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Reasons and purposes of evaluation; expectations from evaluations; role players and motives in evaluation. Criteria and indicators of development, development projects and development organisations. Methods of evaluation; formulation of objectives and scale construction for evaluation; developing and coding the measuring instrument. Sampling and sampling techniques; data analysis and interpretation; compiling an evaluation report.

AGV 429 Human and organisational behaviour change and management 429
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Understanding behaviour: characteristics of human behaviour and basic concepts; perception, decision making and problem solving, learning, innovativeness and adoption behaviour. Diffusion of Innovations: elements and phases of diffusion, opinion leaders and contact farmers, methodological implications for extension. Psychological, cultural and social barriers to change. Behaviour change or modification: comparison of different approaches and strategies. A practical model: background principles and theories, identifying “forces” or behaviour determinants; designing effective extension messages for development programmes. Introduction to organisational dynamics. Role of extension organisations in rural development. Theoretical perspectives on organisational change. Understanding organisations and society; organisational pathologies; organisational effectiveness.

AGV 712 Leadership and group dynamics 712
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Nature, philosophy and objectives of Extension. The group as channel and instrument in extension; definitions and characteristics of groups; group formation; theories regarding the functioning of groups; group norms; group goals; small group techniques; rural groups and their engagement; definitions and theories of leadership; behaviour and attitude in group work; the extensionist as professional leader; group analysis in group context and process; training of leaders. Conflict resolution, mediation and negotiation. Ethics in extension and agricultural development. Management in extension; strategic planning; functions of management.

AGV 713 Communication for sustainable rural development 713
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 ppw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Introduction to the Communication Process, its role and importance. Communication and perception – role of Extension in AKIS. Clarification of principles and definitions; theory of communication; strategies for communication and extension methods. Key elements and

channels of communication; credibility; persuasion; public speaking; audiovisual aids; mass media and their effect; new reporting; articles and newsletters. Designing communication interventions. Impact assessment approaches and tools. Appreciative Communication Inquiry: 5-D Approach.

AGV 715 Principles and approaches of rural development and extension 715
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Overview of the origin, role, development of extension; Philosophy and principles of extension. International approaches to extension delivery: Training and visit, farming system development, project approach, farmer field schools, participatory extension and participatory technology development. Extension's role in sustainable agriculture development; adult learning principles, privatizing and outsourcing of agricultural extension; the role of non-governmental organisations (NGOs) in extension delivery. Decentralisation of extension. Participation and coordination of stakeholders in the planning of linkages between extension, research and the farming community.

AGV 726 Extension programme planning and management 726
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 2 lpw 1 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Nature, purpose and principles of a programmed and purposeful Extension. The philosophy, principles and assumptions of programme development. Institutional framework for community participation, ownership and empowerment; linking with complementary and support services. Overview of the program cycle: consideration, survey, planning, action and evaluation phases. Participatory need appraisal, problem identification and delimination; problem conceptualisation and development of survey instrument; situation surveys and analysis; formulation of objectives; identification and scheduling of methods and activities; work plan of calendar construction, budgeting. The project management process. Personnel management and administration.

AGV 728 Extension programme evaluation and research 728
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 ppw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Meaning, scope and place of evaluation in extension; the research and evaluation process; problem identification; theory and hypotheses; objectives; literature research and information sources; sampling; methods of data collection; evaluation criteria; quality of measuring instruments; scale construction; interviewing; conducting research and reporting research findings. Preparation of an evaluation report of an extension programme/project.

AGV 729 Human and organisational behaviour change and management 729
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 2 lpw
Period of presentation: Year

Language of tuition: English **Credits:** 20
Module content:
Understanding change and the time lag phenomenon. Principles of human behaviour and its influence on change. Theoretical perspectives on behaviour change. Understanding resistance and barriers to change. Adoption and diffusion of new innovations. Theories and models of decision-making. Introduction to organisational dynamics; role of extension organisations in rural development. Theoretical perspectives on organisational change; organisations as rationale and open systems. Understanding organisations and society; organisational pathologies; organisational effectiveness.

AKM 705 Actuarial mathematics 705
Academic organisation: Insurance and Actuarial Science
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
The stochastic approach to annuities and assurances involving one of two lives. Definitions, estimation and use of select mortality functions. Multiple decrements and pension funds. Variable benefit, disability, long-term care contracts. Life insurance contracts: expenses and bonuses. Net and gross premiums and reserves for fixed and variable benefit contracts. Discounted emerging cost techniques. Profit testing. Asset shares for life insurance contracts. Alterations to contracts. Costs of guarantees under life insurance contracts. Factors affecting mortality, selection, standardisation. The process of population projection and its main determinants. Valuation of benefits under a disability insurance contract.

APS 761 Crop physiology 761
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw, fortnightly practicals
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
An overview of photosynthesis and respiration, with the aim of examining the physiological basis of yield in cropping systems. This includes an assessment of parameters for determining plant growth, factors governing yield, partitioning of photo-assimilates within plants and opportunities for increasing yield. Crop growth and yield will be put into context of a changing global climate. Evaluation of the manner in which plants respond to various abiotic stresses and how plants sense changing environments. The various roles of plant growth regulators in plants and the importance of these compounds in agriculture.

ARD 780 Rural development studies 780
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Overview of the concepts and theories of rural development including evolution of rural development theories, role of agriculture in rural developments, natural resource base and role of government. Rural livelihood systems focusing on household farming systems, decisions and operation of farming systems, the farm as a social system, non-farm, off-farm small, micro- and medium enterprises in the rural economy, development

intervention and household food security. Rural institutions including local governance, community-based and farmer organisations, agricultural credit and rural finance, input and output markets, human capital formation, land tenure and land reform, policy making institutions, and institutions of the agricultural knowledge triangle (research, teaching and extension). The relationship between rural sociology, community development and extension; physical and social structures of communities; cultural relativism; sustainability; indigenous knowledge; social stratification; development as change; principles and functions of community development; development barriers; participatory development methodologies, rural poverty. Methodologies for rural development including farming systems approach, participatory appraisal techniques, assessment of land-use patterns and agrarian systems in rural settings: zoning techniques, socioeconomic and technical assessment of the farming system, topological techniques and gender sensitive methodologies. Communication for rural development and planning rural development at local levels.
Practical assignment in collaboration with rural communities managed by the School's outreach department.

ARD 781 Development principles: Theory and evidence 781
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
*Co-ordinated in the Department of Agricultural Economics, Extension and Rural Development. (Only for Extension students and covers first part of ARD 780)
Overview of concepts, theories and key definitions of development and rural development, poverty and food security to understand the magnitude and different dimensions of rural development in developing countries; evolution of rural development theories, policies and practices along recent history; the dynamic role of agriculture in the development process at country level and the successive phases of its contribution from early developing stages to industrial economies; smallholder agriculture and development; concepts and dimensions of rural livelihoods as the basis cluster of rural development; farming systems in smallholder agriculture; rural non-farm enterprises; food security and development; institutions and rural development; land tenure systems, property rights and land reform; rural finance and agricultural credit; agricultural markets with some policy and implementation dimensions; local institutions, property rights and collective action in communities; development support interventions.

ARD 782 Physical-biological resources and development 782
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
Review of the most important physical-biological agricultural resources – soil, water, climate, topography, plant species, animal species; differences in characteristics, quality and vulnerability; the concept of optimum land-use; resource conservation; general ecological principles; examples of problems caused by mismatching of physical-biological resources and land use during development planning; principles of sensible technology transfer.

ARD 784 Research project 784
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
Research project and case study of rural problems, challenges and dynamics in rural communities. The research project should address an important contemporary rural development problem or challenge and contribute towards the solution thereof.

BCM 771 Trends in biochemical research 771
Academic organisation: Biochemistry
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Study and discussion of topical research results from recent scientific publications.

BCM 773 Research project and report 773
Academic organisation: Biochemistry
Contact time: 1 other per week
Period of presentation: Year
Language of tuition: English **Credits:** 60

BCM 774 Research methods 774
Academic organisation: Biochemistry
Prerequisites: Admission into BScHons in Biochemistry, Biotechnology, Genetics, Microbiology, Bioinformatics or Human Physiology
Contact time: 2 ppw 2 web-based periods per week 4lpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Students are guided through the methodology of research planning and data handling, as well as science communication skills. They are offered hands-on experience in a range of advanced techniques employed in biochemistry, molecular technologies and biochemical analysis. Scientific writing and presentation skills required for research in biochemistry, are also addressed. Ethical and philosophical issues in the broader field of the Cellular and Molecular Sciences are also addressed. Several of these aspects will be presented collaboratively by the Department of Genetics and the Department of Microbiology and Plant Pathology.

BCM 775 Advanced biochemistry 775
Academic organisation: Biochemistry
Prerequisites: Admission into BScHons in Biochemistry, Genetics, Microbiology, Bioinformatics or Human Physiology
Contact time: 4 lpw 4 web-based periods per week
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The latest trends towards a biological systems approach of metabolism, functional genomics and control. This includes integration of metabolic pathways, mechanisms of regulation and metabolic control analysis.

BIF 701 Bioinformatics theory and applications 701
Academic organisation: Biochemistry
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
General concepts in bioinformatics; sequence motifs and features; sequence databases; common bioinformatics tools; programming in Python; the bioinformatics toolkit for Python; pair wise and multiple sequence alignments; genome analysis; data visualisation; specialised statistics for bioinformatics; specialised algorithms for bioinformatics; nucleic acid modelling; transcription analysis; microarray data analysis; genome annotation; phylogenetics; mapping and markers; structural modelling.

BIF 702 Trends in bioinformatics and literature seminar 702
Academic organisation: Biochemistry
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Study and discussion of topical research results from recent scientific publications.

BIF 703 Research project and report 703
Academic organisation: Biochemistry
Contact time: 1 other per week
Period of presentation: Year
Language of tuition: English **Credits:** 60

BIF 704 Introduction to molecular biology for bioinformatics 704
Academic organisation: Biochemistry
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Atoms and molecules; the chemistry of life, organisation of the cell; energy; chromosomes; heredity; DNA; RNA and protein synthesis; gene regulation; genetic engineering; genomes; genes and development; evolution; speciation; diversity.

BME 780 Introduction to mathematical statistics for bioinformatics 780
Academic organisation: Statistics
Contact time: 4 lpw 1 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Sampling and statistical descriptive methods, indices, correlation and curve fitting. Elementary probability and distribution theory. Statistical distributions. Statistical inference: estimation and hypothesis testing, including analysis of variance, categorical data analysis and distribution-free methods. Use of statistical computer packages with application in bioinformatics. Report writing.

BNG 700 Investments 700
Academic organisation: Insurance and Actuarial Science
Contact time: 2 lpw

Period of presentation: Year
Language of tuition: English **Credits:** 27
Module content:
The module covers a whole range of finance- and investment-related topics within the framework of the actuarial control cycle: principles and objectives of investment management and analysis of investors' needs. Principal investment assets and the markets in such assets as well as the economic influences on these. Asset modelling. The underlying legislative, taxation and regulatory framework for investment management and the securities industry. Actuarial techniques for assessing capital investment projects. Constructing investment indices. Developing appropriate investment strategies. Valuing individual investments and portfolios and understanding its appropriateness in different situations. Portfolio management (including risk control techniques) and performance appraisal of investment portfolios. Project management. Credit risk and credit ratings.

BOT 705 Molecular techniques 705
Academic organisation: Plant Science
Prerequisites: Admission into BScHons in Plant Science (Plant Biotechnology/ Physiology)
Contact time: 1 lpw 5 ppw 1dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Students are guided through the methodology of research planning and data handling. They are offered hands-on experience in a range of advanced techniques employed in molecular research and analysis.

BOT 712 Plant nomenclature 712
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
The regulations of the International Code for Botanical Nomenclature. Principles of nomenclature. History of plant collecting. Type specimens.

BOT 714 Seed ecology 714
Academic organisation: Plant Science
Contact time: 1 web-based period per week 1 ppw 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Regeneration of plants from seed under natural conditions. Early stages in the life of a plant from ovule to established seedling: seed production; seed predation; seed dispersal; seed germination and dormancy, seed bank dynamics and seedling establishment.

BOT 717 Plant morphology 717
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10

Module content:
Speciation in flowering plants; plant variation. Sex determination in flowering plants. Reproductive systems in flowering plants.

BOT 718 Introduction to plant biotechnology 718
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Plant genome: structure and composition of the plant genome (nuclear, mitochondrial and chloroplast); applications in plant biotechnology: plant tissue culture (micropropagation, somatic embryogenesis and cell suspension cultures). Genetic manipulation and gene transfer technology (Agrobacterium-based and other) and DNA-marker technology.

BOT 719 Primary plant metabolism 719
Academic organisation: Plant Science
Contact time: 1 ppw 1 web-based period per week 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Regulation and interaction of primary plant metabolic pathways on the sub-cellular and whole plant level.

BOT 730 Plant ecology and conservation 730
Academic organisation: Plant Science
Contact time: 2 lpw 5 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
Applications of plant ecology principles in plant conservation: species-distribution modelling, alien plant invasions, conservation planning, threatened ecosystems, South African environmental legislation. Experimental design and vegetation survey techniques. Discussion of relevant topics in plant ecology. This module includes a compulsory 5-day field component.

BOT 741 Plant taxonomy 741
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Classification, identification and nomenclature, methodology of a revision study, analysis and presentation of taxonomic information, evolution, phylogeny and cladistics.

BOT 742 Plant classification 742
Academic organisation: Plant Science
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Sources of taxonomic information; morphology, anatomy, chemotaxonomy, cytogenetics,

reproductive biology, plant geography, palynology, ethnobotany and paleobotany. Importance of different characteristics, methods to obtain information and interpretation of observed patterns in variation.

BOT 746 Applications in plant biotechnology 746
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Creation of genetically modified plants and their impact on modern agriculture.

BOT 748 Phytopharmacology 748
Academic organisation: Plant Science
Contact time: 1 ppw 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Pharmacological action of low molecular plant constituents and high molecular weight compounds. Plant constituents as anticancer, antibacterial, antiviral, hypoglycaemic, free-radical scavengers, hypotensive and as anti-inflammatory agents. Cell culturing, cell growth and apoptosis, cell mediated immune responses. Drug development in TB as models for research. Enzymes, receptors and plant constituents. The unique challenges of plant-based medicines.

BOT 749 Pharmacognosy/Phytotherapy 749
Academic organisation: Plant Science
Contact time: 1 dpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Basic concepts of toxicology. Systemic, developmental, genetic and organ-specific toxic effects. Hallucinogenic, allergenic, teratogenic and other toxic plants. Plant constituents, contradictions and interactions. Phytotoxicity unrelated to plant constituents. Safety and efficacy issues of commonly used phyto-drugs with emphasis on pharmaceutical applications. Practical aspects related to the manufacture of good quality plant-based medicines. Phyto-drug formulation, standardisation and aspects concerning different dosage forms.

BOT 761 Advanced phytomedicine 761
Academic organisation: Plant Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Metabolism and functions of secondary compounds such as tannins, alkaloids, terpenoids, flavonoids and free amino acids. Importance of secondary compounds in the defence mechanisms of plants. Isolation and identification of medicinal bioactive compounds from plants. Their current scope and potential applications in ethnobotany. Strategies to discover new pharmaceuticals from ethnomedicine.

BOT 782 Research report 782
Academic organisation: Plant Science
Period of presentation: Semester 1
Language of tuition: English **Credits:** 60
Module content:
Teaching and planning, execution and documentation of a research project.

BOT 783 Seminar 783
Academic organisation: Plant Science
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Literature study, discussion and oral presentation of a subject related to the main discipline.

BOT 784 Trends in plant science 784
Academic organisation: Plant Science
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Literature study of recent publications in a subject related to one of the elective disciplines.

BOT 786 Practical plant identification 786
Academic organisation: Plant Science
Prerequisite: BSc with first year Botany/Plant Science
Contact time: 2 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Principles of identification, classification and nomenclature; identification of plants; family recognition; collection of plant specimens for identification; herbarium as a source of information. Variation in seed plants and breeding systems. Practical work involves an excursion.

BOT 788 Spatial analysis in ecology 788
Academic organisation: Plant Science
Contact time: 2 lpw 2ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Mapping and analysing spatial data. Theory and basic techniques of analysing and manipulating spatial data using geographical information systems. Mapping of vegetation types, species distributions and diversity, species traits. Understanding the spatial drivers of biodiversity patterns. The influence of scale on biodiversity analyses. Relevance for conservation planning for mapping biodiversity risk and prioritising conservation, especially in a South African context.

BOT 790 Plant ecology and conservation for wildlife management 790
Academic organisation: Plant Science
Contact time: 2 lpw 2 ppw
Period of presentation: Semester 1

Language of tuition: English **Credits**: 10
Module content:
Applications of plant ecology principles in plant conservation: species-distribution modelling, alien plant invasions, conservation planning, threatened ecosystems, South African environmental legislation. Discussion of relevant topics in plant ecology.

BTW 701 Biotechnology in the workplace 701
Academic organisation: Genetics
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Introduction to the principles and realities of working in the field of biotechnology. Discussions on various aspects, including entrepreneurship; intellectual property; patent rights; financial management; grant applications and product marketing. The module will be assessed by way of a simulated grant application for the development of a hypothetical biotechnological venture.

CMY 706 Analytical chemistry A 706
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Selected aspects of –
Mass spectrometry: ion sources, analysers, detectors, isotope ratios, accurate mass, ion fragmentation, tandem mass spectrometry.
Chromatography: theory and instrumentation of gas, liquid and supercritical fluid chromatography, multidimensional systems and coupling to mass spectrometry.

CMY 707 Analytical chemistry B 707
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Selected aspects of –
Electrochemistry: fundamental theory, voltammetry, metal-ligand equilibria, modelling and measurement of solution composition.
Statistics: precision and accuracy, random errors, hypothesis testing, method of least squares, curve fitting, multivariate statistics, interpreting patterns of data.
Chemical metrology: propagation of errors, quality control of quantitative and qualitative analytical information, international standards, interlaboratory calibration.

CMY 708 Organic chemistry A 708
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Stereocontrolled organic synthesis: substrate stereocontrol in diastereoselective synthesis. Retrosynthesis: principles and applications. Protecting groups in synthesis. Aromatic and heteroaromatic chemistry.

