Revised Academic Framework for Registration of the South African Geomatics Council (SAGC)

GISc Branch

Approved:

March 2024

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GLOSSARY

academic framework	A specification of the minimum credits per knowledge area, which is used to "determine which educational programmes or qualifications relating to geomatics, registered or to be registered with the NQF by the South African Qualifications Authority in terms of that Act, would be recognised for the purposes of subsection (4)(a), (b)(i), (c)(i) and (d)(i)" (Geomatics Profession Act 19 of 2013), that is, for the purposes of registration with the SAGC.
branch	As per the Geomatics Profession Act 19 of 2013, branch "means a specific specialisation field of geomatics, including land surveying, topographical surveying, engineering surveying, mine surveying, geo-spatial information science, hydrographic surveying and photogrammetric surveying or any other specialisation field which may be determined by the Minister by notice in the Gazette". Examples of branches are Engineering Surveying, Land Surveying, Mine Surveying, and Geographical Information Science.
category	As per the Geomatics Profession Act 19 of 2013, a person may be registered in one or more of the categories within a branch. These categories are: candidate geomatics practitioner, geomatics technician, geomatics technologist, and geomatics professional. For brevity in this report, the last three categories are referred to as Technician, Technologist, and Professional abbreviated to GTc, GTg, GPr.
credit	"A measure of the volume of learning required for a qualification or part-qualification, quantified as the number of notional study hours required for achieving the learning outcomes specified for the qualification or part qualification. One credit is equated to ten (10) notional hours of learning." (NQF Standard Glossary of Terms, published by SAQA, 2017).
curriculum	"A statement of the training structure and expected methods of learning and teaching that underpin a qualification or part-qualification to facilitate a more general understanding of its implementation in an education system." (NQF Standard Glossary of Terms, published by SAQA, 2017).
EAC	Education Advisory Committee of the SAGC
GISc	geographical information science, synonymous with geographic information science, geo-spatial information science, geospatial information science and geo-information science.
GPA	Geomatics Profession Act 19 of 2013
GPr	Geomatics Professional
GTc	Geomatics Technician
GTg	Geomatics Technologist
knowledge area (KA)	A set of themes and keywords that describes related content in the SAGC academic framework. *Note: A knowledge area is not necessarily aligned with courses or modules in a curriculum; its contents may be covered by multiple courses or modules over multiple years of study.*
notional hour	"The agreed estimate of the learning time that it would take an average learner to meet the defined learning outcomes; it includes consideration of contact time, research, completion of assignments, time spent in structured learning in the workplace, individual learning and assessment. Ten notional hours equate to one credit." (NQF Standard Glossary of Terms, published by SAQA, 2017).
SAGC	South African Geomatics Council
voluntary association	"any association, organisation, institute or other body of registered persons recognised by the Council in terms of section 18" (Geomatics Profession Act No.19 of 2013).

1 Introduction and Purpose of the Review

The South African Geomatics Council (SAGC) approved a review of the SAGC Academic Framework at its meeting on 11-12 February 2020. The review was to be done for the following branches*: Land Surveying, Engineering Surveying, GISc* and *Mine Surveying*. Topographical surveying (mentioned in the Geomatics Profession Act 19 of 2013) is no longer used as a separate branch of registration. In industry, education, and for registration purposes, topographical surveying is understood to be part of the Engineering Surveying branch. The review was proposed by the Education Advisory Committee (EAC).

The scope of the work is a comprehensive review of the current academic framework for the four branches identified above and in each of their categories of registration. This has been done based on future trends in the profession, both in South Africa and in other countries.

2 Structure of the Review Process

2.1 Structure of panels

The EAC set up the Review panels for the review process. A panel was set up for each of the four branches of registration and the Panel Conveners who would coordinate the review in each panel were nominated by the EAC. This was to ensure a thorough process of review by practitioners in that branch. The Panel of Conveners was chaired by the Chairperson of the EAC. The following are the roles and responsibilities of **each** Review Panel as extracted from the Terms of Reference:

2.1.1 Chairperson of the Conveners' Panel

The review shall be led by the **Chairperson of the Education Advisory Committee (EAC)**, who will:

a. Coordinate the review process, provide guidance to conveners and their panels and the necessary oversight.
b. Chair the convener meetings.
c. Liaise with voluntary associations regarding the nomination of panel members, and appoint panel members.
d. Arrange consultation workshops with SAGC members.
e. Attend some of the meetings of the four panels.
f. Consolidate the recommendations from individual panels into a final report.
g. Coordinate the process of sharing the revised academic frameworks with the voluntary associations and universities, processing the comments received with the respective panels, and drafting final recommendations.
h. Present the revised academic framework to the EAC and Council for approval.

