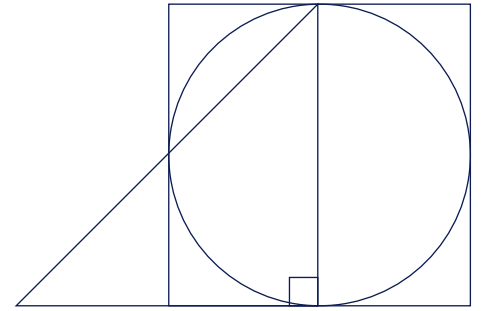


# Report

05/06



## Faculty of Natural and Agricultural Sciences



# Faculty of Natural and Agricultural Sciences

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Cover page: Aspects of natural and agricultural sciences.

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# From the Dean's office



*Prof. Herman van Schalkwyk.*

The Faculty of Natural and Agricultural Sciences at the University of the Free State (UFS) leads the way in the practising of natural and agricultural sciences in South Africa and the highest levels of quality and credibility are reflected.

Our commitment, however, reaches far beyond just this. It reaches beyond the borders of the country and across continents; its multi-disciplinary and practical approach is vested in all the disciplines presented by the faculty.

In 2005/06 the Faculty experienced significant growth in measurable outputs. A contributing factor was the comprehensive apparatus strategy and plan which was implemented in 2005. With this strategy, university funds were used to leverage other funds in order to obtain huge discounts from suppliers of apparatus. In this way the faculty managed to obtain almost R50 million worth of apparatus in 2005.

The strategy was continued in 2006 when an agreement to the value of R7 542 531 was reached with Shimadzu, according to which apparatus was supplied to the faculty at discount prices. The agreement, which is valid for three years, entails the free replacement of apparatus which is purchased during this period with upgraded versions.

The new apparatus forms part of the UFS vision to compete internationally with quality research outputs in certain niche areas, to provide leadership in advanced training to students from the African continent and to establish the university as a leader among South African universities.

Two researchers with a B rating from the National Research Foundation (NRF) were also appointed. Both of these initiatives bore fruit and in 2006 the faculty increased its total research outputs by

about 13%. As an example, the Department of Chemistry's outputs increased by 100%.

The faculty has been bursting at the seams over the past couple of years. Student figures rose from 3 935 undergraduate, postgraduate and occasional students in 2005, to 4 224 in 2006. There is also strong representivity of students from other African countries and in 2005/06 almost 600 students studied at the faculty.

An extended B.Sc. programme has been presented to students since 2005. The programme aims at providing students who do not comply with all the requirements for the B.Sc. programme with the necessary sub-structure to complete the B.Sc. degree successfully. A preliminary evaluation of the results indicates that the programme is delivering the desired results.

The alignment of the Qwaqwa Campus, which was incorporated into the UFS in January 2003, remains a challenge. Regular discussions are held with staff on the campus in order to make the faculty's programmes more sustainable and to align it with the broader strategic plan of the UFS.

On a national level, the faculty is in the process of making its mark in terms of teaching and community service. In 2005 the faculty again actively began utilising its

experimental farms. A three-way agreement between the UFS, the National Farmers Union (NAFU) and the Mangaung Local Municipality led to the establishment of the Lengau Agricultural Development Centre on the Sydenham Experimental Farm. The centre provides training and mentorship to small-scale upcoming farmers.

To be dynamic and progressive requires innovative thinking. It requires commitment and a desire to deliver excellent teaching and learning opportunities to students. It requires a willingness to form partnerships, and a multi-disciplinary and practical approach to the tertiary education environment in South Africa.