CMY 709 Organic chemistry B 709
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Stereocontrolled organic synthesis: chiral auxiliaries in synthesis; reagent controlled synthesis; catalyst controlled synthetic methods. Pericyclic reactions and transition metals in organic synthesis. Aliphatic and heterocyclic amine chemistry.

CMY 714 Inorganic chemistry A 714
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Inorganic and organometallic chemistry. Classification of ligands and complexes. Synthesis, structure, bonding and reactivity of complexes. From complexes to clusters to networks. Reaction kinetics and mechanisms.

CMY 715 Inorganic chemistry B 715
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Main group chemistry. Bioinorganic and bioorganometallic compounds. Metals in medicine. Homogeneous catalysis and template effects. Supramolecular chemistry.

CMY 716 Physical chemistry A 716
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Crystallography: theoretical principles, symmetry elements and operations, point groups, space groups, theory of crystals, X-rays, crystallographic techniques, structure determinations, powder diffraction and crystallographic data bases.
Molecular modelling: molecular structure/energy, methodology, principles and and molecular surfaces.

CMY 717 Physical chemistry B 717
Academic organisation: Chemistry
Contact time: 6 lpw for 4 weeks; 1.5 dpw for 4 weeks
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 10
Module content:
Chemical kinetics: rates of chemical reactions, equilibrium reactions, temperature dependence of reactions, complex reactions, reaction mechanisms and kinetics by thermal analysis.
Statistical mechanics: Boltzmann distribution, partition functions, ensembles, thermo-dynamic functions, equilibria.

CMY 718 Organic/Inorganic Project 718
Academic organisation: Chemistry
Contact time: 5 ppw (4.5 hour practical sessions) for 7 weeks and 1 seminar
Period of presentation: Semester 1 and 2
Language of tuition: English **Credits:** 20
Module content:
Students work on one project during the year which has a significant laboratory component requiring preparation or manipulation of inorganic or organic chemicals. A report and a presentation are required.

CMY 719 Physical/Analytical Project 719
Academic organisation: Chemistry
Contact time: 5 ppw (4.5 hour practical sessions) for 7 weeks and 1 seminar
Period of presentation: Semester 1 and 2
Language of tuition: English **Credits:** 20
Module content:
Students work on one project during the year which has a significant component that can be described as instrumental or computational or analysis of data or theoretical. A report and a presentation are required.

CMY 730 Advanced practical techniques 730
Academic organisation: Chemistry
Contact time: 5 lpw for 6 weeks; 5 tpw for 6 weeks.
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Chemical information literacy; Molecular modelling; NMR spectroscopy; Mass spectrometry; Crystallography and Metrology will be presented from a practical point of view with an emphasis on the interpretation of data and use of instrumentation rather than on underlying theory.

EKT 713 Econometrics 713
Academic organisation: Economics
Prerequisite: Only for BComHons in Agricultural Economics, Econometrics or Economics students; STK 310 and STK 320
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
An introductory yet comprehensive module in econometrics, encompassing an in-depth examination of elementary statistics and regression analysis. This includes the fundamentals of simple and multiple regression analyses, as well as estimation, inference and hypothesis testing. Considerable attention is devoted to practical applications on current economic issues and examples drawn from the applied economic literature.

EKT 720 Introduction to statistical learning 720
Academic organisation: Statistics
Prerequisite: RAL 780, STK 310, 320
Contact time: 1 lpw 1 web-based period per week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15

Module content:
The emphasis is on the theoretical understanding and practical application of advances in statistical modelling. The following topics are covered:
Single equation models: Nonparametric regression. Bootstrap procedures within regression analysis, k-nearest neighbour classification. Modelling categorical dependent variables –Logit/Probit models. Multiple outputs. Linear regression of an indicator matrix. Ridge regression. Non-linear regression modelling. Some new developments in regression and classification.
Simultaneous equation models: Specification, identification and estimation of simultaneous equation models.

EKT 723 Econometrics 723
Academic organisation: Economics
Prerequisite: Only for Hons Econometrics or Economics students; EKT 713
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
An advanced module in econometrics that goes beyond elementary statistics and regression analysis. This includes in-depth analyses of the theory and application of stationarity, unit roots and co-integration in single equations. In addition to this, the concepts of qualitative analysis, cross-sectional modelling and simultaneous-equation modelling are dealt with.

ENV 703 Research and presentation skills 703
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 10
Module content:
A module zooming in on research methodologies, data-capturing techniques as well as visual and oral presentation skills. A significant part of the module assessment is constituted by the final presentation of the honours project contents.

ENV 727 Environmental compliance 727
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 5 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Tools for achieving environmental compliance, constitutional and administrative requirements, environmental legislative requirements, criminal legislative requirements, business entities and liability, mandate and powers of environmental inspectors, enforcement ethics, networks and resources, conflict management.

ENV 728 Conservation environmental enforcement 728
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 5 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Health and safety during conservation enforcement, compliance inspection principles in biodiversity conservation, principles of investigation, approaches and procedures during prosecution.

ENV 729 Industrial environmental enforcement 729
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: ENV 727
Contact time: 5 lectures for period of one week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Health and safety during industrial enforcement, compliance inspection principles in industry, principles of investigation, environmental sampling and chain of custody of samples, interaction with ISO 14001, procedures during prosecution.

ENV 785 Environmental assessments 785
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 block week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
The aim of this module is to understand the principles and processes behind environmental assessments. The module will give an overview of the history of assessments, compare assessment processes internationally, evaluate the strengths and weaknesses of different approaches, provide an overview of the South African regulatory context and the environmental authorisation process.

FNI 700 Finance and investment 700
Academic organisation: Insurance and Actuarial Science
Prerequisite: BNG 700 #
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
The application of modern techniques in financial management to the financing of corporate entities and the management of assets. Topics include: the theory of finance, valuation of investments, asset modelling, capital structure and the cost of capital, portfolio management, capital project appraisal and performance management.

FSK 700 Physics 700
Academic organisation: Physics
Contact time: 1 other per week 1 dpw 1 spw 10 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 135
Module content:
The module content is determined by the Head of the Department of Physics. In addition to the usual subjects, viz classical mechanics, quantum mechanics, statistical mechanics, electrodynamics, solid state physics, experiments or modelling, and a mini-research project, there are also elective subjects.

FSK 710 Mathematical methods 710
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 15

Module content:
Series; complex analysis; Bessel and other special functions; integral transforms; Green functions.

FSK 711 Classical dynamics 711
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Advanced problems in classical dynamics; Hamilton formalism; canonical transformations; continuum mechanics.

FSK 713 Quantum mechanics (I) 713
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Measurement process, General indefinite relations, Harmonic ossilator, symmetry, invariants and conservation laws, angular momentum, spin, perturbation theory, Schrödinger-Heisenberg and interaction pictures.

FSK 714 Electrodynamics (I) 714
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Poisson equation, Green functions, Maxwell equations.

FSK 727 Nuclear physics 727
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Collective model, shell model, approximate nuclear structure methods, for example Hartree-Fock, random phase approximation, Tamm-Dankoff reaction theory and optical model.

FST 700 Research methodology and seminars 700
Academic organisation: Food Science
Contact time: 1 workshop of 5 days in semester 1, 1 day seminar in semester 2
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Lectures and assignments: Research methodology. Literature study and seminar presentations on topics in Food Science and/or Technology. The candidate must also pass an oral examination at the end of the module.

FST 701 Animal food technologies 701
Academic organisation: Food Science
Contact time: 30 discussion classes 9 practical sessions
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Dairy technology: The technology of fluid, concentrated, dried, frozen and fermented dairy products and starter cultures. Requirements for milk supply and other ingredients. Principles for the manufacturing of products in this category. Possible defects, causes and prevention.
Practical work: Preparation of condensed milk, custard, ready-to-eat milk-based desserts, flavoured milk beverages, dairy-fruit juice mixtures; ice cream and other frozen desserts; yoghurt and cultured milk products; cheeses. Evaluation and analysis of the products. Effect of processing on the nutritional value of dairy products. Factory visits.
Meat, poultry, fish and egg technology: Meat, poultry, fish and egg processing and equipment. Meat emulsion, curing, dehydration and fermentation technology. Preservation and storage. Packaging. Legislation. Quality control and hygiene. Effect of processing on the nutritional value of meat products. Practical work: Manufacturing of dried, cured, fermented and emulsion type products. Visits to processing factories.

FST 702 Advanced plant food science and technologies 702
Academic organisation: Food Science
Contact time: 5 discussion classes in semester 2, 8 discussion classes in semester 1 3 practical sessions in semester 2 5 practical sessions in semester 1
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Plant food functionality: Starch, non-starch polysaccharides, protein. Advanced rheology and texture. Malting and brewing. Ready-to-eat (RTE) technologies and their impact on functional and nutritional quality. Plant oil processing. Minimal processing of fruits and vegetables. Practical work: Pasting properties of starch; Dough rheology; Isolation of legume and cereal proteins; SDS-PAGE electrophoreses of legume and cereal proteins; Malting and mashing of sorghum and barley male; Extraction of essential oils; Extraction and identification of phenolic compounds; Minimal processing of fruit and vegetables.

FST 712 Sensory evaluation 712
Academic organisation: Food Science
Contact time: 12 discussion classes, 6 practical sessions
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Lectures: Principles and applications of sensory evaluation. Types of panels, tests and test conditions and their functions. Selection and training of panellists for descriptive sensory evaluation. Instrumental sensory quality measurements. Statistical analysis and interpretation of data.
Practicals: Practical aspects and execution of sensory evaluation techniques, analysis and interpretation of data. Instrumental sensory quality measurements.

FST 713 Product development and quality management 713
Academic organisation: Food Science
Contact time: 6 practical sessions 15 discussion classes
Period of presentation: Semester 1

Language of tuition: English **Credits:** 25
Module content:
Lectures: Principles involved and steps that are followed to develop new food products that are safe, tasty, nutritious and cost-effective. Application of the theory of food product development. Quality management systems with specific reference to Good Manufacturing Practices, HACCP and ISO 9000. National and international standards, Codex Alimentarius, FDA. Application of food legislation. Food packaging.
Practicals: A product development project will be planned, conducted and presented. Application and implementation of HACCP.

FST 720 Advanced food science 720
Academic organisation: Food Science
Contact time: 12 discussion classes
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Discussion classes in advanced level food chemistry, food microbiology, food engineering, food processing and nutrition. Problem solving and literature discussion.

FST 763 Research project 763
Academic organisation: Food Science
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
A short research project on an approved topic in food science and/or technology is planned, executed and presented in the form of a written report.

GDK 771 Advanced environmental soil chemistry 771
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Advanced theoretical and experimental soil chemistry, including the organic fraction.

GDK 772 Advanced environmental soil physics 772
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Advanced theoretical soil physics with the emphasis on mathematical modelling of fluxes of water, heat and solutes.

GDK 773 Plant nutrition, soil biology and soil fertility 773
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Study of the latest trends and developments in plant nutrition, soil biology and soil fertility.

GDK 775 Project in environmental soil science 775
Academic organisation: Plant Production and Soil Science
Period of presentation: Year

Language of tuition: English **Credits:** 30
Module content:
Research project on a practical aspect of Environmental Soil Science.
Literature review, formulation of a problem statement, hypotheses and aims of the research, as well as the design and execution of a laboratory or field scale trial. Project to be written up in a specific scientific format suitable for publication with an oral and visual presentation on the research.90

GGY 701 Selected theme 701
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 dpw 1 web-based period per week
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
A self-study module on an aspect or aspects of geographical or environmental science selected in consultation with the head of the department from:
(a) themes not covered in existing options; or
(b) educational subjects.

GGY 702 Research project 702
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 35
Module content:
An approved individual research project, carried out under the guidance of a lecturer. The project culminates in a research report in the format of a research paper and presentation. The student is expected to obtain the respective skills (theoretical and practical research techniques, data analysis, communication and computer skills) necessary for the research topic.

GGY 710 Geographical and environmental principles 710
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 25
Module content:
The module provides a critical review of the structures and paradigms in which the geographical and environmental sciences are practised. Particular reference is made to the development and impact of paradigms and the interdependence of systems within space and time.

GGY 718 Applied geomorphology 718
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
This module focuses on processes and applications of geomorphology. Topics that may be studied include: soil erosion and conservation, weathering, geomorphic response to environmental change, slope processes and geomorphological hazards. The module includes practical fieldwork and field assessments.

GGY 780 Urban geography 780
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The main themes of the module include: overview of global urbanisation theories and processes; urban morphology and change; the administrative structure and functions of African cities and; the quality of urban life in the developing world.

GGY 789 Environmental change 789
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 2 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
This module involves the study of the causes and consequences of environmental change from multidisciplinary perspectives. A focus of this module is human-environmental interaction. Study themes include past environmental change, causes and consequences of human-induced environmental change and South Africa and climate change.

GGY 793 Aspects of land reform and the environment 793
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The module aims to provide students with a basic understanding and knowledge of contemporary land reform issues against the background of international land reform experiences. The module also touches on other rural development strategies and ultimately aims to enhance the student's ability to conceptualise and analyse policy in the context of broader environmental issues.

GIS 701 Research methods 701
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 14 contact hours per year
Period of presentation: Quarter
Language of instruction: English **Credits:** 10
Module content:
The module introduces students to planning, research design, scientific reading, writing and presentation as required for geoinformatics research
GIS 702 Research project 702
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 35
Module content:
An approved individual Geoinformatics research project with a system design and/or spatial analysis component. The project is carried out under the guidance of a lecturer. The student is expected to obtain the respective skills necessary for the research topic. Compilation of a research proposal. Literature survey. Selecting an appropriate research method. Carrying out of the research. Preparation of a research project.

GIS 703 GIS professional practice 703
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
Professionalism, including professional ethics, professional practices, partnerships, client relationships, SA Council for Professional and Technical Surveyors (including legislation and rules) and social responsibility. Relevant legislation, including Promotion of Access to Information Act and Spatial Data Infrastructure Act. Role of international associations/ societies in Geoinformatics.

GIS 704 Spatial statistics and geodesy 766 704
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GMC 310 and GIS 320 or equivalent
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
Principles of least squares in statistics, spatial least squares regression, surface interpolation using least squares and coordinate transformations.
Topics in Geodesy: Space-based measurement systems, sea level measurements, determination of the geoid, earth axis orientation determination and earth dynamics.

GIS 705 Advanced geospatial data 705
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GIS 310 or equivalent
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English **Credits:** 15
Module content:
Advanced topics in geospatial data management, such as data quality assurance, data quality assessment and the supply chain for geospatial data acquisition.

GIS 706 Internet GIS 706
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: INF 164 or equivalent
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
This module aims to explore the Internet as a platform for accessing and delivering geospatial data and services. Students will be exposed to the theory and practice of technologies and technology approaches that make Internet GIS a reality. From the basic building blocks of Internet GIS, to advanced Spatial Data Infrastructure concepts, this module covers current and emerging issues in bringing geospatial data and processes to the wider world. Students will be required to reflect on the implications of using such technologies. A significant portion of the module will involve 'hands-on' work in designing and building Internet GIS applications and accessing Internet-based data and services. This module also includes consideration of a number of case studies within different problem domains.
Students should leave the module with an understanding of the building blocks that make

Internet GIS possible and be able to consider what are good practices in the development of Internet GIS applications and services.

GIS 707 Special topics 707
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English **Credits:** 15
Module content:
A special topic in Geoinformatics linked to research specialisation in the department and/or visiting lecturers. For example, research trends and advances in a specific topic or field of specialisation in Geoinformatics. The module is presented in the form of guided advanced readings, seminars and/or discussion sessions.

GLY 702 Volcanology 702
Academic organisation: Geology
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 12
Module content:
This module traces the path of magmas from their ultimate source in the mantle, storage and evolution in the crust, through eruption at the surface where they interact with the landscape and atmosphere. Volcanic eruptions and the transfer of mass and volatiles from the deep interior of the planet. Transformation of the landscape by violent eruptions, and impact on the atmosphere on short timescales. An integrated history of magmatism and its central role in the production of the crust and the degassing history of the planet. The fluid dynamics of volcanoes, from viscous magma flows to turbulent, multiphase eruptions.

GLY 703 Geophysics and basin analysis 703
Academic organisation: Geology
Contact time: 5 lpw 5 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
Physical properties of rocks and minerals: porosity and permeability; density; magnetic properties; natural radioactivity; elastic properties; seismic wave attenuation; thermal properties; electrical properties. Basic principles and applications of various geophysical techniques: gravity, magnetic, resistivity, electromagnetic, seismic and radiometric techniques. Principles of basin analysis; controls on sea level change; subsurface analytical methods; basin mapping methods; subsidence analysis (decompaction and sediment loading, subsidence curves); sequence stratigraphy; sedimentation systems in different basin types; Precambrian basins.

GLY 704 Crustal evolution 704
Academic organisation: Geology
Contact time: 2 ppw 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 12
Module content:
Precambrian crustal evolution. Precambrian plate tectonics. Precambrian evolution of the African plate (Eburnean, Kibaran and Pan-African events). Phanerozoic evolution to the

African plate; global examples of tectonics as a continental crustal source. Determination of deformational history of crustal rocks; determination of palaeostress conditions in ancient crustal rocks. Practical experience of structural analysis and determination of deformational history.

GLY 706 Ore deposits and mining methods 706
Academic organisation: Geology
Contact time: 2 ppw 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
Systematic review of major metallic and non-metallic ore types and examples in South Africa and world-wide; ore type models (geometry, size, geodynamic setting, grade, chemistry/mineralogy). Controlling legislation and infrastructural requirements for mining. Mining methods: open cast and underground. Metallurgical treatment, metallurgical plants and waste disposal. Pollution, acid drainage and acid rain.

GLY 707 Mapping camp 707
Academic organisation: Geology
Contact time: 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 9
Module content:
Mapping and analysis of a geologically complex area using different techniques.

GLY 710 Honours project 710
Academic organisation: Geology
Contact time: 5 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Independent acquisition of geological field and/or laboratory data, treatment and interpretation thereof, and writing of an honours essay.