2.1.2 Panel Convener

The EAC nominated a **convener** for each branch. Each convener will lead a panel. The convener will:

a. Attend convener meetings and consultation workshops.
b. Lead and coordinate the review of the academic framework for a specific branch and its categories of registration, amongst others, assigning tasks to panel members in line with the brief of work for the panel and setting timelines and milestones together with the panel members.
c. Coordinate the revision of the academic framework for the specific branch and its categories of registration.
d. Review comments from the voluntary associations and universities.
e. Draft final revised academic framework.
f. Present the revised academic framework to the Chairperson for coordinating EAC and Council approval.

2.1.3 Panel Members

In consultation with the voluntary associations and universities, **Panel members** were appointed for each panel.

a. Are either academics at a South African university or registered with the SAGC in the branch for which their panel is responsible.
b. Attend panel meetings and consultation workshops.
c. Actively contribute to the research for and review of the academic framework for a specific branch.

The list of panel members who participated in the review process is provided in Appendix 1, organised by Branch.

The Engineering Surveying (ES) and Land Surveying (LS) panels worked jointly from the earliest stages to the end of the review process because of the significant overlap between the two branches. The Conveners for the two branches co-chaired the joint meetings of the panels.

2.1.4 The Registrar's Office

The **Registrar's Office** will support the review process by

a. Taking care of the logistics of meetings and workshop arrangements, including but not limited to managing expenses on the allocated budget.
b. Provide collation and editing of documentation as required by conveners and the Chairperson.

2.2 The Review Process

The review considered:

a. Current minimum academic requirements for each branch and category, as specified in the SAGC academic framework.
b. Tertiary qualifications in other countries relevant to each branch and category.
c. Academic requirements for registration or licensing in each branch and category in other countries.
d. Feedback and suggestions in reports from previous accreditation visits.
e. Relevant legislation and regulations, such as the Mine Health and Safety Act, Land Survey Act and Spatial Data infrastructure Act.
f. The review will also consider comments received from EAC and SAGC members.

The review shall follow the steps in the process outlined in section 2.4.

2.3 Outcomes of the Review Process

The outcome of the review is a revised SAGC Academic Framework for Registration that:

a. *Identifies the foundational knowledge* that is common to all branches.
b. Is *flexible* enough so that it can be readily adjusted to new developments.
c. *Specifies the minimum academic requirements* for each branch in terms of knowledge and skills taking cognisance of tasks, work activities and legislation.
d. *Specifies the amount of unspecified content per category and branch*, providing higher education institutions with some degree of academic autonomy and allowing them to specialize and differentiate their offering in order to be at the forefront of developments and to provide leadership and forward thinking in the profession.
e. Necessitated the need to clarify the definitions within the branches and categories, resulting in the development of the 'Definitions' document included in Appendix 4.

2.4 Schedule of Work

The schedule of work for the panels is outlined in the Terms of Reference. A summary is included here but the detailed schedule is in the TORs in Appendix 2.

The main aspects of the schedule of work for the review were *five-fold*. *Firstly*, to constitute the Panels for the respective Branches under review by requesting representation from voluntary associations and universities and the Chief Surveyor General's (CSG) office. *Secondly,* the panels began their work of reviewing the framework by branch. This process involved research using both local and international sources, collation and integration aided by robust debate. The *third* aspect is the alignment and collation of the content by the Panel of Conveners before sending the revised academic framework out to the voluntary associations and universities for comment. The *fourth* aspect is the review of the proposed framework by the voluntary associations and universities. The *fifth* aspect is the update, final review and adoption of the revised framework by the SAGC.

During the revision process it became necessary to clarify the differentiation between the Geomatics branches and categories for purposes of interpretation of the academic framework. It therefore became necessary to develop a document detailing the definitions for branches and their categories based on existing legislation. The document is outlined in Appendix 4.