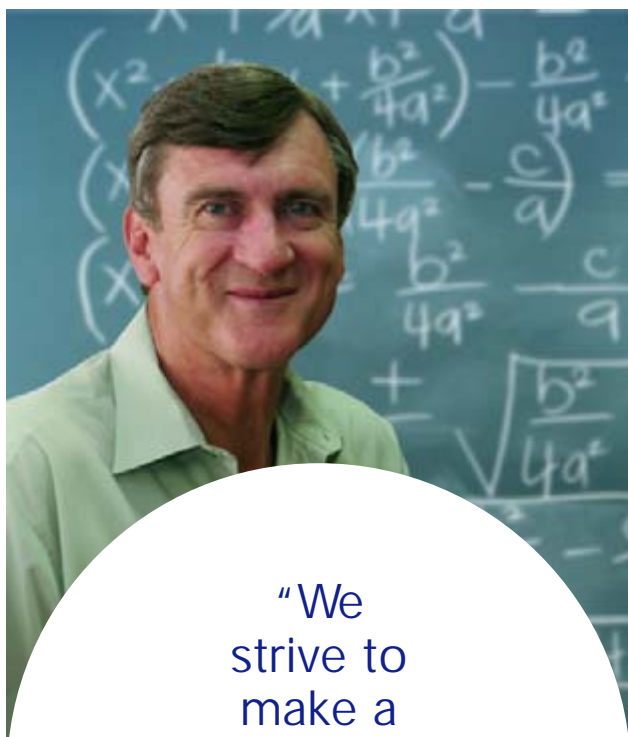
This report covers the faculty's activities in 2005/06. It is a reflection of two years' commitment on the part of a team of skilled and motivated academics and support staff.



**Prof. Herman van Schalkwyk**

Dean: Faculty of Natural and Agricultural Sciences  
University of the Free State

# Mathematics and Applied Mathematics



“We strive to make a difference.”

Prof. Dana Murray.

## Overview

The Department of Mathematics and Applied Mathematics offers a wide range of courses, at both undergraduate and postgraduate level. Many of the staff members are active in research and community service.

At postgraduate level, the department had four Ph.D. students in 2005, of whom three were specialising in Applied Mathematics and one in Mathematics. One of these Ph.D. students, Mr Patrick Mbambo, is a fellow of the AW Mellon Foundation and had a contract appointment as junior lecturer at the Qwaqwa Campus. The department had one M.Sc. student, who is in the process of completing his studies in graph theory.

Prof. Schalk Schoombie took research leave during the second semester of 2005. He completed two projects, each leading to a research article. The projects entailed a study of false modulations in the solving of a numerical difference scheme for the Van der Pol equation, and a Benjamin Feir analysis of the modulation stability of the Korteweg de Vries equation. In both cases use was made of a discreet multiple scale technique. Both articles were submitted for publication.

In 2006 Mrs Julia van Niekerk was promoted to the position of senior lecturer in recognition of her excellence in teaching. Prof. Herman le Roux retired at the end of the year. The department acknowledges and appreciates his dedication, especially during the incorporation of the Vista Campus.

Prof. Schoombie initiated several projects in collaboration with Prof. Eben Maré of the University of Pretoria. These projects included:

- A general study of the ability of central difference methods to approach the modulations of weak non-linear disturbances of simple harmonic movement.
- Techniques to solve the Black-Scholes comparison numerically on the real line and on the half real line.
- The use of high order central differential techniques for the numerical solving of non-linear dispersive wave comparisons.



Proff. Maré en Schoombie also initiated two other projects, each involving a Ph.D. student:

- The numerical calculations of singular evolution points and their classification in the case of chaotic population models, using the principles of adaptive dynamics.
- Developing a model to predict conflict between three and more persons in a working environment.

Prof. Johan Meyer conducted research in ring and module theory, as well as near-ring theory in 2005 with Ms Karen Howell, a Ph.D. student. In 2006 he continued his research on near-rings and near-fields together with Ms Howell, also focusing on near vector spaces.

Prof. Meyer delivered a paper on work in the group near-rings during the 19th International Congress on Near-Rings and Near-Fields held in August 2005 in Chi-Tou, Taiwan. This paper covered work that he had done the previous year in collaboration with Prof. Groenewald of the University of Port Elizabeth. An article in this context was submitted for publication.

In 2005 Proff. Meyer and Alain Clout submitted an article about certain identities which was accepted for publication in the *International Journal of Mathematics Education of Science and Technology*. Furthermore, the article: *Tolerance intervals for the unbalanced one-way random effects model, using a Bayesian procedure* by Van der Merwe, Pretorius and Meyer, was accepted for publication in the *Journal of Quality Technology*.