GLY 711 Igneous petrology and geochemistry 711
Academic organisation: Geology
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 12
Module content:
Interpretation and application of advanced petrogenetic tools: the Rb/Sr and Sm/Ndisotopic systems, quantitative interpretation of binary and ternary phase diagrams, assimilation-fractional crystallisation – partial melting. Abundance of elements in the crust, crust-forming models. Hydrous geochemistry. Recognition of geochemical anomalies. Analytical methods and the treatment of geochemical data.

GLY 712 Metamorphic petrology and geochemistry 712
Academic organisation: Geology
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 12

Module content:
Geothermometers and geobarometers, PT-t loops. Studies of major African and other mobile belts: Limpopo, Natal-Namaqua, Pan-African and Hoggar.

GLY 713 Economic geology 713
Academic organisation: Geology
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
Basic remote sensing methods and their applications to geology; basic geophysical and geochemical exploration techniques; exploration target generation – philosophies and methods; professional geological practice; the SAMREC and similar codes; geologists in the business environment; case studies. Practical component (runs parallel to theory above) encompasses ore-microscopy: ore mineral identification; ore textures; analysis of ore assemblages; instrumental techniques applied to ores.

GMA 705 Advanced remote sensing 705
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GMA 320 or equivalent
Contact time: 28 contact hours per semester
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
The aim of the module is to provide knowledge and understanding of image analysis and information extraction methods in remote sensing. The emphasis is on equipping students with knowledge and skills necessary to process imagery to extract diverse biophysical and geospatial information.
The module gives insight into the possibilities and limitations of the application of modern remote sensing/image acquisition systems for Earth and atmosphere research purposes at different levels of detail.

GTK 702 Seminar course 702
Academic organisation: Genetics
Contact time: 1 dpw 1 spw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Students are guided to collect relevant literature from disparate papers and to condense and collate this into a written seminar. Seminars are presented, along with formal article talks. Themes and articles covered in the course form part of the written examination upon completion of the module.

GTK 703 Research project 703
Academic organisation: Genetics
Period of presentation: Year
Language of tuition: English **Credits:** 60
Module content:
A mini-dissertation with well-defined limits is undertaken under the guidance of a supervisor. The students are allowed to choose from a number of projects from the different research programmes in the department. The module also has a strong theoretical component since emphasis is placed on writing and presenting a

comprehensive literature review and project proposal. Additional technical and analytical training is provided. The project is concluded with a final report, presented in the format of a short manuscript, as well as a poster and an oral presentation.

GTK 704 Trends in genetics 704
Academic organisation: Genetics
Contact time: 4 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Discussions and essays focusing on a selection of advanced topics, as well as recent advances in the field of genetics, with an emphasis on contextualising these developments within the broader framework of the Biosciences and its role in modern society. Ethical and philosophical issues in genetics are debated.

GTK 705 Research methods 705
Academic organisation: Genetics
Contact time: 5 lpw 5 ppw 10 dpw 5 web-based ppw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Students are guided through the methodology of research planning and data handling. They are offered hands-on experience in a range of advanced techniques employed in molecular research and analysis. Scientific writing and presentation skills, required for research in genetics, are also addressed.

GTX 713 Site investigation project 713
Academic organisation: Geology
Prerequisite: GLY 363/GLY 364 or TDH
Contact time: 1 lpw, 13 practicals over 11 weeks
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Field work which includes mapping, soil and rock description, joint surveys, borehole testing, water sampling, interpretation of laboratory test results and compilation of site investigation reports. Larger projects of at least two months of fieldwork and report writing which involves surface and underground studies, mapping, drill core logging, discontinuity surveys, rock mass classification, stability analyses, interpretation of laboratory tests or pollution studies including water and/or soil sampling, interpretation of laboratory tests, development of a rehabilitation plan or groundwater model and compilation of a report. Compulsory attendance at conferences, short courses, specialist lectures, visits to construction sites and field excursions.

GTX 714 Engineering geology of South Africa 714
Academic organisation: Geology
Prerequisite: SGM 311 or TDH
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Overview of site investigation phases; site investigation techniques; soil profiling and rock core description. Literature study and compilation of reports on the stratigraphy of South

African rock types and engineering problems of rocks and soils within different stratigraphic units and climatic regions.

GTX 715 Environmental geochemistry 715
Academic organisation: Geology
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Principles of low temperature geochemistry; geochemistry and origin of acid mine water; acid-mineral reactions; industrial effluents, remediation methods, waste disposal, environmental sampling and data analysis; geochemical modelling.

GTX 716 Environmental management and risk assessment 716
Academic organisation: Geology
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Principles of integrated environmental management; environmental impact assessment; environmental management systems (ISO 14000 series); water resource management; environmental legislation; site investigation guidelines; natural hazard risk assessment; seismicity; project management and professional business practice. Geological models and software.

GTX 718 Hydrogeological modelling 718
Academic organisation: Geology
Prerequisites: GTX 725
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Finite-difference methods; numerical solution of the flow and transport equations; spatial and temporal discretisation, stability criteria; development of conceptual models; introduction to PMWIN/Modflow.

GTX 719 Contaminant transport 719
Academic organisation: Geology
Prerequisite: GTX 715 or TDH
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Theory of contaminant transport in porous and fractured aquifiers, determination of transport parameters, boundary conditions, analytical solutions of 1-, 2- and 3-dimensional transport equations for porous aquifiers, analytical solutions for fractured aquifiers.

GTX 721 Construction materials 719
Academic organisation: Geology
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15

Module content:
Requirements for and use of concrete aggregates, road and dam construction materials; site investigation and site development methods; quality control.

GTX 722 Rock engineering 722
Academic organisation: Geology
Prerequisites: GLY 364 or TDH
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Mapping, description (core logging and discontinuity surveys) and classification of rock masses; engineering properties of rock masses including deformability, shear strength of discontinuities, in situ strength and permeability of rock masses; effects, theoretical derivation and practical measurements of in situ stresses.

GTX 723 Engineering applications 723
Academic organisation: Geology
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The influence of geology on construction projects with specific reference to the requirements of dams, tunnels, slopes, waste disposal and urban development.

GTX 725 Fluid mechanics in geological media 725
Academic organisation: Geology
Prerequisites: GLY 363 and GLY 265
Contact time: 2 lpw, 2 ppw (for 3 weeks)
Period of presentation: 3 weeks during the course of the year
Language of tuition: English **Credits:** 15
Module content:
Statics and dynamics of fluids including water, aqueous phase liquids (saline water), non-aqueous phase liquids (petroleum hydrocarbons), gases (atmospheric air) and man-made fluids (grout) through natural and man-made porous media (eg soil, rock, concrete). Single phase flow and multiphase flow; saturated and unsaturated flow. Quantification of hydrological parameters. South African hydrostratigraphy. Drainage and dewatering.

GTX 726 Rock and soil improvement 726
Academic organisation: Geology
Prerequisites: GLY 264 or TDH
Contact time: 2 lpw, 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Grouting materials and procedures; rock and soil anchors; rock and soil compaction; drainage methods.

HSC 780 Fruit tree crops 780
Academic organisation: Plant Production and Soil Science
Contact time: 4 lpw, 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30

Module content:
An overview of the South African fruit industry indicating economic importance and the areas of production of the various crops. Principles governing orchard establishment and orchard management, including location and site selection, crop and cultivar choices, site preparation, orchard layout and design, irrigation, fertilisation, pruning and training, the application of plant growth regulators and disease and pest management. Harvesting practices and the post-harvest physiology of fruit which determines storage protocols and the quality of fruit reaching the consumer. Climatic requirements, phonological models, cultivars and rootstocks, fruit manipulation, physiological disorders and pest and disease complexes of subtropical and deciduous fruit crops produced in South Africa.

IAS 712 Liabilities 712
Academic organisation: Insurance and Actuarial Science
Prerequisite: IAS 361
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Professionalism. Stakeholders and providers of benefits. Risks and uncertainties. Risk management and monitoring. Marketing. Life insurance products. General insurance products. Reinsurance. Regulation, regulatory regimes and the external environment. Capital management. Introduction to contract design. Valuation of benefits and the discount rate. Input validation. Valuation assumption setting. Provisioning. Product design: costing, pricing and funding. The relationship between assets and liabilities. Development of expected values. Reporting of actual results. Maintaining profitability. Asset management. Surplus management. Mergers, acquisitions, insolvency and closure. Options and guarantees.

IAS 722 Actuarial communication 722
Academic organisation: Insurance and Actuarial Science
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Communicating technical actuarial concepts effectively, the drafting process of a document, planning and structure of a document or presentation, style and tone of a document or presentation. Drafting documents (letters, reports, discussion documents, memos, emails). Presentations (preparation and delivery, follow up, designing visual aids).

IEK 780 International economics 780
Academic organisation: Economics
Prerequisite: MIE 780 and MEK 780 and WEK 780
Contact time: 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
The module aims to utilise students' prior microeconomic, macroeconomic and international economics knowledge, to study and analyse the international trade and international finance environment, in a systematic and scientific manner. The module is designed to go beyond traditional theory, and includes recent empirical findings and real-life applications. In respect of its practical application, students will be required to apply

the theory in analysing the manner in which such policies and practices are being applied in South Africa and the Southern African Customs Union (SACU). In such analysis students will learn more about the South African and SACU authorities that deals with customs, excise, and international trade matters.

KTV 700 Short-term insurance 700
Academic organisation: Insurance and Actuarial Science
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
Insurance companies, the actuarial control cycle, general insurance products, general insurance markets. The following aspects of the operation of a general insurance company: Actuarial investigations, outstanding claims reserves, reserves for IBNR and unexpired risks, reserving bases, premium rating, rating bases. Reinsurance products and applications, modelling for financial planning, investment, asset-liability modelling, accounting principles, interpreting accounts, claims analysis, other analyses.

LEK 713 Agricultural marketing 713
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Agricultural marketing. The nature, development and conceptualisation of marketing and marketing study; the marketing environment, nationally and internationally; the functional and institutional approaches to marketing study; price discovery and margins; dynamics of agricultural and food marketing channels; competition and concentration on horizontal and vertical level; conflict and power relationships in agricultural marketing; economics of food consumption, consumer behaviour and consumer action; food market segmentation; food quality and branding, price, product, promotional and distributional policy; marketing analysis and planning. Global food marketing issues, contracting and changing global food retail patterns.

LEK 720 Agribusiness management 720
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 3 lpw
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15

Module content:
Strategic management in agriculture. Dynamics of agricultural management. Entre-preneurship. Environmental scanning. Productivity measurement and improvement thereof by the organisation of manpower, capital and financial sources. Business growth. Formulation and implementation of competitive strategy. Corporate governance, strategic analysis and strategic choice, strategy implementation, balanced scorecard.

LEK 722 Agricultural finance and risk management 722
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15

Module content:
Agricultural finance. Economic theory underlying agricultural finance and agricultural finance institutions. Supply and demand of agricultural financial services. Servicing the farm and the agricultural business firm. Agricultural finance within the broader financial market in South and Southern Africa. Risk assessment and management. Risk in agricultural finance and mitigation strategies.

LEK 783 Agricultural economics 783
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 dpw 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
Research methodology and thesis design. Research in perspective. The research process. Formulating research problems, hypotheses and objectives. Developing a conceptual framework. Review of literature. Methods and procedures. Data collection, processing and analysis. Developing a good research proposal. Writing and presenting a good research report.

LEK 785 Agricultural project planning and appraisal 785
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
a) Project planning and priority setting (project concept to rural socioeconomic development, logical framework analysis, research priority setting methods, strategic planning, scenario planning).
b) Economic analysis of agricultural development projects through CBA (decision making in public and private sectors, financial, social and economic considerations; identification of Cs and Bs, valuation of Cs and Bs; project assessment criteria).
c) Monitoring, evaluation and impact assessment (process and program monitoring, M&E systems; causality, incrementality and the attribution problem; impacts assessment methodology).
d) Project management (scheduling, techniques for management, managing risk and uncertainty, monitoring performance).
e) Welfare economics and political economy considerations (Pareto optimality, compensation tests, efficiency and distribution, politics of CBA, development projects vs development policies, first vs second best shadow prices, market failure).

LEW 700 Life assurance 700
Academic organisation: Insurance and Actuarial Science
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
The following aspects of the operation of a life insurance company are covered: General business environment; products offered; asset shares for life insurance contracts; with-profits surplus distribution; actuarial funding; models; setting of assumptions; aspects of products design; alterations to contracts; development and maintenance; investment; risk management procedures including reinsurance and underwriting; cost of guarantees; policy data checks; capital management and the actuarial control cycle. Modelling and

monitoring policy cashflows for purposes of pricing, profit analysis, statutory valuation reserves and ongoing solvency.

LKM 750 Environmental biophysics 750
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Environmental variables. Quantitative description and measurements of atmospheric environmental variables and water in organisms. Mass and energy fluxes. Quantitative description of energy fluxes in organisms' environments. Energy balances of animals and plant communities will be derived.

LMO 710 Linear models 710
Academic organisation: Statistics
Prerequisite: WST 311, WST 312, WST 321 and WST 322
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Projection matrices and sums of squares of linear sets. Estimation and the Gauss-Markov theorem. Generalised t- and F- tests.

LMO 720 Linear models 720
Academic organisation: Statistics
Prerequisite: LMO 710
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
The singular normal distribution. Distributions of quadratic forms. The general linear model. Multiple comparison. Analysis of covariance. Generalised linear models. Analysis of categorical data.

MCE 730 Mathematics education 730
Academic organisation: Science, Mathematics and Technology Education
Period of presentation: Semester 2
Language of tuition: Double medium **Credits:** 16
Module content:
Perspectives in the teaching and learning of mathematics. This module will focus on contemporary issues in mathematics education such as: Types of mathematical knowledge in teacher education; learning theories in mathematics education; use of technology in the teaching of mathematics; classroom research; gender; language; culture (Ethno mathematics). Mathematics in context: prospects and challenges. This module also focuses on the role of mathematics in different contexts (including real life contexts): Nature of mathematics – mathematics as a human activity; rationale for learning mathematics; the theory of realistic mathematics education; content-driven and context-driven approach in mathematics; mathematical literacy; knowledge ‘transfer’: some challenges – school mathematics vs real world.

MCP 751 Research methods 751
Academic organisation: Microbiology and Plant Pathology
Contact time: 7 lpw 5ppw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
The module provides students with planning, data handling, writing and presentation skills required for microbiological research. In addition, students are provided with hands-on experience in the advanced techniques utilised in research and analysis. Ethical and philosophical issues in the broader field of microbiology and plant pathology are also addressed.

MCP 752 Seminar course 752
Academic organisation: Microbiology and Plant Pathology
Contact time: 3 dpw 2 spw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Students are guided to collect relevant literature from disparate papers in the broader field of Microbiology and Plant Pathology and to condense and collate this into a written seminar, which is also presented verbally.

MCP 753 Trends in microbiology 753
Academic organisation: Microbiology and Plant Pathology
Contact time: 3 dpw 2 spw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Discussions and essays focusing on recent advances in the broader field of microbiology and plant pathology, as well as contextualising these developments within the broader framework of the biosciences and its role in modern society.

MCP 754 Research project and literature study 754
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: English **Credits:** 60
Module content:
The module includes both practical and theoretical components. In addition to an individual research project with well-defined limits that is undertaken under the guidance of a lecturer, the module also acquaint the student with the theoretical aspects relevant to a specific research topic.
The research project is thus preceded by the presentation of an in-depth review of the relevant literature, and the project is concluded with a progress report, presented in the format of a short publication and an oral presentation

MEK 780 Macroeconomics 780
Academic organisation: Economics
Prerequisite: Admission into relevant programme
Contact time: 1 spw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15

Module content:
This module will cover the core theoretical concepts of macroeconomics focussing specifically on labour and goods markets as well as intertemporal issues, such as capital markets. Topics will include economic growth, exogenous and endogenous, business cycles, monetary economics, stabilisation policies and structural policies.

MFK 700 Medical physics 700
Academic organisation: Physics
Period of presentation: Year
Language of tuition: Afrikaans **Credits:** 20

MIE 780 Microeconomics 780
Academic organisation: Economics
Prerequisite: Admission into relevant programme
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
The core concepts of microeconomic theory will be the focus of the module, including: demand and supply, consumer theory, firm theory, markets and market structure, general equilibrium, information economics and behavioural economics. Applications of this theory will feature prominently.

MLB 721 Molecular and cellular biology 721
Academic organisation: Microbiology and Plant Pathology
Contact time: 2 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Principles and applications of recombinant DNA, and other novel molecular and genomics technologies, to address questions in the biological sciences and/or biotechnology. Strong emphasis is placed on the principles of research planning, including identifying suitable research objectives, formulating a research strategy and understanding the relevance and feasibility of research.
The module is assessed by means of a research project proposal, conceived and formulated by each student. The proposal must focus on the use of molecular technologies in addressing realistic questions in biology and/or biotechnology. There is also an oral defense of the project proposal.
This module is jointly presented in the departments of Biochemistry, Genetics and Microbiology and Plant Pathology.

MVA 710 Multivariate analysis 710
Academic organisation: Statistics
Prerequisite: WST 311, WST 312, WST 321and WST 322
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Matrix algebra. Some multivariate measures. Visualising multivariate data. Multivariate distributions. Samples from multivariate normal populations. The Wishart distribution. Hotelling's T^2 statistic. Inferences about mean vectors.

MVA 720 Multivariate analysis 720
Academic organisation: Statistics
Prerequisite: MVA 710
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
The matrix normal distribution, correlation structures and inference of covariance matrices. Discriminant analysis. Principal component analysis. The biplot. Multi-dimentional scaling. Exploratory factor analysis. Confirmatory Factor analysis and structural equation models.

NLB 780 Wildlife ecology 780
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Research in wildlife management focuses on gaining a better understanding of patterns of animal distribution, abundance, and diversity, and implementation of scientifically sound strategies for sustainable management and conservation of wildlife populations. This module will develop an in-depth understanding of core wildlife management concepts with a focus on population characteristics, the density concept, mortality, natality, life tables, population growth, harvesting quotas, population regulation, population structure, dispersal, dispersion, aggregation, isolation and territoriality, competition and predator-prey relationships. This module will also explore new ideas, and advanced research methods to evaluate ecological data in the context of wildlife ecology.