3 Summary of the Revised Academic Frameworks by Branch

Summaries of the Revised Academic Frameworks for each branch and its related categories are outlined in this section to provide an overview of the overall process. The summary frameworks are presented showing the distribution of credits for the knowledge areas (KAs) in the '*New*' and '*Old*' frameworks as well as the NQF level for each registration category. The detailed Revised Academic Frameworks are found in Appendix 3. Section 4 of the report, along with Appendix 3, falls within the scope of the Review – it therefore requires acceptance or rejection by the Council.

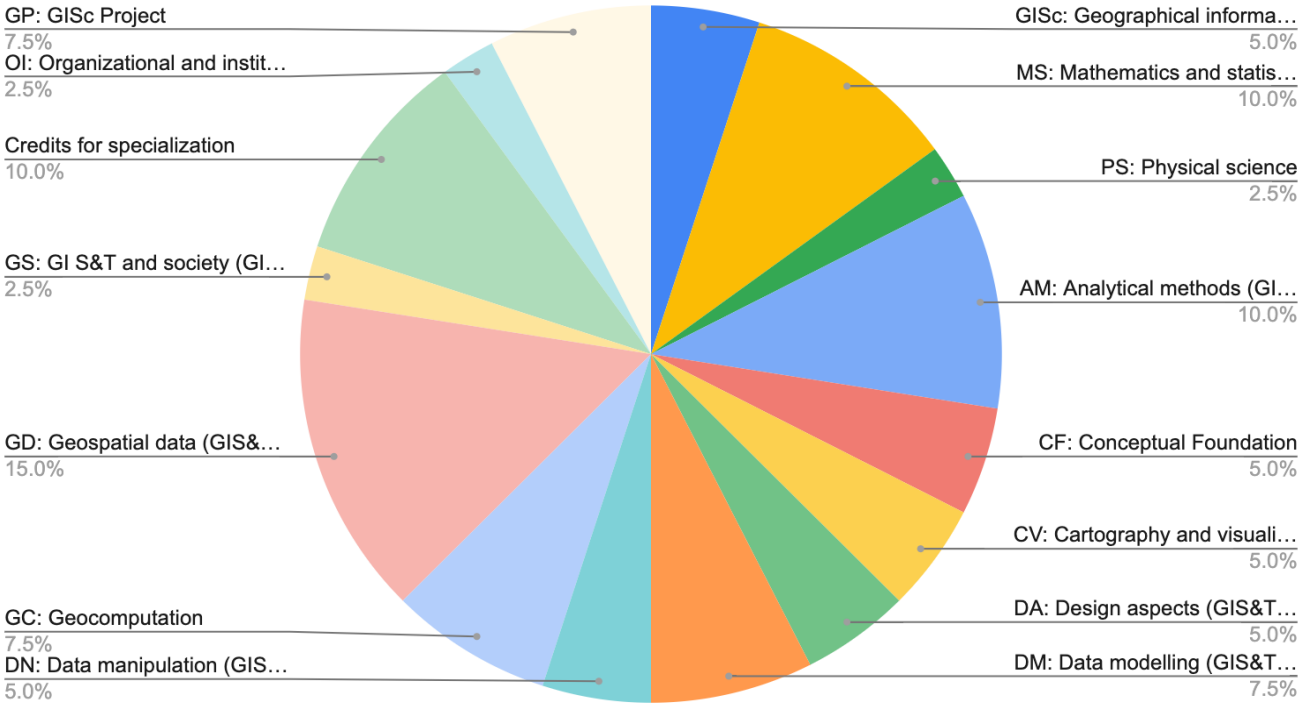
South African Geomatics Council (SAGC)