Prof. Jo Schröder from the Qwaqwa Campus submitted an article in the field of combinatorica for publication in 2005. He also delivered a lecture entitled: *Schröder numbers of arbitrary integer slope* at the annual congress of the South African Mathematics Society in Grahamstown. Prof. Clout continued his fundamental research in the field of fractional order derivatives and the possible applications thereof in groundwater studies. A start was also made in comparative studies on the relationships between fractional order derivatives and fractals.

In April 2006 Prof. Meyer attended a symposium on training and research during the Pan African Mathematics Olympiad at the Kenya Institute of Education in Nairobi, Kenya, where he delivered a talk on the Nautilus Mathematics Project in the Free State Province.

During July 2006, Prof Meyer visited Prof. W-F Ke of the National Cheng-Kung Univer-

sity in Tainan, Taiwan, where he worked on planarity in matrix near-rings. He also delivered three research talks on group near-rings, matrix near-rings and forcing linearity. In August 2006 he attended the International Congress of Mathematicians in Madrid, Spain.

In November 2006 Prof. Meyer was the main organiser of the 49th Annual Conference of the South African Mathematics Society, held on the Main Campus in Bloemfontein. There were 130 delegates, delivering 90 research papers (in four parallel sessions) on various topics such as Graph Theory, Combinatorics, Algebra, Dynamical Systems, Topology, Functional Analysis, Operator Theory, Mathematical Physics, Computational Methods, Category Theory, the History and Teaching of Mathematics, Financial Mathematics and the Application of Mathematics in the Sciences. In addition, five invited speakers delivered plenary talks in the areas of Pure Mathematics, Applied Mathematics and the Teaching of Mathematics.

Prof. Meyer helped to compile the final round paper for the senior division (Grades 10-12) of the South African Mathematics Olympiad during October 2006.

Prof. Jo Schröder from the Qwaqwa Campus took research leave during the second semester of 2006. During this time he worked at the Department of Mathematics of the Freie Universität Berlin. He benefited not only from a number of well-equipped scientific libraries in Berlin, but also from talks and seminars presented by colleagues. He submitted two articles in the field of combinatorics for publication and delivered an invited lecture entitled: *Schröder Zahlen beliebiger ganzzahliger Steigung* at the Mathematics Colloquium of the Freie Universität.

Prof. Clout developed a new postgraduate course on Fractional Calculus. He also continued the fundamental research on the topic of partial derivatives of non-integer orders and their applications in ground-water modelling.

Dr Samantha Dorfling researched a new graph invariant called the completion number of a graph. She studied its relationship to the (circular) chromatic and (circular) clique numbers of simple and perfect graphs. The main idea was to find better approximations for the latter invariants.