NLB 781 Wildlife management principles and techniques 781
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 5
Module content:
The most important techniques applicable to wildlife management and wildlife research are discussed. The principles, applications and restrictions of the following are discussed amongst others: wildlife counts, age determination, age and sex ratios, translocation of animals, chemical immobilisation, mechanical capture techniques, transport of wildlife, land-use, predator control and predator-prey studies.

NLB 782 Wildlife nutrition 782
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
The digestive functioning of selected wild ruminant and non-ruminant herbivores is discussed as well as their nutrient requirements and deficiencies that commonly occur. The spatial scaling of nutrients in vegetation is explained, followed by which foraging strategies large African herbivores of varying body sizes use to adapt to spatial and temporal nutrient heterogeneity, including optimal foraging theory.

NLB 783 Parasites, diseases and the capture of wildlife animals 783
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Parasites, diseases and capture of wild animals. An overview of veterinary aspects with reference to important parasites and diseases of wild animals. The capture of wildlife and the stress-related consequences of the capture of wild animals. The module content includes a discussion of all the different chemicals used to immobilise wild animals, darting, and handling of wild animals under sedation. The internal and external parasites, most important contagious wildlife diseases and the prevention of capture related diseases are discussed.

NLB 785 Scientific communication 785
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw 2 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 10
Module content:
This module focuses on elements of science communication, developing practical elements of scientific communication, writing and public presentations.

NLB 795 Research project 795
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: English **Credits:** 50
Module content:
A research protocol, field work and project report based on an ecological or wildlife management topic.

NMQ 725 Introduction to quantitative research 725
Academic organisation: Educational Psychology
Contact time: 1 dpw 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Statistical techniques in the educational research process; Basic concepts and principles; Survey methodology and questionnaire design; Classification and graphical representation of data; Descriptive measures; Statistical inference; Data-processing procedures; Parametric versus non-parametric tests; Some test statistics(eg F-Test and T-test).

NPN 780 Research project 780
Academic organisation: Insurance and Actuarial Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 30
Module content:
The research project is compulsory. A detailed project proposal should be submitted to the head of department by a prescribed date for approval, as described in the depart-mental document in this regard.

PAN 780 Production analysis 780
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: Double medium **Credits:** 20
Module content:
The module comprises of three distinctive sections. The first section focus on determinants that causes shifts in agricultural supply an demand, elasticties of supply an demand and impact multipliers. After a theoretical overview of supply, demand and its related issues, the student is required to apply the discussed principles empirically. The second section is on price determination under different market forms. Additional aspects covered in this section are price indexing and the effect if different macro economic factors on agricultural prices. The third section gives an overview of the modern food and agribusiness system. Marketing, investment and operational management concepts, specifically pertaining to an agribusiness, are discussed here.

PFS 700 Production physiology 700
Academic organisation: Animal and Wildlife Sciences
Contact time: 3 lpw
Period of presentation: Year
Language of tuition: Double medium **Credits:** 22
Module content:
Specialised study of physiological and anatomical factors that influence growth, development, production and product quality. Stress and intensification effects on product quality. Animal science pharmacology. (Theoretical components include VKF 411 and VSX 420.)

PGW 701 Research project in crop science 701
Academic organisation: Plant Production and Soil Science
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Students will design, execute and write up a research project in any one of the subdisciplines of Crop Science, eg Agronomy, Horticultural Science or Pasture Science.

PGW 702 Scientific communication 702
Academic organisation: Plant Production and Soil Science
Contact time: 3 spw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Principles of the scientific process. Literature accessing and article assessment. Manuscript preparation and presentation of seminars. Use of visual aids.

PGW 704 Research methodology 704
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Basic experimental designs. Measurements and control over experimental error. Factorial experiments and interactions. Analysis of variance (ANOVA) and data interpretation.

PHY 701 Mathematical methods 701
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
The purpose of this module is two-fold: (1) To refresh and systematize your knowledge of mathematics (sequences, series, vector calculus, functions of many variables etc); (2) To give you working knowledge of mathematical methods that were not (or not sufficiently) covered in the underground modules, such as Fourier series and transforms; Ordinary and partial differential equations; Abstract vector spaces; Operators and their eigenvectors; Complex analysis; Calculus of variations; Integral equations; Group theory; Probability and statistics; Numerical methods.

PHY 702 Classical mechanics 702
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Lagrangian dynamics: Lagrange's equations, d'Alembert's principle, energy, applications, the tangent bundle, action, symmetry, conservation, Noether's Theorem, linear oscillations, normal modes.
Hamiltonian dynamics: Hamilton's equations, symplectic notation, phase space, Liouville's Theorem, Poisson brackets, canonical transformations, generating functions, the Hamilton-Jacobi equation. Elementary Lagrangian field theory.

PHY 703 Quantum mechanics 703
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Origins of quantum mechanics; mathematical tools; postulates and quantization; conservation laws; one-dimensional problems; linear harmonic oscillator; three-dimensional problems; angular momentum; hydrogen atom; addition of angular momenta; spin; approximate methods (WKB, variational approach, time-independent perturbations); time-dependent perturbations; scattering; partial wave scattering; identical particles; Hartree-Fock approach; many-body problems and quantum statistics; second quantisation; relativistic equations.

PHY 704 Statistical physics 704
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Thermodynamic behaviour of an ideal Bose gas: Bose-Einstein functions, the virial expansion, the Riemann zeta-function, Bose-Einstein condensation. Phonons: the field of sound waves, inertial density of the sound field, elementary excitations in liquid helium II. Ideal Fermi systems: thermodynamic behaviour of an ideal Fermi gas, Fermi-Dirac functions and their relation to Bose-Einstein functions, the virial expansion, the Fermi

energy, asymptotic expansions at low temperature, magnetic behaviour of an ideal Fermi gas (Pauli paramagnetism, Landau diamagnetism). Quantised fields: free bosonic quantum fields, interacting quantum fields, interacting Hamiltonian, interactions in terms of creation and annihilation operators, imperfect Bose gasses at low temperature, fermionic quantum fields, interacting theory, the ground state of an imperfect Fermi gas. Phase transition in the Ising model: mean field theory, critical exponents.

PHY 705 Electrodynamics 705
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Conservation laws in electrodynamics; electromagnetic waves in vacuum, dielectrics, conductors and wave guides; potentials and fields, guage transformations, Liénard-Wiechert potentials; electric and magnetic dipole radiation, radiation by a point charge; relativistic electrodynamics.

PHY 706 Project and seminar 706
Academic organisation: Physics
Period of presentation: Year
Language of tuition: English **Credits:** 25
Module content:
A theoretical or an experimental project can be selected. The project must be approved by the head of department. The project must be summarised in the form of a written report and presented at an open seminar.

PHY 708 Many body physics 708
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Second quantisation. Coherent states. Single particle behaviour. Hartree-Fock – perturbation – linearisation of operators. Quasi-particles, effective mass and applications: atom physics, electron gas, one-dimensional delta function. Collective behaviour. Tamm-Dancoff approximation: linearisation. Time dependent Hartree-Fock. Random phase approximation.
Applications: giant dipole resonance, screening in an electron gas, correlation energy in an electron gas, plasma oscillations, zero sound. Canonical transformation – Cooper pairs, BSC theory. Thomas-Fermi theory. Density functional theory. Superconduction. Ginzberg-Landau theory. Zero field finite temperature BCS.

PHY 710 Numerical physics 710
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Numerical nature of physical problems such as atomic structure, electric fields, harmonic oscillators (classic and quantum mechanics), heat conduction, hydrodynamics, Ising model, molecular vibrations, order and chaos, potential scattering, Schrödinger equation, wave equation.

PHY 711 Solid state physics 711
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Electronic band structure, vibration properties of solids, electronic properties of defects, electric transport, optical properties, quantum confinement.

PHY 712 Quantum optics 712
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Coherent states of free and forced oscillators. Semi-classical electrodynamics (including time dependent perturbations and stimulated transitions). Mode composition of the electromagnetic field. Properties of laser light. Resonators and modes. Laser types (ruby, Nd-YAG, Carbondioxide, He-Ne, excimer and GaAs).

PHY 713 Electronic materials 713
Academic organisation: Physics
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Structure, electrical and optical properties of semiconductors; semiconductor metal contacts; Ohmic and Schottky contacts; influence of impurities and defects on properties of the contacts; quantum well semiconductor structures.

PHY 714 Analytical physics 714
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Review of surface analytical techniques, surface structure determinations, surface topography techniques, theory of contrast in electron microscopy; electron microscopic surface and interface techniques; scanning tunnelling microscopy; electrical and electro-optical characterisation of semiconductors; determination of defects and impurities in semiconductors; propagation of laser rays; photoluminescence.

PHY 715 Nuclear solid state physics 715
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Mössbauer effect; positron annihilation; perturbed angular correlations; neutron scattering; RBS; channeling; nuclear reaction analyses.

PHY 716 Group theory 716
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Introduction to group theory needed in physics. Thirty-two crystallografic point groups; selected groups; full rotation groups; applications such as classification of spectral terms; selection rules; Clebs-Gordon coefficients.

PHY 717 Quantum field theory 717
Academic organisation: Physics
Prerequisites: Admission only by permission of the Head of Department of Physics
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Special relativity. Representation of transformations in quantum physics. Canonical quantisation of free scalar fields. Interactions, scattering and the reduction formula. Path integrals in quantum mechanics; the harmonic oscillator. Free fields. Interacting fields, perturbation theory and Feynman diagrams. Scattering amplitudes and the Feynman rules. Renormalisation: Dimensional analysis, the exact propagator, the exact three point vertex, higher order corrections and perturbation theory to all orders. Symmetry: Continuous symmetries and conserved currents, discrete symmetries. The renormalisation group: Infrared divergences, different renormalisation schemes and asymptotic freeness, the renormalisation group. Spontaneous symmetry breaking: A discrete example, a continous example, the Goldstone boson.

PHY 718 Experimental physics 718
Academic organisation: Physics
Contact time: 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Guided experiments designed to expose students to modern experimental techniques, leading to a report written in the format of a research article.

PHY 719 Nuclear physics 719
Academic organisation: Physics
Prerequisites: Admission only with permission of Head of Department, Physics
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Quarks, nucleons, isobaric invariance, NN-interaction, two-nucleon system, deuteron, elements of scattering theory, NN-scattering, few-body nuclear systems, general properties of medium and heavy nuclei, nuclear models, radioactivity, nuclear reactions, α-, β-, and γ-decays, nuclear fission, nuclear fusion, nuclear astrophysics.

PHY 720 Radio astrophysics 720
Academic organisation: Physics
Prerequisites: Completion of core components of the BScHons

Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits**: 10
Module content:
Goals an techniques of modern radio astronomy, studies of galaxies and interstellar medium, radiation mechanisms, neutral hydrogen, astro-chemistry, masers, supernovae, pulsars and transient phenomena, high red-shift universe, qasars. Radio receivers and techniques.

PHY 781 Foundations of physics 781
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Conceptual basis of physics: The nature of Laws of Physics, basic concepts and misconceptions. Nature of physics, its history, nature of evidence, paradigms, current views and controversies of the nature of the physics enterprise. Indigenous knowledge in the field of physics, and alternative world views, physics in society. Limits and abuses of the results of Modern Physics.

PHY 782 Current trends in physics 782
Academic organisation: Physics
Prerequisite: Completion of core components of the BScHons
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
A chosen field of physics that is linked to the research specialisations of groups within the Physics department. Approaches and trends in research advances in new topics in physics. The module follows a format of guided advanced readings, seminars and discussion sessions.

PNP 720 Parametric stochastic processes 720
Academic organisation: Statistics
Prerequisite: WST 312
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Introduction to statistical measure theory. Queueing processes: M/M/1; M/M/S; M/G/1 queues and variants; limiting distribution of the queue length and waiting times. Queuing networks. Some stochastic inventory and storage processes.

PNS 700 Pensions 700
Academic organisation: Insurance and Actuarial Science
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
Providers of pension and related benefits. Needs of beneficiaries and sponsors. State sponsored vs private sector sponsors. Presentation and reporting of benefits and contributions. Professional guidance. General and detailed benefit design, risk and

uncertainty in pension funds. Methods of financing, pension fund investment and investment matching. The actuarial control cycle in the pension fund industry. Asset valuation, asset-liability modelling. Funding methods. Valuation, valuation data, basis assumption setting and analysis of experience. Discontinuance, options and guarantees, pension fund risk benefits.

PPR 712 Plant production: Herbicides and control 712
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Weeds and their importance in Southern Africa. Properties and uses of herbicides. Herbicides in soils and their mode of action in plants.

PPR 713 Agroforestry 713
Academic organisation: Plant Production and Soil Science
Contact time: 1 ppw 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Agro-ecological zones (climate and soil); trees for fruit, fodder, fuel and/or timber; inter-cropping or alley cropping with grains, vegetables or pastures; management (including aspects such as nursery production, establishment, fertilisation, pest control) and utilisation/marketing.

RAL 780 Regression analysis 780
Academic organisation: Statistics
Prerequisite: STK 310 and STK 320
Contact time: 1 lpw 1 web-based period per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Simple and multiple regression models. Residual analysis. Diagnostics for leverage, influence and multicolinearity. Indicator variables. Regression approach to analysis of variance. Weighted least squares. Nonlinear regression. Ridge regression. Logistic regression. Theory is combined with practical work. Specific attention is given to matrix algebra.

SFT 720 Sampling techniques 720
Academic organisation: Statistics
Prerequisite: BScHons: WST 311, WST 312, WST 321, WST 322;
BComHons: STK 310, 320
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Simple random sampling. Estimation of proportions and sample sizes. Stratified random sampling. Ratio and regression estimators. Systematic and cluster sampling. Complex survey methodology. Handling of nonresponse.

SIZ 711 Insect diversity: Economic and ecological implications 711
Academic organisation: Zoology and Entomology
Contact time: 2 dpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Insect classification and the structuring of diversity; economically and ecologically important insect taxa: apterygote and exopterygote insects – silverfish, mayflies, dragonflies, cockroaches, mantids, termites, earwigs, locusts, stick insects, lice, bugs and thrips; endopterygote insects – lacewings, beetles, flies, fleas, butterflies moths, bees, wasps and ants.

SIZ 724 Integrated pest management 724
Academic organisation: Zoology and Entomology
Contact time: 2 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
The origin of insect pests; their host crops; threshold values; pest status; insect pest management; biological, cultural and chemical control of insects; insect herbivores as weed biocontrol agents; insects as vectors in human and animal disease; non-vector problem insects; control methods in veterinary entomology; conservation, agriculture and human health; beneficial insects; beekeeping; silk production; insects as human and animal food; insects and ecosystems; chemicals and the environment; insects and ecotourism.

SPC 780 Statistical process control 780
Academic organisation: Statistics
Prerequisite: BScHons: WST 311, WST 312, WST 321, WST 322;
BComHons in Statistics: STK 310, 320
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Quality control and improvement. Shewhart, cumulative sum (CUSUM) and exponentially weighted moving average (EWMA) and Q control charts. Univariate and multivariate control charts. Determining process and measurement systems capability. Parametric and nonparametric (distribution-free) control charts. Constructing control charts using Microsoft Excel and/or SAS. Obtaining run-length characteristics via simulations, the integral equation approach, other approximate methods and the Markov-chain approach.

TLR 700 Animal breeding and genetics 700
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 ppw 2 lpw
Period of presentation: Year
Language of tuition: Double medium **Credits:** 24
Module content:
Qualitative characteristics. Calculation of population criteria and the interpretation in the industry. Specific problems with relation to the selection and breeding of cattle, small stock, pigs and poultry. The application of genetic theory in practice with relation to hereditability of quantitative characteristics. (Theoretical components include TLR 410 and TLR 420.)

TRA 720 Analysis of time series 720
Academic organisation: Statistics
Prerequisite: STK 310 and STK 320
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
In this module certain basic topics relating to discrete, equally spaced stationary and non-stationary time series are introduced as well as the identification, estimation and testing of time series models and forecasting. Theoretical results are compared to corresponding results obtained from computer simulated time series.

VDS 713 Recipe development and standardisation 713
Academic organisation: Consumer Science
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 30
Module content:
Recipe development process. Development of appropriate recipes and food products for a given situation. Standardisation of recipes. Food styling and food photography.

VDS 723 Food consumerism and product advice 723
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Factors influencing food consumption, consumer behaviour and food choice. Food product advice. Consumer advice, marketing of food products, consumer education.

VGE 703 Animal nutrition 703
Academic organisation: Animal and Wildlife Sciences
Contact time: 5 lpw 1 dpw 1 ppw
Period of presentation: Year
Language of tuition: Double medium **Credits:** 50
Module content:
Advanced study with specialisation in the neutrino of monogastric species for example poultry, dogs and pigs. Advanced study of foregut and hindgut digestive processes and flow dynamics. Manipulation of digestion, end-product metabolism, ad libitum and controlled feed intake. Energy, protein, mineral and vitamin requirements and standards for beef and diary cattle, small stock and horses. Appropriate ration formulation. The study embodies lectures, seminars, practical assignments and a research project with the results reported in a research paper. (Theoretical components include VGE 411, VGE 421 and VGE 423.)

VKU 700 Animal science 700
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Double medium **Credits:** 70
Module content:
The study of animal-environment and genotype-environment interactions and the impact on natural resources. Adaptational mechanisms of breeds and species. The formulation

of optimal farming systems with respect to adaption. The determination of biological outputs and the classification of animal breeds and species in terms of biological traits. A study of specific topics by way of literature, seminars, discussions and research assignments. Each student does a research project and compiles a research paper. Research and study assignments are executed taking the academic needs of the candidates into consideration. (Theoretical components GVK 420, KVK 420, PVK 420, VKD 410, VKU 411, VKU 412 and WKE 420.)

VMT 710 Distribution-free methods 710
Academic organisation: Statistics
Prerequisite: WST 311, WST 312, WST 321 and WST 322
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
A selection of: Nonparametric stochastic processes. Power and asymptotic power of distribution-free procedures. Theory and simulation. Asymptotic relative efficiency. Linear rank tests: Definition, properties and applications. Equal in distribution technique. Counting and ranking statistics. Introduction to one and two sample U-statistics. Permutation and distribution-free rank-like statistics. Multi-sample distribution-free tests, rank correlation and regression. Some nonparametric bootstrap and smoothing methods.