GUIDELINES FOR MINIMUM QUALIFICATION REQUIREMENTS FOR REGISTRATION IN THE GISc BRANCH

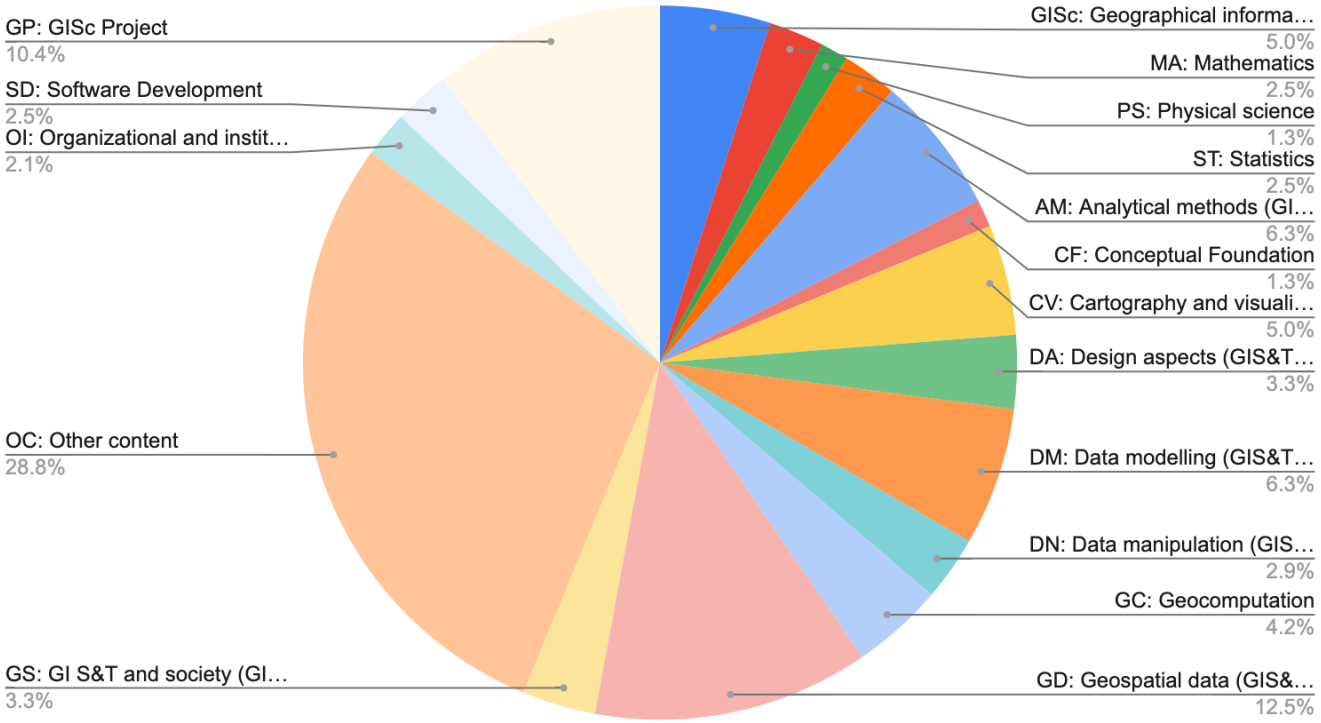
To be used in conjunction with knowledge area (KA) content specifications.
One credit is considered to be 10 hours of notional learning.
A knowledge area is not necessarily aligned with courses or modules in a curriculum; its content may be covered by multiple courses or modules over multiple years of study.
A knowledge area for which credits are not specified is assessed qualitatively, e.g., as a graduate attribute or overall degree outcome based on outcomes embedded in all the knowledge areas in the curriculum.
10% leeway per KA is allowed as long as there is no material impact on the qualification.
Note: Themes and keywords in this framework draw on the UCGIS Geographic Information Science and Technology Body of Knowledge, see http://gistbok.ucgis.org/, the Project Management Body of Knowledge (PMBoK), see https://www.pmi.org/, and the IEEE Software Engineering Body of Knowledge (SWEBoK), https://www.computer.org/education