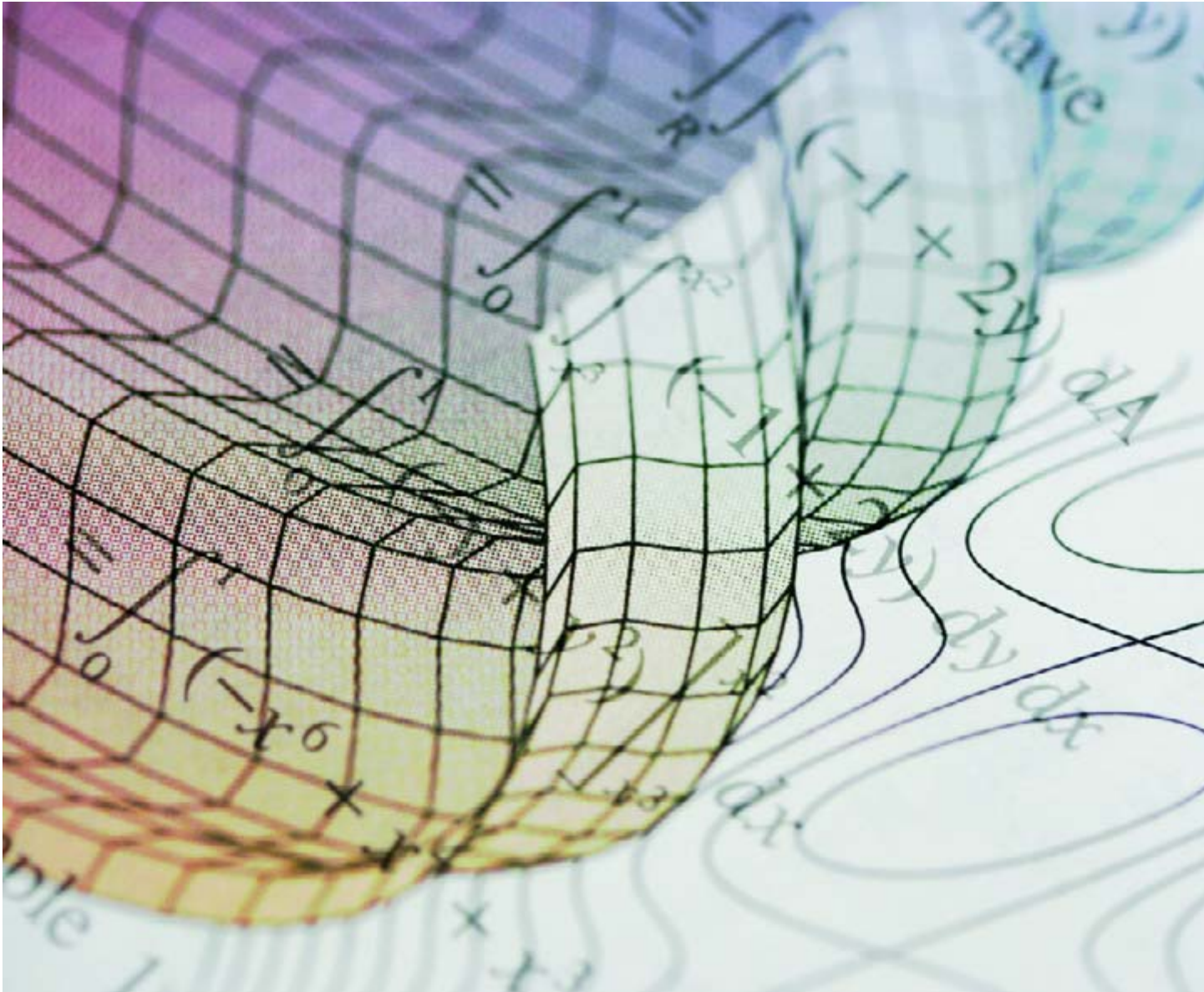
In the area of community service, Prof. Meyer and Mr Christiaan Venter were closely involved during 2005/06 with the Nautilus Mathematics Project, which is presented quarterly at Grey College in Bloemfontein. This project is an attempt to moti-



vate talented learners from the Free State Province, as well as certain parts of the Northern Cape, to perform better in Maths Olympiads. Prof. Meyer and Mr Venter were also involved in the preparation of the Free State team that took part in the inter-provincial Maths competition. Over the past few years, these teams (both juniors and seniors) have fared relatively well compared to teams from the rest of the country, mainly because of the intensive

coaching that they receive through the Nautilus Project.

The department took part in the UFS 2006 Open Day and made a contribution towards the popularisation of Mathematics at the National Maths Week held in Kroonstad and Bloemfontein. Mr Venter again organised the involvement of the Faculty of Natural and Agricultural Sciences in the Sasol Science Expo held in Sasolburg.



## Academic staff

### Main Campus

**Professors:** Proff. Johan Meyer, Schalk Schoombie, Dana Murray, Alain Cloot

**Senior Lecturers:** Dr Hubertus

Bargenda, Ms Julia van Niekerk

**Lecturers:** Dr Samantha Dorfling, Mr Chistiaan Venter, Ms Ansa Kleynhans

**Temporary Lecturers:** Mss Magrietha Theron, Yvette Erasmus, Martie Jacobs, Martie Calitz, Anita Swart, Marina Botha

### Qwaqwa Campus

**Associate Professor:** Prof. Jo Schröder

**Temporary Lecturers:** Messrs Patrick Mbambo, Nalapan Sebastian, Neo Tsosane, Ms Christa Faber

### Vista Campus

**Professor:** Prof. Herman le Roux

**Associate Professor:** Prof. Thomas Acho

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## Research outputs

### Publications

**Cloot, A.H.J.J. & Meyer, J.H.** 2006. An interesting family of identities. *International Journal of Mathematics Education in Science and Technology* 37(2): 247-252.