VVW 720 Advanced nutrition and food sciences 720
Academic organisation: Food Science
Contact time: 12 discussion classes
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Discussion classes in advanced level nutrition and food sciences. Problem solving and literature discussion.

VVW 763 Research project 763
Academic organisation: Food Science
Contact time: 1 lpw 3 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
A short research project on an approved topic in Nutrition and Food Sciences is planned, executed and presented in the form of a written report.

VVW 765 Micronutrient malnutrition 765
Academic organisation: Food Science
Contact time: 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Introduction to malnutrition in sub-Saharan Africa. Selected micronutrients (ie vitamin A, Fe, iodine, Zn): their role as micronutrients and their significance in health, deficiency disorders and prevention thereof. Conceptual framework for understanding micronutrient deficiencies. Nutritional epidemiology. Micronutrients in nutritional support of individuals with HIV/aids.

WDE 701 Range management in wildlife systems 701
Academic organisation: Plant Production and Soil Science
Contact time: 5 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Range evaluation and utilisation with the emphasis on aspects important in wildlife production, and integrated wildlife/livestock production systems.

WDE 750 Environmental resource assessment and management 750
Academic organisation: Plant Production and Soil Science
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 14
Module content:
Determining resource potential of land on the basis of botanical composition, vegetation cover, animal grazing and browsing potential, water quality, soil quality, chemical, physical and biological soil degradation, soil erosion and other important environmental processes. These are essential for integrated agricultural land use practices. Evaluation of grasses and other vegetation types in terms of environmental adaptation, acceptability and adaptability to a sustainable utilisation system and the management requirements of an integrated and adaptive management system.

WDE 781 Rangeland management 781
Academic organisation: Plant Production and Soil Science
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The development of rangeland management strategies integrating ecological and physiological principles with economic and sociological constraints to achieve desired objectives whilst ensuring the conservation, and where necessary, the recuperation of natural resources.

WDE 782 Pasture science 782
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The identification of adapted pasture and fodder species (including grasses, legumes, fodder trees and drought tolerant crops) for different agro-ecological areas. The establishment, fertilisation and irrigation requirements of different pastures. The management requirements when utilised as green grazing, standing hay or conserved feed.

WDE 783 Integrated plant and animal production 783
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 14
Module content:
The role of crop rotations and ley crops in marginal cropping conditions to ensure

sustained production. The integration of pastures and silvicultural/ horticultural crops (eg Agroforestry) to produce timber, firewood, fruits/nuts and livestock products. Provision of feed requirements for both commercial and communal livestock enterprises by combining livestock requirements and feed supply in a process of economic optimisation and emphasising the importance of records and responses in the process of implementation.

WKD 703 Seasonal climate modelling 703
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
Fundamentals of seasonal forecasting. The El Niño/Southern Oscillation. Empirical orthogonal functions. Canonical correlation analysis. Empirical forecast models practical. Sea-surface temperature models. Fully coupled and two-tiered general circulation modelling. Dynamical and empherical downscaling techniques. Significance testing using Monte Carlo techniques. Modelling pitfalls. User application forecasting. Projections of decadal and multi dacadal climate anomalies.

WKD 704 Numerical modelling: Applications 704
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Initial atmospheric state, observation network, data assimilation, initialisation, parameterisation, post-processing. Ensemble methods, probability forecasting, forecast verification. Global circulation models, limited-area and mesoscale models, variable resolution models, dispersion models. Seamless prediction. Practical applications.

WKD 706 Dynamic meteorology 706
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 16
Module content:
Atmospheric oscillations: Linear perturbation theory (shallow water gravity waves, inertia gravity waves, Rossby waves). Baroclinic instability. Two-layer model. Energetics of Baroclinic waves. Zonally averaged circulation. Angular momentum budget. Lorenz energy cycle. Programming in meteorology.

WKD 707 Radar meteorology
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
Basic principles and characteristics of the weather radar.The influence of the atmosphere on the propagation of electro-magnetic waves. Weather radar equation.The influence of attenuation on observations. The measurement of precipitation with a radar. Doppler Radar. Convective storm analysis with radar.

WKD 719 Boundary layer meteorology 719
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
Introduction to, and the importance of the boundary layer. Structure of the boundary layer. Transfer of heat (molecular and turbulent). Impacts of the turbulent nature of the boundary layer on the dynamics of atmospheric motions. Closure and boundary layer parameterisation. Applications to air pollution dispersion.

WKD 731 Overview of tropical and mid-latitude meteorology 731
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
An overview of the weather and climate of the tropics and the mid-latitudes. Air masses. Instability and cloud formation. Weather systems of the tropics and mid-latitudes. Analysis of weather systems by utilising remote sensed data.

WKD 733 Satellite meteorology
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
Overview of the basic principals of satellite imagery. Types of meteorological satellites.Basic principals of radiation.The different images available, their resolution, and the advantages and limitations of each image.
Image interpretation

WKD 734 Mesoscale meteorology
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
An introduction to mesoscale meteorology. Surface mesoscale features, instability, severe storm classification and thunderstorms, flooding and flash flooding events.

WKD 736 Selected themes
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
A module on an aspect or aspects of meteorology not covered in the existing options with special emphasis in Cloud microphysics and Basic concepts of numerical modelling.

WKD 763 Research project 763
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 35
Module content:
Introduction to the philosophy of scientific research. Hypothesis testing. Reporting of scientific research. Identification of an appropriate research project. Compilation of a research proposal. Literature survey. Acquisition and manipulation of information. Introduction to innovative strategy and research management. Preparation of a research report (or paper). Presentation of research findings.

WKD 781 Cloud dynamics 781
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 12
Module content:
Scaling and interpretation of equations of motion for mesoscale processes. The role of stability and other trigger actions on initial cloud formation and the evolution of clouds. Shallow and deep convective processes. Gravity and Lee wave effects. Tropical and mid-latitude cloud generation processes and characteristics. Cloud splitting. Cumulus convective schemes in numerical models. Parameterisation of radiation and heat in atmospheric models.

WST 795 Research report: Mathematical statistics 795
Academic organisation: Statistics
Prerequisite: WST 311, WST 312, WST 321 and WST 322
Period of presentation: Semester 1 and Semester 2
Language of tuition: English **Credits:** 30
Module content:
Refer to the document: Criteria for the research management process and the assessment of the honours essays, available on the web: www.up.ac.za under the Department of Statistics: Postgraduate study.

WTW 710 Functional analysis 710
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Real analysis on third-year level
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
An introduction to the basic mathematical objects of linear functional analysis will be presented. These include metric spaces, Hilbert spaces and Banach spaces. Subspaces, linear operators and functionals will be discussed in detail. The fundamental theorems for normed spaces: The Hahn-Banach theorem, Banach-Steinhaus theorem, open mapping theorem and closed graph theorem. Hilbert space theory: Riesz's theorem, the basics of projections and orthonormal sets.

WTW 712 Modern portfolio theory 712
Prerequisite: Enrolment for WTW 732 required
Academic organisation: Mathematics and Applied Mathematics

Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
An introduction to Markowitz portfolio theory and the capital asset pricing model. Analysis of the deficiencies in these methods. Sensitivity-based risk management. Standard methods for Value-at-Risk calculations. RiskMetrics, delta-normal methods, Monte Carlo simulations, back and stress testing.

WTW 724 Axiomatic set theory and mathematical logic 724
Academic organisation: Mathematics and Applied Mathematics
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits**: 15
Module content:
Axiomatic set theory, ordinals, transfinite induction and recursion, ordinal arithmetic, the axiom of choice, cardinal arithmetic, the continuum hypothesis. Propositional and first order logic. The completeness and compactness theorems. Decidability, Gödel's incompleteness theorems.

WTW 727 Special topics 727
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: WTW 710, WTW 731, WTW 734 and WTW 724.
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits**: 15
Module content:
A selection of special topics will be presented that reflects the expertise of researchers in the Department. The presentation of a specific topic is contingent on student numbers. See the website of the Department of Mathematics and Applied Mathematics for more details.

WTW 731 Algebra 731
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Algebra on third-year level
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
The following topics will be covered: Galois theory and solving equations by radicals, introduction to the theory of R-modules, direct sums and products, projectivity and injectivity, finitely generated modules over Euclidean domains, primary factorisation, applications to Jordan and rational canonical forms of matrices.

WTW 732 Mathematical models of financial engineering 732
Academic organisation: Mathematics and Applied Mathematics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Introduction to markets and instruments. Futures and options trading strategies, exotic options, arbitrage relationships, binomial option pricing method, mean variance hedging,

volatility and the Greeks, volatility smiles, Black-Scholes PDE and solutions, derivative disasters.

WTW 733 Numerical analysis 733
Academic organisation: Mathematics and Applied Mathematics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
An analysis as well as an implementation (including computer programs) of methods are covered. Numerical linear algebra: Direct and iterative methods for linear systems and matrix eigenvalue problems: Iterative methods for nonlinear systems of equations. Finite difference method for partial differential equations: Linear elliptic, parabolic, hyperbolic and eigenvalue problems. Introduction to nonlinear problems. Numerical stability, error estimates and convergence are dealt with.

WTW 734 Measure theory and probability 734
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Real analysis on third-year level
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Measure and integration theory: The Caratheodory extension procedure for measures defined on a ring, measurable functions, integration with respect to a measure on a σ-ring, in particular the Lebesgue integral, convergence theorems and Fubini's theorem.
Probability theory: Measure theoretic modelling, random variables, expectation values and independence, the Borel-Cantelli lemmas, the law of large numbers. L^1-theory, L^2-theory and the geometry of Hilbert space, Fourier series and the Fourier transform as an operator on L^2, applications of Fourier analysis to random walks, the central limit theorem.

WTW 735 Main principles of analysis in applications 735
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Calculus on 2nd-year level (e.g. WTW 218) and one 3rd-year level module on analysis or applications of analysis, e.g. WTW 310, WTW 382, WTW 383 or WTW 386
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Study of main principles of analysis in the context of their applications to modelling, differential equations and numerical computation. Specific principles to be considered are those related to mathematical biology, continuum mechanics and mathematical physics as presented in the modules WTW 772, WTW 787 and WTW 776, respectively.

WTW 750 Mathematical optimisation 780
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Multivariate Calculus on 2nd-year level; Linear Algebra on 2nd-year level
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Classical optimisation: Necessary and sufficient conditions for local minima. Equality

constraints and Lagrange multipliers. Inequality constraints and the Kuhn-Tucker conditions. Application of saddle point theorems to the solutions of the dual problem. One-dimensional search techniques. Gradient methods for unconstrained optimisation. Quadratically terminating search algorithms. The conjugate gradient method. Fletcher-Reeves. Second order variable metric methods: DFP and BFCS. Boundary following and penalty function methods for constrained problems. Modern multiplier methods and sequential quadratic programming methods. Practical design optimisation project.

WTW 762 Mathematical models of financial engineering 762
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 732 or WTW 364 Financial engineering
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Exotic options, arbitrage relationships, Black-Scholes PDE and solutions, hedging and the Miller-Modigliani theory, static hedging, numerical methods, interest rate derivatives, BDT model, Vasicek and Hull-White models, complete markets, stochastic differential equations, equivalent Martingale measures.

WTW 763 Finite element method 763
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 733 is strongly recommended
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
An analysis as well as an implementation (including computer programs) of methods is covered. Introduction to the theory of Sobolev spaces. Variational and weak formulation of elliptic, parabolic, hyperbolic and eigenvalue problems. Finite element approximation of problems in variational form, interpolation theory in Sobolev spaces, convergence and error estimates.

WTW 764 Stochastic calculus 764
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 734 or WTW 735
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Mathematical modelling of Random walk. Conditional expectation and Martingales. Brownian motion and other Lévy processes. Stochastic integration. Ito's Lemma. Stochastic differential equations. Application to finance.

WTW 772 Mathematical methods and models 772
Academic organisation: Mathematics and Applied Mathematics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
This module aims at using advanced undergraduate mathematics and rigorously applying mathematical methods to concrete problems in various areas of natural science and

engineering. The module will be taught by several lecturers from UP, industry and public sector. The content of the module may vary from year to year and is determined by relevant focus areas within the department. The list of areas from which topics to be covered will be selected, includes: Systems of differential equations; dynamical systems; discrete structures; Fourier analysis; methods of optimisation; numerical methods; mathematical models in biology, finance, physics, etc.

WTW 776 Partial differential equations of mathematical physics 776
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 710 or WTW 735
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Field-theoretic and material models of mathematical physics. The Friedrichs-Sobolev spaces. Energy methods and Hilbert spaces, weak solutions – existence and uniqueness. Separation of variables, Laplace transform, eigenvalue problems and eigenfunction expansions. The regularity theorems for elliptic forms (without proofs) and their applications. Weak solutions for the heat/diffusion and related equations.

WTW 787 Continuum Mechanics 787
Academic organisation: Mathematics and Applied Mathematics
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Analysis of spatial versus material description of motion. Conservation laws. Derivation of stress tensors. Analysis of finite strain and rate of deformation tensors. Stress and strain invariants. Energy. Linear and nonlinear constitutive equations. Applications to boundary value problems in elasticity and fluid mechanics.

WTW 790 Topology 790
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Real analysis on third-year level
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
General topology: Concepts such as convergence, compactness, connectedness, separation axioms and continuity are introduced in topological spaces. Their basic properties are treated. Important topologies like the product topology and the quotient topology are discussed. Algebraic topology: Homotopy, the fundamental group, covering spaces, homotopy type.

WTW 792 Project 792
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Refer to Department.

WTW 795 Project 795
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Refer to Department.

ZEN 701 Research project 701
Academic organisation: Zoology and Entomology
Period of presentation: Semester 1 and Semester 2
Language of tuition: English **Credits:** 70
Module content:
Research project

ZEN 702 Research methods 702
Academic organisation: Zoology and Entomology
Contact time: 1 ppw 4 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13
Module content:
Basic skills in philosophy of science; research planning; experimental design; data handling; mathematical techniques for biologists; scientific writing; scientific public speaking.

ZEN 703 Systematics, evolution and biogeography 703
Academic organisation: Zoology and Entomology
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13
Module content:
The object of this module is to introduce students to several contemporary problem areas in systematics, evolutionary theory and biogeography, and to use this as a basis for exploring current approaches and methods in systematics.

ZEN 704 Environmental physiology 704
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13
Module content:
Photoperiodism and chronobiology – the ability to measure daylength, the concept of circadian rhythm and the nature of the clock which drives such processes. Water availability and temperature – physiological responses of animals to changing water availability and temperature in the context of global climate change. Regulation or reproduction – physiological mechanisms which couple reproduction to external and internal environmental factors.

ZEN 705 Principles in applied ecology 705
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13

Module content:
The module focuses on forces that drive population and community patterns and processes across temporal and spatial scales. Attention is given to the scientific application of ecological and macro-ecological principles that relate to short- and long-term population and community responses to environmental change.
Group discussions based on current literature provide opportunities to apply theoretical principles to problem solving.

ZEN 707 Integrated pest management in Africa 707
Academic organisation: Zoology and Entomology
Contact time: 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13
Module content:
Pest outbreaks and the practice of integrated pest management using different control methods; philosophy of IPM; socioeconomic implications; politics and legislation; pest models; decision tools and techniques.

ZEN 710 Mammal ecology 710
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 13
Module content:
Contemporary issues in mammal ecology; the focus will be on current understanding at individual, population, community and ecosystem levels.

ZEN 712 Behavioural ecology 712
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 13
Module content:
The use of ecological and evolutionary processes to explain the occurrence and adaptive significance of behaviour patterns. Empirical, comparative analyses relating behaviour to environment will be addressed, including the use of behavioural processes to predict ecological patterns.

ZEN 713 Scientific communication 713
Academic organisation: Zoology and Entomology
Period of presentation: Semester 1 and Semester 2
Language of tuition: English **Credits:** 13
Module content:
An essay, two oral presentations, prescribed reading and an oral exam.

ZEN 782 Insect-plant interactions 782
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 13
Module content:
An overview of the complex world of insect-plant interactions. Insects and plants have co-

occurred and co-evolved on this planet for at least 400 million years, and in many systems insects are the primary consumers of plant tissue. The diverse strategies and counter-strategies that have evolved at the interface between herbivory and plant defences will be examined, using case studies and applying unifying theory wherever possible.

ZEN 783 Global climate change and biodiversity 783
Academic organisation: Zoology and Entomology
Contact time: 3 dpw 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 13
Module content:
The module aims to provide students with an understanding of global climate change and its impact on the conservation of biodiversity.

ZEN 784 Contemporary research techniques 784
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 13
Module content:
Stable isotope ecology – applications of stable isotope-based techniques in zoological research, including (i) tracking animal movements, (ii) dietary reconstruction, (iii) delineation of trophic levels, (iv) tracing nutrient allocation to reproduction, (v) forensic applications, and (vi) doubly-labelled water and water tracer applications. Stress hormones – the spectrum of stress molecules, how they are regulated, what their impacts are, and how they are measured to reflect acute and chronic stress. Photogrammetry – (i) appropriate equipment for photogrammetry, (ii) photographic techniques for photogrammetric use, (iii) photogrammetry software, (iv) building three-dimensional models, (v) measuring models. Applications of molecular biology to conservation genetics, infectious disease epidemiology and ecology, forensics (host and pathogen-based) and diagnostics.

AGR 890 Dissertation: Agronomy 890
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presentation of the research results. In addition to the dissertation, the student is also expected to compile a concept research paper for publication in a peer-reviewed UP accredited scientific journal.

AGV 800 Agrarian extension 800
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 20
AGV 801 Report: Extension 801
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 40

AGV 890 Dissertation: Agrarian extension 890
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits**: 180

AGV 891 Mini-dissertation: Extension 891
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120

AKW 890 Dissertation: Actuarial science 890
Academic organisation:
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

APZ 802 Dissertation: Animal production management 802
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: English **Credits:** 180

AQM 811 Boundary layer meteorology 811
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Introduction to global circulation and South African weather and climate. Mathematical functions and atmospheric balance laws. Stability and mixing heights. The atmospheric boundary layer over urban and rural areas. Turbulence. Earth's energy budget. Transfer and exchange of energy. Introduction to atmospheric and chemical dispersion modelling. Practical modelling of air pollution: Box models, Gausian puff or plume models, stochastic models, trajectory models.