Knowledge Area (KA)	GISc Professional NQF Level 8				GISc Technologist NQF Level 7				GISc Technician NQF Level 6			
	Credits (old)	% of 480	Credits (new)	% of 480	Credits (old)	% of 360	Credits (new)	% of 360	Credits (old)	% of 240	Credits (new)	% of 240
Fundamental Kas												
GISc: Geographic information science	24	5	24	5	24	7	24	7	24	10	24	10
MA: Mathematics	0	0	12	3	0	0	12	3	0	0	8	3
MS: Mathematics and statistics	48	10	0	0	48	13	0	0	24	10	0	0
PS: Physical science	12	3	6	1	12	3	6	2	12	5	6	3
ST: Statistics	0	0	12	3	0	0	12	3	0	0	12	5
Core KAs												
AM: Analytical methods (GIS&T BoK)	48	10	30	6	32	9	30	8	18	8	26	11
CF: Conceptual Foundation	24	5	6	1	16	4	6	2	12	5	6	3
CV: Cartography and visualization (GIS&T BoK)	24	5	24	5	24	7	24	7	24	10	24	10
DA: Design aspects (GIS&T BoK)	24	5	16	3	12	3	16	4	12	5	6	3
DM: Data modelling (GIS&T BoK)	36	8	30	6	24	7	30	8	12	5	18	8
DN: Data manipulation (GIS&T BoK)	24	5	14	3	24	7	14	4	12	5	12	5
GC: Geocomputation	36	8	20	4	24	7	20	6	12	5	10	4
GD: Geospatial data (GIS&T BoK)	72	15	60	13	56	16	60	17	36	15	44	18
GS: GI S&T and society (GIS&T BoK)	12	3	16	3	12	3	14	4	12	5	12	5
Credits for specialization	48	10	0	0	20	6	0	0	10	4	0	0
OC: Other content	0	0	138	29	0	0	50	14	0	0	10	4
OI: Organizational and institutional aspects (GIS&T BoK)	12	3	10	2	12	3	10	3	12	5	8	3
SD: Software Development	0	0	12	3	0	0	12	3	0	0	6	3
Non-core KAs												
GP: GISc Project	36	8	50	10	20	6	20	6	8	3	8	3
Non-credit based KAs												
PC: Professional communication			embedded in all Kas				embedded in all Kas				embedded in all Kas	
SS: Soft skills			embedded in all Kas				embedded in all Kas				embedded in all Kas	
Total	**480**	100	**480**	100	**360**	100	**360**	100	**240**	100	**240**	100

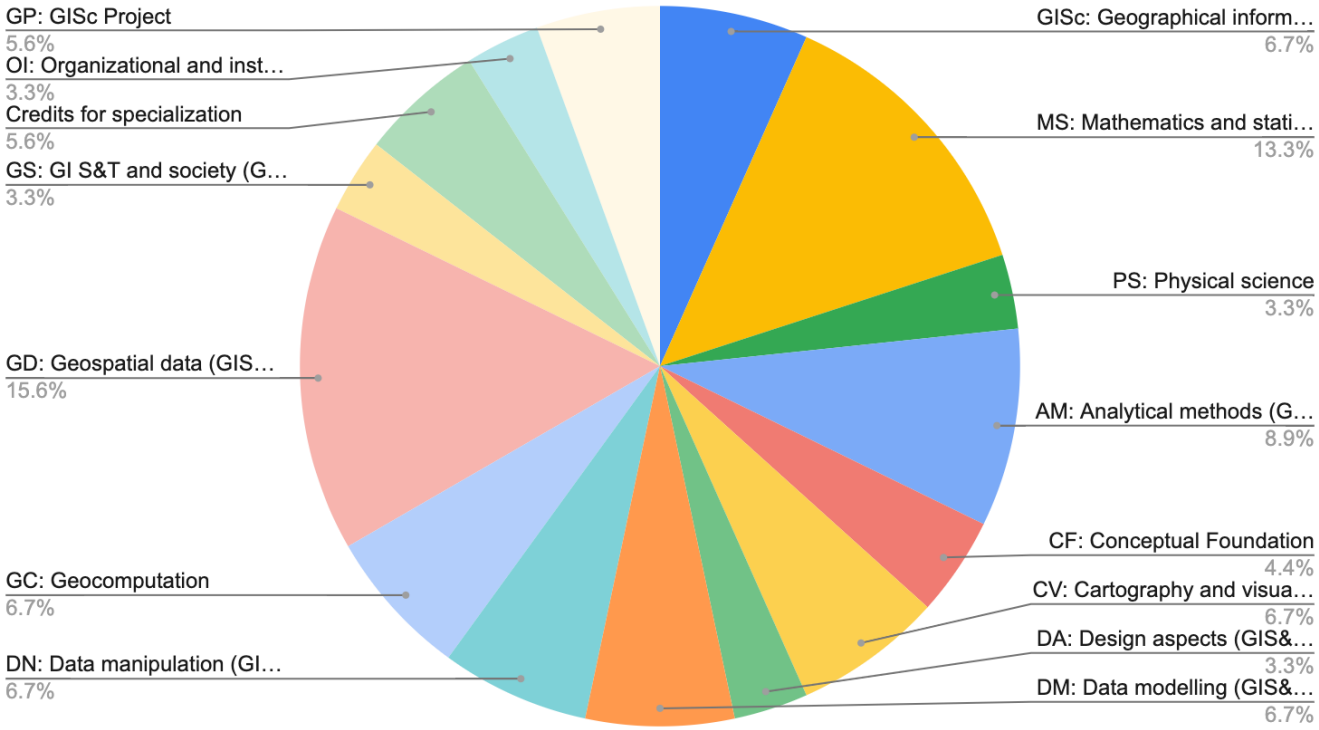
GISc Professional (old)