**Van der Merwe, A.J., Pretorius, A.L. & Meyer, J.H.** 2006. Tolerance intervals for the unbalanced one-way random effects model, using a Bayesian procedure. *Journal of Quality Technology* 38(3): 280-293.

### Conference contributions

**Meyer, J.H.** 2005. *Prime ideals in group near-rings*. Paper presented at the 19th International Conference on Near-rings and Near-fields, Chi-Tou, Taiwan.

**Schoombie, S.W. & Maré, E.** 2006. *Spurious behaviour of leapfrog schemes for some perturbed harmonic oscillators*. Paper presented at the 30th Annual Symposium on Numerical and Applied Mathematics, Stellenbosch, South Africa.

**Schröder, J. & Oosthuizen, J.dP.** 2005. *Schröder numbers of arbitrary integer slope*. Paper presented at the 48th Annual Congress of the South African Mathematical Society, Grahamstown, South Africa.

# Statistical data of the faculty



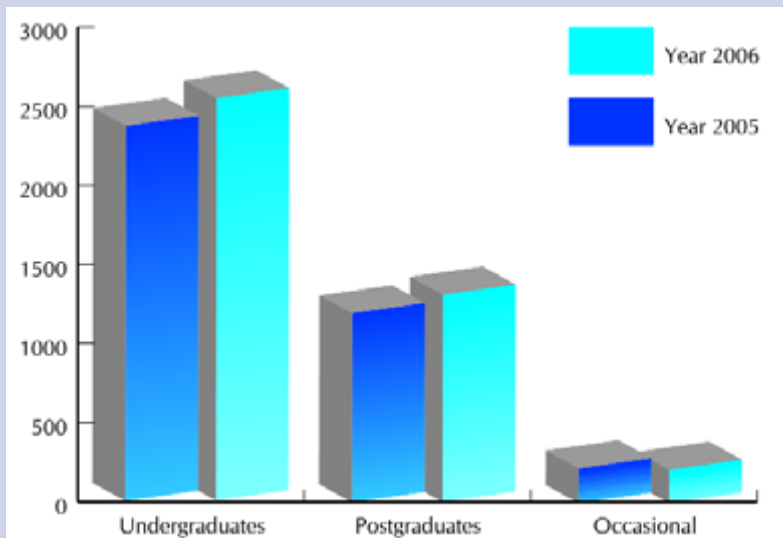
# Student figures

Faculty of Natural and Agricultural Sciences, 2005/06

Male					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	676	31	26	724	1457
Postgraduate	351	22	15	400	788
Occasional	84	3	4	17	108
<b>Total 2005</b>	<b>1111</b>	<b>56</b>	<b>45</b>	<b>1141</b>	<b>2353</b>
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	729	28	21	768	1546
Postgraduate	385	21	16	431	853
Occasional	68	2	2	23	95
<b>Total 2006</b>	<b>1182</b>	<b>51</b>	<b>39</b>	<b>1222</b>	<b>2494</b>

Female					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	563	41	11	394	1009
Postgraduate	206	16	11	221	454
Occasional	101	5	2	11	119
<b>Total 2005</b>	<b>870</b>	<b>62</b>	<b>24</b>	<b>626</b>	<b>1582</b>
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	641	39	17	401	1098
Postgraduate	243	15	17	234	509
Occasional	103	2	2	16	123
<b>Total 2006</b>	<b>987</b>	<b>56</b>	<b>36</b>	<b>651</b>	<b>1730</b>