AQM 812 Atmospheric chemistry 812
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The history of atmospheric pollution. Cycles of matter and atmospheric transformations. Gaseous inorganic pollutants. Gas phase organic pollutants. Particulates. The chemistry of atmospheric environmental problems, including acid rain; global warming; ozone depletion; persistant organic pollutants; and photochemical smog. Atmospheric monitoring: sampling methods; sampling strategies; and analytical techniques.

AQM 813 Atmospheric thermodynamics 813
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Gas laws. Virtual temperature. The hydrostatic and hypsometric equations. Dry adiabatic

processes. The first law of thermodynamics. Latent heat. Stabilities and instabilities. Dry adiabatic temperature lapse rate. Potential temperature. Inversion layers. Atmospheric moisture and saturated-adiabatic processes. Vapour pressure. Saturation and condensation. Dew and frost point. Relative humidity. Saturated adiabatic temperature lapse rate. Cloud and rain formation. The second law of thermodynamics.

AQM 814 Air pollution: Society and environment 814
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
International air quality criteria and standards. Ambient air quality and meteorological monitoring. Domestic pollution. Household fuel burning. Vehicle emissions. Toxicology and physiology. Industrial pollution. Emissions inventory and report sources. Air pollution and biomass. Air pollution control. Identification of alert air quality thresholds and associate information reporting, investigation and mitigation requirements. Renewable energy. Air pollution and climate. Practical experience.

ARD 891 Mini-dissertation: Rural development 891
Academic organisation: Agricultural Economics, Extension and Rural Developmen
Period of presentation: Year
Language of tuition: English **Credits:** 115

AWM 890 Dissertation: Meteorology 890
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

BCM 890 Project and dissertation 890
Academic organisation: Biochemistry
Period of presentation: Year
Language of tuition: English **Credits:** 180

BIF 803 Bioinformatics research project and report 803
Academic organisation: Biochemistry
Period of presentation: Year
Language of tuition: English **Credits:** 180

BOT 802 Plant systematics 802
Academic organisation: Plant Science
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Plant variation and evolution; theory and practice of plant classification; concept of categories in the taxonomic hierarchy; sources and handling of taxonomic data; taxonomic collections (herbaria and curating of collections); the process of plant identification; code of nomenclature; taxonomic publication.

BOT 890 Dissertation: Plant science 890
Academic organisation: Plant Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

CHM 890 Dissertation: Chemistry 890
Academic organisation: Chemistry
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

EGF 890 Dissertation: Exploration geophysics 890
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

EKN 812 Microeconomics 812
Academic organisation: Economics
Prerequisite: Only for students in relevant programmes
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
The module will first expose students to knowledge related to how individual consumers and firms behave under a very strict set of circumstances. Toward the end of the semester, the module will then begin to examine behaviour under less strict assumptions. The module covers in detail, firm behaviour, consumer behaviour, general equilibrium, behaviour under uncertainty and risk, strategic behaviour, information, game theory and to a lesser extent, the interaction between the government and the individual.

EKN 813 Macroeconomics 813
Academic organisation: Economics
Prerequisite: Only for students in relevant programmes
Contact time: 1 other per week
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 15
Module content:
The basic framework for this module will be infinitely-lived dynamic stochastic and non-stochastic macro models in both discrete and continuous time frames. Overlapping generation models will also be used to deal with certain topics. Topics include:

- The Lucas Critique
- Growth models
- Expectations
- Business cycles
- Basics of a new Keynesian business cycle model
- Overlapping generations models.

EKN 816 Monetary economics and banking 816
Academic organisation: Economics
Prerequisite: Only for students in relevant programmes
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 15
Module content:
This module presents an advanced treatment of critical topics in monetary economics and the models economists use to investigate the interactions between real and monetary factors. It provides extensive coverage of general equilibrium (DSGE) models, models of the short-run real effects of monetary policy, and game-theoretic approaches to monetary policy. Among the topics covered are models of time consistency, monetary policy

operating procedures, interest rates and monetary policy. Throughout, this module focuses on the implications of interest rate control for monetary policy. The module is designed for advanced graduate students in monetary economics, economic researchers and economists working in policy institutions and central banks. The module includes discussions of empirical evidence on the new Keynesian model, inflation forecast targeting models, optimal policies in forward-looking models, stability and the Taylor principle, and open economy new Keynesian models. It explicitly treats policy analysis in new Keynesian models and their underlying DSGE foundations for both a closed economy, a small open economy and a two-country world economy; the discussion includes the derivation of the policy objective function, optimal commitment and discretionary outcome, targeting rules and instrument rules.

ENS 811 Environment and development 811
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The foundation of the module is the interrelations between societal and environmental dynamics. It deals with issues of social structure, culture, politics, education, migration, production, urbanisation, demographics and social institutions and how these impact upon the environment. Also dealt with is how the consequences of impacts, such as environmental change, in turn affect societies. Analysis of complex interrelationships between society and the environment, social-environmental linkages and multiplier effects are dealt with.

ENS 822 Strategic environmental management 822
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Strategic environmental planning: introduction, objectives and principles; levels; South African overview; guidelines: national and international; strategy and management; structure, strategy and agency; South African guidelines; diagnostic tools; RESP analysis; strategic resource planning; applications, implementation and control; development and policy implementation; South African environmental policy; evaluation frameworks; portfolio analysis; competitive forces; alliances; business benefits; intangibles, survival and catalytic contributions; South African legislation and regulations.

ENS 823 Environment and land reform 823
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The need and purpose of land reform in South Africa and its contribution towards sustainable social-environmental interaction. An overview of the global variety of land tenure systems, and tenure reform programmes in other countries. Overview of previous systems of land tenure in South Africa. Land reform policy in South Africa: restitution, redistribution, and tenure reform. Critical assessment of progress in terms of land reform objectives. Evaluation of the contribution of the South African land reform programme towards creating sustainable environments.

ENS 824 Social modelling and assessment 824
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
In this module students will be introduced to the various methods of modelling and assessing social impacts. Specific emphasis will be placed upon modelling societal-economic-environmental interactions, formulating stochastic and dynamic models of population-development-environment interactions, conducting research to determine possible impacts of environmental changes on communities and performing social impact surveys. Students will be introduced to both quantitative as well as qualitative methods of conducting social impacts assessments.

ENT 890 Dissertation: Entomology 890
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 810 Environmental paradigms 810
Academic organisation: Zoology and Entomology
Contact time: 5 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Environmental philosophy and ethics, environmental ecology, environment, society and development, environmental economics, environmental management, critical resources management: water utilisation, air quality control, land-use planning: soil characteristics, biodiversity planning, critical resource management: determinism vs co-evolutionary environmental frameworks, research methodology and practice.

ENV 816 Environmental law 816
Academic organisation: Zoology and Entomology
Contact time: 2 ppw 1 web-based period per week 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Legislation for sustainable development within the framework of international agreements, the different acts affecting water quality and water use, the SEMAs within the NEMA framework, the NEMA EIA regulations, legislation pertaining to hazardous substances, interaction between mining development and NEMA, energy law, strategic environmental legislation, marine and coastal management.

ENV 822 International environmental management systems 822
Academic organisation: Zoology and Entomology
Contact time: 20 lpw over a period of 1 week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
The ISO framework, environmental risks and opportunities for companies, global environmental concerns, environmental legislation, identification of environmental impacts, environmental certification and auditing, follow-up activities, the Forestry Stewardship Council framework, chain of custody requirements, production standards, FSC reporting.
(** additional costs involved for international UK certificate)

ENV 833 Trees in a multifunctional landscape 833
Academic organisation: Plant Production and Soil Science
Contact time: 5 dpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 15
Module content:
Place and role of trees in multifunctional rural landscapes. Trees outside forests. Multipurpose trees. Trees and biodiversity. Trees and environmental services. Trees and sustainable development. Domesticated forests. Agroforestry (definition, classification, challenges and examples). Multiple use of forests and trees. Non-timber tree and forest products. Domestication of multipurpose trees. Forests and people. Trees and agricultural production systems (yield, interactions, synergy, competition, pests and diseases). Case-study examples from sub-Saharan Africa.

ENV 891 Research project 891
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 90
Module content:
The student needs to conduct a research project under the supervision of an academic member of staff associated with the Centre for Environmental Studies. This project needs to be of a sufficient quality to be publishable in the open scientific literature. The research report is examined as a manuscript for a suitable journal.

ENV 892 Dissertation: Environmental ecology 892
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 893 Dissertation: Environmenta and society 893
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 894 Dissertation: Environmental management 894
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 896 Dissertation: Water resource management 896
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 897 Dissertation: Environmental education 897
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

ENV 898 Dissertation: Air quality management 898
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

EWM 810 Water quality management 810
Academic organisation: Microbiology and Plant Pathology
Contact time: 20 discussion classes
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Theoretical basis for the development of chemical and microbiological water quality management and monitoring programmes. Severity of waterborne disease, accurate risk analysis, the use of indicator organisms, toxicity risks, bacterial, viral and protozoal contamination.

EWM 821 Water conservation and demand management 821
Academic organisation: Microbiology and Plant Pathology
Contact time: 20 discussion classes
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Public access to information regarding water quality, water supply sustainability and public education, demand projections, water management efficiency systems approach to water management, watershed protection, drinking water treatment and distribution, wastewater collection and treatment, effects of deforestation and treatment, and complex water system developments, destruction of wetlands, effects of recreation, agriculture and aquaculture on eutrophication.

EWM 822 Water supply and sanitation 822
Academic organisation: Chemical engineering
Contact time: 20 discussion classes per week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Background and constrains related to the supply of appropriate water supply and sanitation services in South Africa and other developing coutries. Understanding of water production processes. Alternative approaches for the supply of water and sanitation services to rural and informal communities.

FOR 831 General introduction to forestry 831
Academic organisation: Plant Production and Soil Science
Contact time: 1 web-based period per week 20 discussion hours per block week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
What is forestry? Global forest resources. Natural forests and plantations in Southern Africa. Forestry systems (natural, multipurpose forests, plantation forestry, agroforestry). Sustainable forestry development policy and legislation. Silviculture and management of plantations. Forest certification. Effects of site and silviculture on wood quality. Forest harvesting, utilisation and forest wood products. Non-timber forest products of natural and plantation forests. Forests and woodlands management (forest planning; forest mensuration, growth and yield estimates and regulation). Environmental management of natural and plantation forests. Forestry research. Human resource management in forestry. This module will also have a field practical expedition to introduce students to the field experience.

FOR 832 Forest resource use planning and management 832
Academic organisation: Plant Production and Soil Science
Contact time: 1 web-based period per week 20 discussion hours per block week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Forest planning. Forest mensuration. Growth and yield models and its application in growth and yield simulators. Quantitative silviculture. Yield regulation and forest economics. GIS and spatial analysis in forestry.

FOR 833 Forest engineering 833
Academic organisation: Plant Production and Soil Science
Contact time: 1 web-based period per week 20 discussion hours per block week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Forest road engineering. Forest road system management. Forest operations analysis. Production planning. Strategic and tactical planning techniques. Forest operations design. Forest transportation systems. Harvesting management. Logging mechanics.

FOR 834 Wood science and forest products 834
Academic organisation: Plant Production and Soil Science
Contact time: 1 web-based period per week 20 discussion hours per block week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Common characteristics of wood. Properties controlling the technical performance of wood. Natural growth phenomena affecting wood quality. Effect of site and silviculture on wood quality. The genetics of wood. Sawmilling and wood drying. Composite wood products. Deterioration of wood and wood products and methods of protection.

FOR 835 Forest ecology and management 835
Academic organisation: Plant Production and Soil Science
Contact time: 1 web-based period per week 20 discussion hours per block week
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Structure and function of natural forests, species composition and diversity, disturbance processes and regimes, recovery (succession) concepts and theory, biodiversity in forest ecosystems, energy and nutrient flux in natural forest ecosystems. Resource assessment and planning. Silvicultural systems and management of natural forests (and woodlands), natural regeneration and forest rehabilitation management for sustainability of natural forest ecosystems: multiple use for timber and non-timber forest products, forest rehabilitation (invader plants, mining, degraded forests).

FOR 836 Silviculture 836
Academic organisation: Plant Production and Soil Science
Contact time: 20 dpw 1 web-based period per week
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Understand the development of modern plantation forestry. Commercial plantation

species. Forest pests and diseases. Forestry site classification. Basis of forestry rotation length (economics, biological, wood quality). Effect of silvicultural practices on wood quality (managing wood quality). Forestry management regimes for different species and end products. Pros and cons of plantation forestry on the environment. Fire management. Propagation techniques for forestry systems and bio-renewable resources, ecological basis of silviculture and fire management systems.

FOR 890 Forest science 890
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 240
Module content:
*Interdepartmental programme. The curriculum is determined by the heads of department in the biological sciences and will include the research methodology and scientific writing. This is followed by research in the area of the chosen specialisation in Forest Science culminating in the preparation and submission of research dissertation.

FPP 801 Advanced courses 801
Academic organisation: Food Science
Period of presentation: Year
Language of tuition: English **Credits:** 90

FPP 890 Mini-dissertation 890
Academic organisation: Food Science
Period of presentation: Year
Language of tuition: English **Credits:** 150

FSK 808 Physics 808
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 36

FSK 890 Dissertation: Physics 890
Academic organisation: Physics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

FST 890 Dissertation: Food science 890
Academic organisation: Food Science
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
Each candidate must write a dissertation on his/her research project in Food science and/or Food technology and at least a concept research paper for publication in a peer-reviewed scientific journal.

GDK 801 Advanced coursework 801
Academic organisation: Plant Production and Soil Science
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120

Module content:
Any module and/or assignment(s) at the advanced level chosen in consultation with the head of department.

GDK 890 Dissertation: Soil science 890
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presentation of the research results. In addition to the dissertation, the student is also expected to compile a concept research paper for publication in a peer-reviewed UP accredited scientific journal.

GDK 891 Dissertation: Soil science 891
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120
Module content:
Each candidate must write a dissertation on his/her research project in land-use planning and at least prepare a concept research paper for publication in a peer-reviewed scientific journal.

GGF 890 Dissertation: Geography 890
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180
GIS 890 Dissertation: Geoinformatics 890
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

GLG 881 Mini-dissertation 881
Academic organisation: Geology
Period of presentation: Year
Language of tuition: English **Credits:** 120
Module content:
A mini-dissertation on a topic approved by the course leader. In this module candidates must do a research project in order to show that they have mastered the theoretical knowledge covered in the theoretical modules and can apply it to a research topic from their own industrial experience.

GLG 890 Dissertation: Geology 890
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

GMO 800 Geometrical optics 800
Academic organisation: Physics
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: Afrikaans **Credits:** 36

Module content:
Mathematical description of waves; Light as an electromagnetic wave; Nature of sources of light; Wave fronts (Huygens principle); Snell's Law; Index of refraction; Exploration of the laws of reflection and refraction at planar and curved surfaces; Ray tracing methodology to find position, Nature of images and magnification; Thin lens formula; Conjugate foci formula; Lensmaker's formula; Ophthalmic prisms: characteristics, classification and refractive power; Thin lenses: types, image formation; Cylindrical lenses: Introduction; Optical systems: Lens combinations (notation, toric lenses); Thick lenses (cardinal points, system power); The eye: structure and function, reduced eye; aberrations in general; eye defects: myopia, hyperopia, presbyopia, astigmatism; Optical apparatus for ophthalmology: invasive/non-invasive, ophthalmic laser, ophthalmoscope, fundus camera, light coagulator.

GTK 890 Dissertation: Genetics 890
Academic organisation: Genetics
Period of presentation: Year
Language of tuition: English **Credits:** 180

GTX 890 Dissertation: Hydrogeology 890
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

GVK 800 Large stock science 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 lpw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Management programmes and systems for beef cattle, dairy cattle and horses. Optimal use of breeds and regional adaptation of cattle. The stud industry and commercial units. Indigenous breeds and production development. The application of animal science practices and the practise of techniques for breed improvement. Seminars, class discussions, literature studies and assignments on certain fields. Research and production techniques. Agro-economic, agro-ecological and socioeconomic assignments can be prescribed.

HSC 801 Advanced coursework 801
Academic organisation: Plant Production and Soil Science
Contact time: 2 dpw 1 spw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 120
Module content:
Any module and/or assignment(s) at the advanced level chosen in consultation with the head of department.

HSC 891 Mini-dissertation: Horticultural science 891
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120
Module content:
Each candidate must write a dissertation on his/her research project in Horticulture and at

least prepare a concept research paper for publication in a peer-reviewed scientific journal.

IGL 890 Dissertation: Engineering geology 890
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

KVK 800 Small stock science 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Advanced aspects of the small stock industry. The wool, fur and meat production potential of South Africa. Production trends and factors influencing them. Production systems. The influence of flock composition on production. Discussions, seminars and prescribed scientific literature studies on various aspects of the small stock industry.

LEK 800 Agricultural economics 800
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 20

LEK 810 Applied econometrics 810
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 725 or equivalent
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Econometrics. Linear regression: assumptions of the linear regression model, OLS estimators and properties, hypothesis testing (single and multiple restrictions), fore-casting, dummy variables. Violations of the linear model assumptions: multi-colinearity, heteroscedasticity, serial correlation and distributed lag models, (GLS estimators). Advanced topics: Quantitative response models (logit, tobit and probit analysis) co-integration, instrumental variables and 2-stage least squares.

LEK 811 Production economics 811
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
This module follows on the final-year module LEK 421 and is taught at the intermediate level and now moves beyond the single input production function to analysis with multi-variable functions. Detailed exposure to production, cost and profit functions, and the duality that exists between these is a core element of the module. The focus will also be on the implications of the properties for the economic behavior of agents. At the end of this module students will have complete competence in algebraically solving for the cost minimisation and profit maximisation problems. Themes covered in the module are: Properties of production functions. Economic theory of cost. Economic Theory of Profits.

Duality between the cost and production functions. Duality between the profit and production functions. Applied topics.

LEK 812 Agricultural policy analysis 812
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Agricultural policy analysis. The importance and place of agricultural policy. Policy incidence. Design of agricultural policy Instruments. Public choice theory and agricultural policy. Political economy of agricultural policy. Agricultural policy distortions. The role of the media in agricultural and food policy. Seminars.