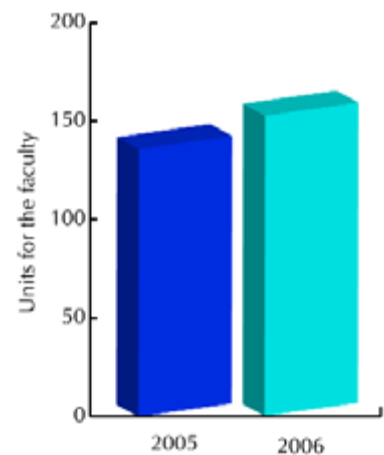
Total					
2005					
Description	African	Coloured	Indian	White	Total
Undergraduate	1239	72	37	1118	2466
Postgraduate	557	38	26	621	1242
Occasional	185	8	6	28	227
<b>Total 2005</b>	<b>1981</b>	<b>118</b>	<b>69</b>	<b>1767</b>	<b>3935</b>
2006					
Description	African	Coloured	Indian	White	Total
Undergraduate	1370	67	38	1169	2644
Postgraduate	628	36	33	665	1362
Occasional	171	4	4	39	218
<b>Total 2006</b>	<b>2169</b>	<b>107</b>	<b>75</b>	<b>1873</b>	<b>4224</b>



Student figures

Student nationality		
Nationality	2005	2006
Angola	1	
Asian countries	21	18
Botswana	20	20
European countries	6	6
Lesotho	142	142
Malawi	2	1
Mauritius		2
Mozambique	8	7
Namibia	40	42
No information	1	
North America	4	4
Other Africa	45	48
South Africa	3610	3893
South America		1
Swaziland	13	13
Zambia	4	6
Zimbabwe	18	21
<b>Total</b>	<b>3935</b>	<b>4224</b>

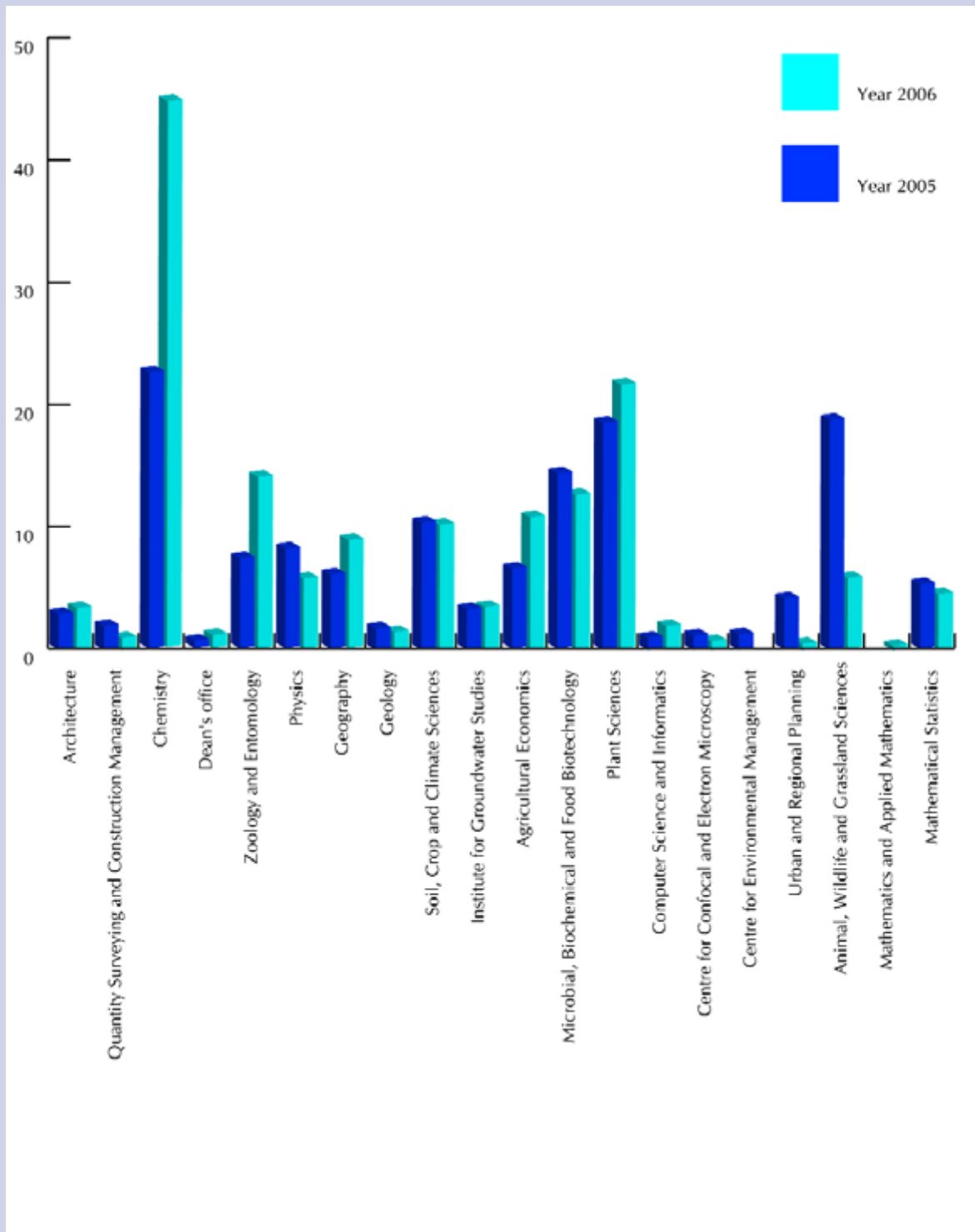
## Research outputs for the Faculty of Natural and Agricultural Sciences