LEK 814 Quantitative models for agricultural and environmental policy 814
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Quantitative models for agricultural and environmental policy. This module will introduce students to applications of discrete choice and linear regression models to agricultural and environmental economics. These include demand systems, production functions and treatment effects/impact assessment models. The second part of the class will focus on mathematical programming and numerical methods including but not limited to multisector models, Input-output and programming models and social accounting matrices for consistent production planning, growth, income distribution and trade policy analysis Multimarket analysis. Computable general equilibrium models.

LEK 815 Applied micro-economics 815
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Economic models and empirical applications in food demand and agricultural production, welfare economics, risk analysis, and industrial organisation as it relates to the agricultural and food industry.

LEK 820 Partial equilibrium modelling and commodity market analysis 820
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: EKT 723 or LEK 810
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
This module focuses on the modelling of agricultural commodity markets, price determination, policy and trade. The main objective is to provide the basic theoretical principles and skills for partial-equilibrium model building and an opportunity to apply these skills. The approach will include:
1) Economic theory: The theoretical foundations of each modelling component of a typical commodity balance sheet and set of prices will be emphasised in the design

and specification of models; price formation and model closure under alternative equilibrium pricing conditions

2) Applied research: Advanced steps in modelling will be emphasised. Throughout the module, applied modelling research will be conducted and presented to gain experience with methods discussed in class. The module applies economic theory and quantitative methods to analyse food and agricultural markets, price, trade and policy issues. The module examines problem formulation, model structure, estimation, and model evaluation applied to demand and supply and to trade and policy interventions.

LEK 826 Environmental valuation and policy 826
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Environmental valuation and policy. This module will review the basic principles of microeconomic theory needed for understanding and analysis of environmental problems, introduce market and non-market techniques of valuation of natural resources and environmental services (hedonic pricing, contingent valuation, transport cost, willingness-to-pay, cost-based techniques, etc), public goods and environmental externalities, property rights regimes and selection of appropriate environmental policy instruments for management of environmental externalities.

LEK 827 International agricultural trade and policy 827
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
WTO/GATT-1994 and agricultural-related agreements and understandings. Regionalism and trade blocks. International trade and economic development. South Africa's agricultural trade policy. Involvement in bilateral and multilateral agreements. Application of international market analysis tools. International agricultural trade and tariff statistics, trade modeling, theory and familiarity in international and regional databases. The module covers the basic tools to understand what determines the flow of agricultural goods across countries, i.e. international trade, and applications to a number of topics of current interest, including the debate on globalisation, free trade agreements, the SA Current account and the medium run prospects for exchange rates.

LEK 831 Forest resource economics and policy 831
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
The economics of optimal management of cultivated and natural forests. Optimal rotation age and harvesting in timber production. Managing forest for their non-timber services. The multiple ecosystem services of forest and their contributions to human wellbeing. Economic valuation of the services of forest ecosystems. Forest resource rents and their capture and distribution under different property rights regimes. Regulation and taxation of forest users. Designing logging concessions and forest exploitation policies. Forest

resource accounting and optimal management of the resource rents. Communities and forests. Case study examples from Sub-Saharan Africa.

LEK 832 Agricultural science and technology policy 832
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: Registration for at least a master's degree
Contact time: 1 lpw 1 dpw
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
The basic definitions and concepts related to agricultural science policy. An overview of the trends in research investment, capacity development in the field of agricultural research, juxtaposed against the regional and international performance in this field. The application of concepts and methodologies used in project planning and management with respect to research evaluation and monitoring. Productivity analysis and its use in evaluating technological change, the determination of the R&D effects in terms of agricultural research and development. Case studies dealing with current topics in agricultural science policy highlighting the application of the methodologies learned.

LEK 833 Food policy 833
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: Registration for at least a master's degree
Contact time: 1 lpw 1 ppw 1 spw
Period of presentation: Semester 1 or 2
Language of tuition: English **Credits:** 15
Module content:
The concept and interrelated causes of food insecurity (production, markets and socio-economic climate) and the global food economy. Household coping strategies and response to risk and shocks. Household dynamics (including livelihoods, purchasing behaviour and nutrition). Practical tools for programme and policy analysis and targeting. Evaluation of possible programme and policy options and their effectiveness in terms of achieving comprehensive and pro-poor growth.

LEK 834 Measuring and monitoring food security 834
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: Registration for at least a master's degree
Contact time: 1 lpw **1 dpw**
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Indicators, scores, indexes, measurement approaches, systems and analysis methods, for food security monitoring and evaluation. Best practice for surveys and qualitative methodologies. Communicating research results and food security information for decision makers. The data included in the module will cover agricultural crop and livestock, food stocks, nutrition, health, agrometerological, behavioural and sanitation related information.

LEK 880 Natural resource and environmental economics 880
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15

Module content:
Natural resource and environmental economics. This module reviews the origins and evolution of natural and environmental resource economics. It describes and studies the application of economic principles and analytical methods for sustainable development of renewable, non-renewable and environmental economics. Examine sources of inefficiency and causes as well as indicators of environmental degradation. The economics of pollution management: Concepts, policies and instruments. Sustainable management of natural and environmental resources. Introduction to natural and environmental resource policy. Economic valuation of natural and environmental resources.

LEK 882 Institutional economics 882
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Institutional and behavioural economics. This module will expose students to the principles of the New Institutional Economics paradigm and how it can be utilised to improve the analysis of agricultural economic and agricultural development problems and issues. Major themes covered are: The agricultural development challenge: stylised features; new institutional economics: distinctive features and concepts; institutions and development: A historical and macro-perspective techno-economic characteristics and agricultural systems and products in poor countries; NIE analysis of markets and markets structures; the State: Political and institutional determinants of agricultural policy; collective action; transactions costs in smallholder agriculture; case studies.

LEK 883 Agricultural supply chain management 883
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Agricultural supply chain analysis. Explore the evolution of supply chain management in the global food industry. Establish the different ways in which supply chain management can provide a source of competitive advantage at industry level and for individual firms. Examine the crossfunctional and multidisciplinary nature of supply chain management as it applies in the global food industry. Introduce the core elements of the theoretical literature on supply chain management and consider applications in different sectors. Provide students with practical experience in applying the principles of supply chain management to the exploitation of a marketing opportunity, using case examples from the fresh produce and meat sectors. Provide students with practical experience of undertaking a supply chain audit, with a view to establishing an appropriate business strategy for a food manufacturing company.

LEK 884 Advanced rural finance 884
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Overview of rural finance: conceptual issues. Role of financial services in economic

development. Relationship between financial development and economic growth. Economic theory underlying rural financial markets: market and government failure, imperfect information, transaction costs, agency theory, and pecking order theory. Supply of and demand for financial services in rural areas: theory and measurement issues. Estimating credit demand, supply and constraints. Institutions involved in the provision of rural financial services and innovations in rural finance. Assessing performance of institutions providing rural financial services.

LEK 886 The economics of natural resources 886
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 780 and LEK 810 or equivalents
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
The economics of natural resources. This module will introduce students to the techniques of optimisation overtime, optimal allocation and management of non-renewable and renewable resources, with case studies from Africa. The influence of property rights regimes on optimal natural resource use will also be stressed. The module consists of three main sections: Methods of dynamic optimisation; Theory of exhaustible and renewable resources and growth models; and Property rights and natural resource use with case studies from Africa.

LEK 887 Selected topics in environmental economics 887
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: MIE 780 and EKT 713 or equivalents
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Selected topics in environmental economics. This module will introduce students to various issues of special importance in environmental economics and policy with special emphasis on international dimensions. Examples of key themes to be covered include trade and the environment, trans-boundary externalities, global public goods, multi-lateral environmental agreements, international aid, economic growth and environmental change, poverty and the environment, etc. The main objective of the module is to equip students with the appropriate tools for analysing the linkages between economic development, trade and globalisation, poverty, economic and environmental policy and environmental change.

LEK 892 Dissertation: Agricultural economics 892
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120

MBY 890 Dissertation: Microbiology 890
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

MFK 800 Medical physics 800
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 36

MFK 801 Medical physics 801
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 36

MPS 890 Dissertation: Medical plant science 890
Academic organisation: Plant Science
Period of presentation: Year
Language of tuition: English **Credits:** 180

MVA 880 Statistical learning 880
Academic organisation: Statistics
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 20
Module content:
Supervised and unsupervised methods, including computational methods, within the broader context of data mining. Supervised learning: Linear methods for regression, classification and prediction. Basis expansions, regularisation, smoothing, additive models and support vector machines. Unsupervised learning: Clustering, principal components, dimensional reduction. Data methods: Organisation of data and exploratory data analysis.

NLB 890 Dissertation: Wildlife management 890
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

NMN 814 Research methodology 814
Academic organisation: Consumer Science
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English Compulsory attendance module
Module content:
The aim of this module is to analyse the core concepts in social research and to provide a conceptual framework of the research process. It includes the following topics: a conceptual model of social science research, the logic of the research process, the different forms of scientific reasoning, and the stages in the research process being the formulation of the research problem, research design, conceptualisation, operationalisation, sampling, data-collection and data-analysis.

OMS 881 Environmental change 881
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15

Module content:
This module involves the study of the causes and consequences of environmental change from multidisciplinary perspectives. A focus of this course is human environmental interactions. Past processes leading to environmental change will also be discussed. In a given period, the following will be investigated: principles of environmental change, causes and consequences of environmental change, Global warming and climate change: causes and impacts of climate change on natural resources; water, forests, biodiversity, land use and land cover change, environmental/climate change and infectious disease, human dimensions of global change and climate change political responses including the Kyoto protocol. Mitigation and adaptation strategies to climate change and effects of climate change on sustainable development.

OMS 895 Research Report: Environment and society 895
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 20

PFS 801 Production physiology 801
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Specialised study of physiological and anatomical factors that influence growth, development, reproduction and production. Stress and intensification effects on the metabolism of animals. The mechanisms of disease and erosion losses and the modification of reproduction and growth. Specific topics are studied by way of literature, seminars, discussions and research assignments.

PPT 890 Dissertation: Plant pathology 890
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

PVK 800 Poultry science 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Specialised study of the management of hatcheries, broiler and layer production units, broiler breeding parent farms, ostriches, cage bird, game bird and waterfowl units, as well as threatened species in conservation programmes. Planning of production units and facilities. Determining ventilation requirements, disease control and biosecurity systems. Product quality, marketing and promotion of birds and their products. Computer-aided management systems and product projection. Execution of projects in certain areas of specialisation. Studies aimed at optimising production efficiency and minimising risk.

SCE 881 Research methods in science education 881
Academic organisation: Centre for Science Development
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15

Module content:
The purpose of this module is to:
– be exposed to the discipline of Educational Research;
– understand research concepts, principles and methods;
– obtain skills such as: the formulation and definition of a research problem, the use of literature to obtain an in-depth understanding of a problem, the design of the research protocol, the interpretation of research results to draw conclusions about a research problem.

SCE 882 Statistics for science education 882
Academic organisation: Centre for Science Development
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
The module follows a conceptual approach to the field of statistical principles as applied within educational research. The emphasis lies on understanding selected statistical procedures and the logic underlying statistical deduction. The purpose of the module is to promote statistical literacy as a research tool.

SCE 883 Curriculum development and assessment – Science education 883
Academic organisation: Centre for Science Development
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
The module reviews modern thinking in science content and curriculum development in both a South African and an international context. Assessment is treated as an integral part of curriculum design. Special attention is given to the theoretical principles of assessment, with special reference to accuracy and reliability: The application of these elements to standardised as well as teaching developed tests are reviewed. Finally, new forms of assessment are explored.

SCE 884 Current developments: Science education 884
Academic organisation: Centre for Science Development
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
The objectives of this module are: to explore and discuss the major approaches currently advocated in science education (eg constructivist learning) and as they pertain to the nature of the scientific fields; to explore and discuss some current restructuring proposals underway and the consequences of the above proposals for the classroom teacher; to develop a curriculum or curricular units, strategies for the implementation of the curriculum and evaluation strategies consistent with the goals of the new curriculum and evaluation strategies consistent with the goals of the new curriculum; to explore activities, computer software, computer interfaced laboratories, video recordings and integrated technological systems that will support the new curriculum.

SCE 885 Seminar: Science education 885
Academic organisation: Centre for Science Development
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20

Module content:
The purpose of the seminar is to contribute and learn from the interaction and research of fellow postgraduate students and professionals. At least 5 presentations on recent literature or your own research in science education or in a science speciality are required. The programme contributes both to the development of the underlying knowledge and research project, but also build a team approach to scientific endeavour, develops and demonstrates scientific presentation skills and scientific reporting and writing.

SCE 890 Dissertation: Science education 890
Academic organisation: Centre for Science Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 240

STK 880 Capita selecta: Statistics 880
Academic organisation: Statistics
Contact time: 1 other per week 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 20
Module content:
The module is primarily article based and covers the most recent literature that discusses the developments and research in, for example, Shewhart charts, Exponentially Weighted Moving Average (EWMA) charts, Cumulative Sum (CUSUM) charts, Q-charts, parametric and nonparametric charts, univariate and multivariate charts, Phase I and Phase II control charts and profile monitoring and other research topics.

TBK 890 Dissertation: Horticultural science 890
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presentation of the research results. In addition to the dissertation, the student is also expected to compile a concept research paper for publication in a peer-reviewed UP accredited scientific journal.

TLR 801 Animal breeding and genetics 801
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 spw 2 ppw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Specialised studies in quantitative and molecular animal breeding in various livestock species. Advanced statistical modelling and EBV estimation. Application of genetic theory in practice with relation to heritability of quantitative characteristics. Advanced theory on the role of molecular technology in genetic improvement of farm animals. Experimental designs for QTL and MAS research and biodiversity studies as well as principles of genomic EBVs and GWAS.
The study entails seminars, a literature study and discussion of selected topics relating to the industry/ specialisation programme. Discussion of research methods and results under local conditions. Policies regarding animal breeding.

TMN 890 Dissertation: Applied mineralogy 890
Academic organisation: Geology
Period of presentation: Year
Language of tuition: English **Credits:** 180

TRA 880 Analysis of time series 880
Academic organisation: Statistics
Prerequisite: WST 321 or TRA 720
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 20
Module content:
Difference equations. Lag operators. Stationary ARMA processes. Maximum likelihood estimation. Spectral analysis. Vector processes. Non-stationary time series. Long-memory processes.

TRG 880 Data analytics and visualisation 880
Academic organisation: Statistics
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 20
Module content:
Regression introduction: Simple and multiple regression. Multicollinearity, hetereoscedasticity, ridge regression. Logistic regression: Estimation, inference and applications. Nonlinear regression: Estimation , inference and applications. Text mining: Topic modelling with applications. Survival regression: Survival models applied in regression. Regression extensions: CART, MARS and Conjoint analysis.

TST 890 Dissertation: Applied statistics 890
Academic organisation: Statistics
Period of presentation: Year
Language of tuition: English **Credits:** 240

TWS 890 Dissertation: Applied mathematics 890
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 120

VBR 890 Dissertation: Consumer science 890
Academic organisation: Consumer Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

VDG 801 Electives: Nutrition 801
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: English **Credits:** 60
Module content:
Modules at the advanced level chosen in consultation with the Director of the Centre for Nutrition and the head of department.

VDG 890 Dissertation: Nutrition 890
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 180

VGE 801 Monogastric nutrition 801
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Advanced study with specialisation in the nutrition of monogastric species for example poultry, dogs, pigs, aquaculture species, pets, cage birds, game birds and waterfowl as well as monogastric species in zoo's and game breeding ranches. The study entails research, seminars and practical assignments.

VGE 802 Ruminant nutrition 802
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Advanced study of foregut and hindgut digestive processes and flow dynamics. Manipulation of digestion, end product metabolism, ad libitum and controlled feed intake. Energy, protein, mineral and vitamin requirements and standards for beef and dairy cattle, small stock and horses. Appropriate ration formulation. The study entails lectures, seminars, practical assignments and a research project with the results reported in a research paper.

VKD 800 Pig science 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Specialised study concerning pig production, considerations when planning pig production units, policy planning and market conditions. Production physiology, housing, nutritional management, breeding practices, diseases and hygiene. Products. Practical scientific and industry orientation through different assignments.

VKU 801 Animal science 801
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 150
Module content:
Dissertation of 150 credits.

VKU 890 Dissertation: Animal science 890
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
Dissertation of 180 credits

VLE 801 Meat science 801
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 15
Module content:
Advanced study of carcass and meat quality characteristics as influenced by breeding, nutrition, physiology, growth and development as well as treatment and processing technology. Cattle, sheep, goats, pigs, poultry and game. Meat quality control from the farm to the retail distribution counter, processing and packaging. Intensive and extensive meat production units, abattoirs, wholesale and retail trade. Nutritional value of meat and meat products. Processing. Saleability, marketing methods, consumer profiles. Organisation and legislation. The module consists of lectures, discussion groups and seminars on topics relevant in the meat industry.

VNE 800 Livestock ecology 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 lpw 1 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
The study of animal-environment and genotype-environment interactions and the impact on natural resources. Adaptational mechanisms of breeds and species. The formulation of optimal farming systems with respect to adaptation. The determination of biological outputs and the classification of animal breeds and species in terms of biological traits. Research and study assignments are executed taking the academic needs of the candidates into consideration.

WDE 801 Advanced coursework 801
Academic organisation: Plant Production and Soil Science
Contact time: 1 ppw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120
Module content:
Any module and/or assignment(s) at the advanced level chosen in consultation with the head of department.

WDE 890 Dissertation: Pasture science 890
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 180
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presentation of the research results. In addition to the dissertation, the student is also expected to compile a concept research paper for publication in a peer-reviewed UP accredited scientific journal.

WDE 891 Mini-dissertation: Pasture science 891
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 120
Module content:
Each candidate must write a dissertation on his/her research project in Pasture Science

and at least prepare a concept research paper for publication in a peer-reviewed scientific journal.

WIS 890 Dissertation: Mathematics 890
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 120

WLK 800 Wool science 800
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 dpw 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Discussions and literature studies on advanced subjects concerning wool and fibre. Factors influencing wool and mohair production. The influence of environment, nutrition and breeding on the chemical and physical composition of wool and mohair. Factors influencing classing, processing and marketing of wool. Discussions and seminars on techniques in quantifying physical and chemical characteristics of wool and mohair, relevant literature and research techniques. Evaluation of variation in skin and fibre.

WST 895 Mini-dissertation: Mathematical statistics 895
Academic organisation: Statistics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 100

WTW 812 Convergence spaces 812
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Topology, Measure theory and Functional analysis on honours level
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Filters. Convergence of filters, sequences and nets in a topological space. Convergence structures, basic properties and constructs. Continuous convergence, c-embedded convergence spaces. Order convergence on lattices and posets. Convergence vector spaces and completions. Continuous convergence and duality on locally convex spaces. The Hahn-Banach theorem in convergence spaces.

WTW 820 Mathematical morphology 820
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Measure theory and Functional analysis on honours level
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
Mathematical morphology – a theory for the analysis of special structures and a powerful methodology for the extraction of useful information from images. Morphological operators and their properties: erosion, dilation, opening, closing, granulometries. Applications to noise removal, filtering, extraction of features, edge detection, etc. LULU

operators – properties and applications. Partial differential equations for morphological operators.

WTW 831 Mathematical and computational finance 831
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Financial Engineering on honours level
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Stochastic calculus: Multidimensional Itô formula, correlated Wiener processes, the infinitesimal operator, SDE's, PDE's, the Kolmogorov equations, martingales, stochastic integral representations and Gisanov's theorem. The Martingale approach to arbitrage theory. Bonds and interest rates: Martingale models, standard models, the Heath-Jarrow-Morton framework. Monte Carlo methods. Finite difference methods.

WTW 832 Advanced methods of financial engineering 832
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Financial Engineering on honours level
Contact time: 3 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Interest rate derivatives. Stochastic volatility models. Models to improve on the flaws in the Black-Scholes model. Principles of deal structuring. Principles of mathematical models. Specialised methods for interest rate and exotic derivatives. Application of numerical methods to relevant practical problems.

WTW 833 Quantitative risk management 833
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Financial Engineering on honours level
Contact time: 1 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Risk in perspective. Traditional RiskMetrics. Methods to calculate VaR. Designing scenario analyses and stress analysis. Risk measures based on loss distributions. Aggregate risk measures which include coherent risk measures. Extreme value theory. Correlation, copulas and dependence. Credit risk management.

WTW 836 Homogenisation of partial differential equations 836
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Functional analysis, Measure theory, Partial differential equations at honours level
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2

Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Review of functional analysis, Sobolev spaces and variational problems; rapidly oscillating function; periodic composite materials; homogenisation of elliptic problems; multiple scale method; two-scale convergence and applications.

WTW 840 Special functions and approximation theory 840
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Complex Analysis at 3rd-year level; Advanced Calculus and Ordinary Differential equations (ODEs)
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The Gamma and Beta functions, the hypergeometric function, orthogonal polynomials and their properties, classical orthogonal polynomials such as Chebychev, Hermite, Laguerre, Ultraspherical and Jacobi polynomials, Padé approximation, applications of zeros of orthogonal polynomials to convergence of Padé approximants.

WTW 846 Stochastic partial differential equations 846
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Functional analysis, Measure theory, Partial differential equations at honours level. Knowledge of Probability theory is advised but not required.
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Generalities on probability theory (random variables, conditional expectations); Martingales; stochastic integrals; Markov processes; existence and uniqueness results for ordinary stochastic differential equations; Sobolev spaces, Aubin-Dubinsky-Simon compactness theorem; convergence of probability measures: Prokhorov and Skorokhod theorems; existence and uniqueness of solutions of stochastic parabolic equations in divergence form: The Galerkin scheme; idea of renormalisation group theory in turbulent flows modelled by Navier-Stokes equations with random forcing.

WTW 850 Mathematical epidemiology 850
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Dynamical systems, Ordinary differential equations (ODEs)
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 30
Module content:
* Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The spread of infections is modelled via dynamical systems defined by sets of differential equations. Compartmental models of the spread of contagious infection (eg MSEIR) and

models of vector borne diseases are considered. Methods of analysis of the local and global asymptotic stability of the disease free and endemic equilibria and their characterisation in terms of the basic reproduction number. Reliable numerical simulations and sensitivity analysis with respect to the parameters of the models.

WTW 851 Introduction to categories and sheaves 851
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Algebra at 3rd-year and honours levels
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The language of categories; limits; additive and abelian categories; abelian sheaves; cohomology of sheaves; homotopy and fundamental groupoid.

WTW 855 Lattice theory 855
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Algebra at 3rd-year level
Contact time: 1 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The following topics will be studies: Ordered sets; down-sets of ordered sets; lattices and complete lattices; modular, distributive and Boolean lattices (as algebras and as ordered sets); the representation of lattices by collections of sets; the lattice of congruences of a lattice; complete partially ordered sets and fixed point theorems and maximality principles.

WTW 863 Finite element analysis 863
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Finite element method and Functional analysis at honours level
Contact time: 1 lpw
Period of presentation: Sem 1 or Sem 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Finite element interpolation theory. Finite element approximation of elliptic boundary value problems and eigenvalue problems. Finite element approximation of parabolic and hyperbolic initial value problems. Applications in a project.

WTW 865 Graph theory 865
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Discrete Structures at 3rd-year level
Contact time: 1 lpw
Period of presentation: Sem 1 or Sem 2
Language of tuition: English **Credits:** 30

Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The basics (including a variety of topics); matchings; connectivity; planarity; colourings and generalised colourings and hereditary properties of graphs.

WTW 866 Hyperbolic systems of partial differential equations 866
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Partial differential equations at 3rd-year and honours level; Advanced calculus and Linear algebra
Contact time: 1 lpw
Period of presentation: Sem 1 or Sem 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Systems of first order partial differential equations and their relationship to wave phenomena. The module will show that the traditional wave equation is over-rated as study material. More detailed contents: Hyperbolicity of first order systems (linear and nonlinear); characteristic curves and surfaces; domains of influence and dependence; well-posedness of initial and boundary value problems; shock phenomena; numerical calculation of solutions; application to the equations of compressible gas dynamics and Maxwell's equations for electromagnetism.

WTW 869 Differential geometry 869
Academic organisation: Mathematics and Applied Mathematics
Prerequisites: Linear algebra, Differential and Integral calculus, Partial differential equations at honours level
Contact time: 1 lpw
Period of presentation: Sem 1 or Sem 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Differentiable manifolds; multilinear algebra; exterior differential calculus; integration of differential forms and De Rham cohomology; connections on frame bundles; Riemannian manifolds and submanifolds; second fundamental form; harmonic mappings between Riemannian manifolds.

WTW 880 Sobolev spaces 880
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Measure theory, Differential equations and Functional analysis on honours level
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
The module focuses on the Hilbertion Sobolev spaces as well as to their applications to elliptic boundary value problems. Topics to be discussed include: Distributions; Sobolev spaces of positive and negative integer orders; Sobolev spaces of traces; Embeddings of Sobolev spaces; Boundary value problems.

WTW 881 Abstract analysis 881
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Measure theory and Functional analysis on honours level
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Capita selecta from the following: Duality theory. Weak and Weak* topologies. The Krein-Milman theorem. The Stone-Weierstrass theorem. Fixed point theorems. Banach Algebras and the Gelfand transform. C*-algebras and their representations. Semigroups of operators. Functional analysis applied to probability theory and stochastics.

WTW 884 Advanced measure theory 884
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Measure Theory and Functional Analysis on honours level
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Lebesgue integral in a general measure space: Basic properties, convergence theorems, convergence in measure. Lebesgue spaces: Completeness, approximation by continuous functions. Complex measures: Absolute continuity, Random-Nikodym Theorem, representation of bounded linear functionals on Lebesgue spaces, Riesz Representation Theorem for bounded linear functionals on the space of continuous functions on a locally convergent Hausdorff space where X is a locally compact Hausdorff space. Applications to probability.

WTW 886 Mathematics 886
Academic organisation: Mathematics and Applied Mathematics
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Refer to the Department regarding the module content.

WTW 887 Dynamical systems 887
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Functional analysis, Partial differential equations and Finite element method at honours level
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Finite dimensional dynamical systems: Autonomous and non-autonomous systems of differential equations, dynamical systems, linear and nonlinear systems, existence and

uniqueness of solutions, extension of solutions, maximal solution and maximal interval of existence, phase space and phase portrait. Stability theory for equilibria and periodic orbits using linear approximation, Liapunov's method and other energy methods and discrete dynamical systems (Poincarè map). Introduction to strange attractors. Application to mechanics and population models. Infinite dimensional dynamical systems: Semigroups, first and second order abstract differential equations, Sobolev spaces, finite dimensional approximation. Application to heat conduction and mechanical vibration. Examples of nonlinear systems.

WTW 888 Special topics in mathematics 888
Academic organisation: Mathematics and Applied Mathematics
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
Content will vary from time to time depending on the availability of expertise in the Department.

WTW 889 Mathematics 889
Academic organisation: Mathematics and Applied Mathematics
Contact time: 1 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
*Consult with the Head of the Department of Mathematics and Applied Mathematics about the availability of this master's module in a particular year.
Refer to the Department regarding the module content.

WTW 892 Dissertation: Mathematics of finance 892
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 120

WTW 893 Dissertation: Mathematics education 893
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 120

WTW 894 Dissertation: Financial engineering 894
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 120

ZEN 808 Conservation planning and monitoring 808
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Biodiversity survey techniques; data and information management; data assessment; principles of data extrapolation; inventories; biodiversity risk assessment (PHVA, small and declining population paradigms, prioritisation); principles of reserve selection;

surrogacy; reserve design; integrated land-use planning.
Landscape theories and models (hierarchy, percolation, metapopulation, source-sink); scaling patterns and processes across landscapes (patches, corridors, mosaics and flows); emerging patterns and processes; principles of landscape dynamics; principles of landscape conservation, management and design (transformation, fragmentation); methods in landscape ecology (numerical and spatial data processing, fractal geometry approach, GIS, remote sensing, GPS, spatially explicit population models).
Skills: GradSect, Access, Excel, Visual Basic, GIS (Arc View) reserve selection algorithms.

ZEN 809 Biogeography and macro-ecology 809
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 15
Module content:
Biogeographic consequences of plate tectonics, Pleistocene southern African climatic, geological, edaphic and geomorphological patterns. Reconstructing biogeographic histories (speciation, extinction, dispersal, vicariance, endemism, provincialism and disjunction); phytogeographical patterns, biomes, vegetation types. Methodological issues in macro-ecology; patterns of body size, abundance and energetics; geographic range sizes; species dynamics in landscapes; implications of macro-ecological patterns to ecology; biogeography and evolution; macro-ecological perspectives on conservation: species richness, hierarchical diversity, hotspots, spatial and temporal patterns in diversity (genetic, taxonomic, functional); causal mechanisms, species diversity, biodiversity and global change.

ZEN 811 Conservation and development 811
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
An international perspective on human resource utilisation and its global effects. The problems of implementing conservation measures in the face of human development. Conservation as an economic process.

ZEN 872 Populations and communities: Spatial and temporal variability 872
Academic organisation: Zoology and Entomology
Contact time: 4 dpw
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Demography with emphasis on forces affecting population growth rate and regulation; competition and facilitation within and between populations; risk and risk assessment; temporal trends and extinction; management, harvesting and control with emphasis on illustrating principles using studies conducted in Africa.
Structure, composition and function of communities with emphasis on factors affecting resilience, resistance and persistence; temporal variability with emphasis on the influences of foodwebs structure and environmental variability; spatial pattern analysis; species-abundance relations; species affinities; community classification.

ZEN 875 Conservation in practice 875
Academic organisation: Zoology and Entomology
Contact time: 4 dpw 1 other per week
Period of presentation: Year
Language of tuition: English **Credits:** 30
Module content:
Conceptual issues in the management of small populations; captive propagation; control of invasive species; control of problem populations; restoration of species and communities; conservation education, and involvement of local communities in conservation programmes; monitoring techniques and data handling; design and interpretation of laboratory and field experiments to solve ecological and conservation problems.

ZEN 891 Research project 891
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 120
Module content:
Research projects may be based either on fieldwork, laboratory work, experiments or the analysis of existing data sets. This decision must be taken in consultation with the candidate's designated project supervisor. The choice of project topic will be determined to a very large extent by the time available for data collection and analysis.
Students should select and approach a potential supervisor based on their own interests and that of the supervisors. A list of projects may be made available, although the students may choose their own project as long as a supervisor agrees to it. Joint supervision of projects by more than one person at the University, or one person from outside the University, is also possible.
The purpose of the research project is to provide students with a thorough grounding in the planning, execution, analysis and scientific writing stages of a research project. Students must complete the background reading, design the objectives and perform the observations and/or experiments pertaining to the chosen project, as well as the analysis and compilation of the results and discussion in the form of a scientific publication. The project should be formatted for submission to a scientific journal.

ZOO 890 Dissertation: Zoology 890
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 180

AGR 990 Thesis: Agronomy 990
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 360
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presenting of the research results. In addition to the thesis, the student is also expected to publish at least one research paper in a peer-reviewed, UP accredited scientific journal. An oral examination covering Agronomic and other fields related to the thesis will be conducted after the thesis has been accepted by examiners. A candidate needs to pass both the written thesis and oral examination to qualify for the degree.

AGV 990 Thesis: Agrarian extension 990
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

APZ 990 Thesis: Animal production 990
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: English **Credits:** 360

ARD 990 Thesis: Rural development 990
Academic organisation: Agricultural Economics, Extension and Rural Developmen
Period of presentation: Year
Language of tuition: English **Credits:** 360

AWM 990 Thesis: Meteorology 990
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

BCM 990 Project and thesis 990
Academic organisation: Biochemistry
Period of presentation: Year
Language of tuition: English **Credits:** 360

BIF 990 Thesis: Bioinformatics 990
Academic organisation: Biochemistry
Period of presentation: Year
Language of tuition: English **Credits:** 360

BOT 990 Thesis: Plant science 990
Academic organisation: Plant Scienc
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

CHM 990 Thesis: Chemistry 990
Academic organisation: Chemistry
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

DPL 990 Thesis: Rural development planning 990
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: English **Credits:** 360

EGF 990 Thesis: Exploration geophysics 990
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

ENT 990 Thesis: Entomology 990
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 990 Thesis: Water resource management 990
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 991 Thesis: Environment and society 991
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 992 Thesis: Environmental ecology 992
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 993 Thesis: Environmental economics 993
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 994 Thesis: Environmental management 994
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 360

ENV 998 Thesis: Air quality management 998
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: English **Credits:** 360

FOR 990 Forest science 990
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 360
Module content:
*Interdepartmental programme. The curriculum is determined by the heads of department in the biological sciences and will include the research proposal development and scientific writing. This is followed by research in the area of the chosen specialisation in Forest Science culminating in the preparation and submission of research dissertation, including submission of scientific papers for peer reviewed credited journals.

FSK 990 Thesis: Physics 990
Academic organisation: Physics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

FST 990 Thesis: Food science 990
Academic organisation: Food Science
Period of presentation: Year
Language of tuition: English **Credits:** 360

GDK 990 Thesis: Soil science 990
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 360
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presenting of the research results. In addition to the thesis, the student is also expected to publish at least one research paper in a peer-reviewed, UP accredited scientific journal. An oral examination covering Soil Science and other fields related to the thesis will be conducted after the thesis has been accepted by examiners. A candidate needs to pass both the written thesis and oral examination to qualify for the degree.

GGF 990 Thesis: Geography 990
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

GIS 990 Thesis: Geoinformatics 990
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

GLG 990 Thesis: Geology 990
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

GTK 990 Thesis: Genetics 990
Academic organisation: Genetics
Period of presentation: Year
Language of tuition: English **Credits:** 360

GTX 990 Thesis: Hydrogeology 990
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

IGL 990 Thesis: Engineering geology 990
Academic organisation: Geology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

LDV 990 Land development 990
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

LEK 991 Thesis: Agricultural economics 991
Academic organisation: Agricultural Economics, Extension and Rural Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MBY 990 Thesis: Microbiology 990
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

MPS 990 Thesis: Medicinal plant science 990
Academic organisation: Plant Science
Period of presentation: Year
Language of tuition: English **Credits:** 360

NLB 990 Thesis: Wildlife management 990
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

PPT 990 Thesis: Plant pathology 990
Academic organisation: Microbiology and Plant Pathology
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

SCE 990 Thesis: Science education 990
Academic organisation: Centre for Science Development
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

TBK 990 Thesis: Horticultural science 990
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 360
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presenting of the research results. In addition to the thesis, the student is also expected to publish at least one research paper in a peer-reviewed, UP accredited scientific journal. An oral examination covering Horticultural Science and other fields related to the thesis will be conducted after the thesis has been accepted by examiners. A candidate needs to pass both the written thesis and oral examination to qualify for the degree.

TST 990 Thesis: Applied statistics 990
Academic organisation: Statistics
Period of presentation: Year
Language of tuition: English **Credits:** 480

TWS 990 Thesis: Applied mathematics 990
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

VBR 990 Thesis: Consumer science 990
Academic organisation: Consumer Science
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

VDG 990 Thesis: Nutrition 990
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 480

VKU 990 Thesis: Animal science 990
Academic organisation: Animal and Wildlife Sciences
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WDE 990 Thesis: Pasture science 990
Academic organisation: Plant Production and Soil Science
Period of presentation: Year
Language of tuition: English **Credits:** 360
Module content:
This module involves the development, presentation and approval of a research proposal, the execution of the research project, and the writing up and presenting of the research results. In addition to the thesis, the student is also expected to publish at least one research paper in a peer-reviewed, UP accredited scientific journal. An oral examination covering Pasture Science and other fields related to the thesis will be conducted after the thesis has been accepted by examiners. A candidate needs to pass both the written thesis and oral examination to qualify for the degree.

WIS 990 Thesis: Mathematics 990
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WST 990 Thesis: Mathematical statistics 990
Academic organisation: Statistics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WTW 990 Doctoral oral 990
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 360

WTW 993 Thesis: Mathematics education 993
Academic organisation: Mathematics and Applied Mathematics
Period of presentation: Year
Language of tuition: English **Credits:** 360

ZOO 990 Thesis: Zoology 990
Academic organisation: Zoology and Entomology
Period of presentation: Year
Language of tuition: English **Credits:** 360

E&OE