Articles published in accredited approved research journals.

## Departmental research outputs

Articles published in accredited approved research journals, 2005/06



# Glossary



# Glossary

## A

ACIAR	Australian Centre for International Agricultural Research
AEASA	Agricultural Economics Association of South Africa
ALPRU	African Large Predator Research Unit
ARC	Agricultural Research Council
ARMSCOR	Armaments Corporation of South Africa
ARS	Agri Risk Specialists
ASAQS	Association of South African Quantity Surveyors
ASSA	Anatomical Society of South Africa
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVS	American Vacuum Society

## C

CANSA	Cancer Association of South Africa
CATSA	Catalysis Society of South Africa
CBD	Convention of Biological Diversity
CCEM	Centre for Confocal and Electron Microscopy
CePHMa	Centre for Plant Health Management
CfPB	Centre for People and Buildings
CIAT	International Centre for Tropical Agriculture
CIDB	Construction Industry Development Board
CIMMYT	International Maize and Wheat Improvement Centre
CIOB	Chartered Institute of Building
CIOB-SA	Chartered Institute of Building - South Africa
CSACEE	Central South African Council on Economic Education
CSIC-INTA	Centro de Astrobiología
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation

## D

DEAT	Department of Environmental Affairs and Tourism
DiMTEC	Disaster Management Training and Education Centre for Africa
DMISA	Disaster Management Institute of South Africa
DST	Department of Science and Technology

## E

EAAP	European Association for Animal Production
EASA	Education Association of South Africa
ECA	European Crystallographic Association
EIGG	Environmental Inorganic Geochemistry Group
EPWP	Expanded Public Works Programme
ESBES	European Symposium on Biochemical Engineering Science
ESREL	European Safety and Reliability
ESRP	Economic and Social Rehabilitation Programme

## F

FAO	Food and Agriculture Organisation
FEMS	Federation of European Microbiological Societies
FMP	Facilities Management Programme
FOTIM	Foundation of Tertiary Institutions of the Northern Metropolis

FSRPO	Free State Red Meat Producers Organisation
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## G

GIS	Geographical Information Systems
Glen ADI	Glen Agricultural Development Institute
GM	Genetically Modified
GMBA	Gauteng Master Builders' Association
GMO	Genetically Modified Organisms
GWK	Griekwaland-Wes Koöperasie

## H

HIV	Human Immunodeficiency Virus
HPCSA	Health Professions Council of South Africa
HPLC	High Performance Liquid Chromatography
HSPCM	Health and Safety Programme for Construction Managers

## I

IAGOD	International Association on the Genesis of Ore Deposits
IAH	International Association of Hydrogeologists
ICCC	International Conference on Coordination Chemistry
ICEC	International Cost Engineering Council
ICID	International Commission on Irrigation and Drainage
ICP	Inductively Coupled Plasma
ICRBM	International Conference on Rodent Biology and Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDC	Industrial Development Corporation
IGS	Institute for Groundwater Studies
IITA	International Institute of Tropical Agriculture
INCRoP	Insects on New Crops Programme
INTSORMIL	International Sorghum and Millet Research Support Programme

## IPMA

IPMA	International Project Management Association
IPMP	Intensive Project Management Programme
IRDP	Institutional Research and Development Programme
IRWH	In-field Rainwater Harvesting
IUCr	International Union of Crystallography
IUMS	International Union of Microbial Societies
IUPAP	International Union of Pure and Applied Physics

## J

JFM	Journal of Facilities Management
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## L

LExEn	Life in Extreme Environments
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## M

MIRCHEN	Microbiological Resources Centre
MIT	Massachusetts Institute of Technology
MRM	Mineral Resource Management
MSA	Master's Degree in Sustainable Agriculture
MSSA	Microscopy Society of Southern Africa
MUCPP	Mangaung University Community Partnership Programme
MURP	Master's Degree in Urban and Regional Planning

## N

NaCOF	National Climate Outlook Forum
NAFU	National African Farmers Union
NAMC	National Agricultural Marketing Council
NASA	National Aeronautics and Space Administration
NASSP	National Astrophysics and Space Science Programme
NCEE	National Council for Economic Education
NDA	National Department of Agriculture
NECSA	National Energy Commission of South Africa
NELSAM	Natural Earthquake Laboratory in South African Mines
NERPO	National Emergent Red Meat Producers' Organisation
NGO	Non-Governmental Organisation
NML	National Metrological Laboratory
NMMU	Nelson Mandela Metropolitan University
NMR	Nuclear Magnetic Resonance
NRF	National Research Foundation
NUFU	Norwegian Council of Universities Committee for Development, Research and Education
NWGA	National Wool Growers' Association

## O

OABS	Optimal Agricultural Business Solutions
OECD	Organisation for Economic Co-operation and Development

## P

PARSA	Parasitological Association of Southern Africa
PDMIW	Processing and Disposal of Mineral Industry Wastes
POT	Peaks over Threshold
PPP	Public Private Partnership
PRT	Protein Research Trust

## R

RICS	Royal Institute of Chartered Surveyors
RIEP	Research Institute of Education Planning
RNA	Research Niche Area
RPO	Red Meat Producers' Organisation

## S

SA	South Africa
SAACE	South African Association of Consulting Engineers
SAB	The South African Breweries Limited
SACI	South African Chemical Institute
SACPCMP	South African Council for the Project and Construction Management Profession
SACPVP	South African Council for the Property Valuation Profession
SACQSP	South African Council for the Quantity Surveying Profession
SADC	Southern African Development Community
SAFMA	South African Facilities Management Association
SAFOI	South African Fryer Oil Initiative
SAIP	South African Institute of Physics
SAISC	Southern African Institute of Steel Construction
SAMSI	Statistical and Applied Mathematical Sciences Institute

SANCIAHS	South African National Committee for the International Association of Hydrological Sciences	SEDA	Small Enterprise Development Agency	UNEP	United Nations Environment Programme
SANCU	South African National Consumer Union	SMME	Small, Medium and Micro Enterprises	UNESCO	United Nations Educational, Scientific and Cultural Organisation
SANPAD	South Africa-Netherlands Research Programme on Alternatives in Development	SRC	Student Representative Council	USA	United States of America
SAPOA	South African Property Owners' Association	SRL	Sustainable Rural Livelihood	USAID	United States Agency for International Development
SAPS	South African Police Services	SSAG	Society of South African Geographers	UTCHEM	University of Texas Chemical Compositional Simulator
SAQA	South African Qualifications Authority	<b>T</b>		UWC	University of the Western Cape
SASAS	South African Society for Animal Science	THRIP	South African National Research Foundation Thrust for Industry-Related Projects	<b>W</b>	
SASQUA	Southern African Society for Quaternary Research	TUE	Technical University Eindhoven	WARFSA	Water Research Fund of Southern Africa
SAVAH	South African Association of Visual Arts Historians	<b>U</b>		WATOC	World Association of Theoretically Orientated Chemists
SBE	Sustainable Built Environments	UCT	University of Cape Town	WFP	World Food Programme
		UFS	University of the Free State	WITS	University of the Witwatersrand
		UJ	University of Johannesburg	WRC	Water Research Commission
		UK	United Kingdom	WUA	Water Users' Association
		UN	United Nations		