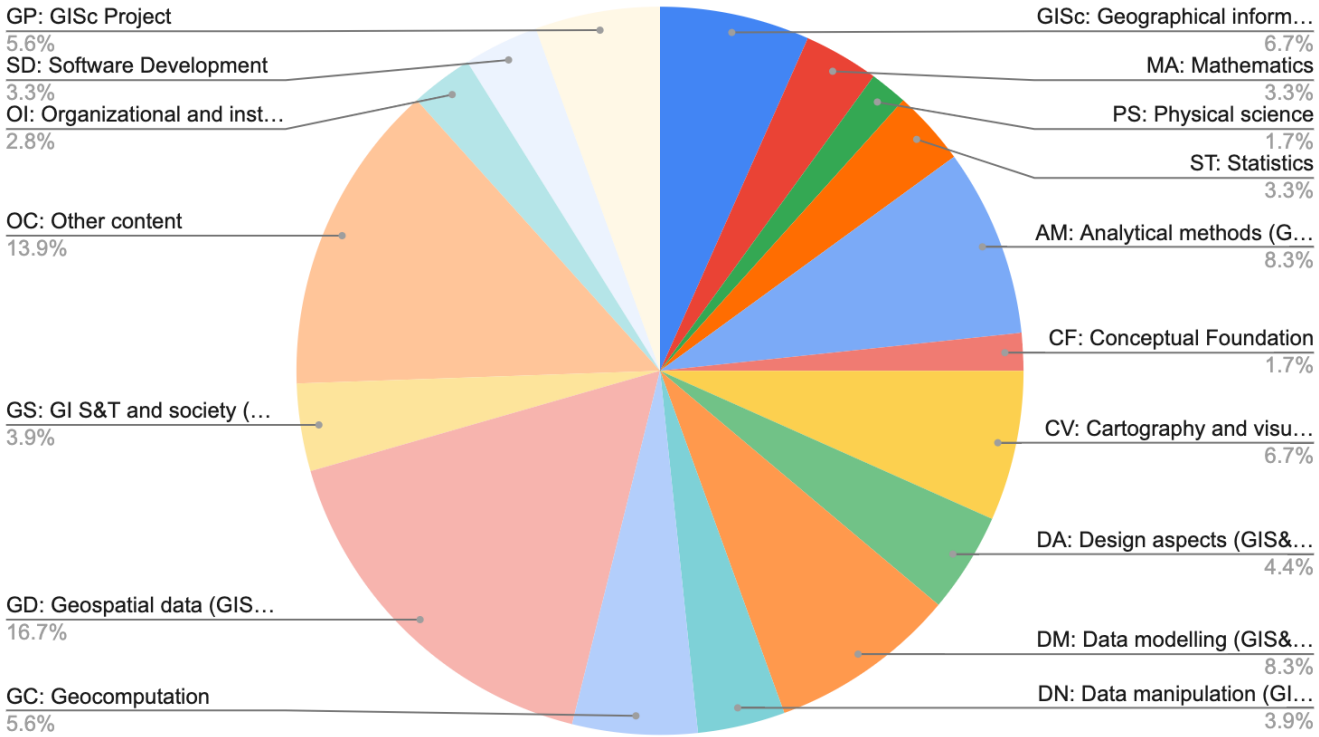
GISc Professional (new)



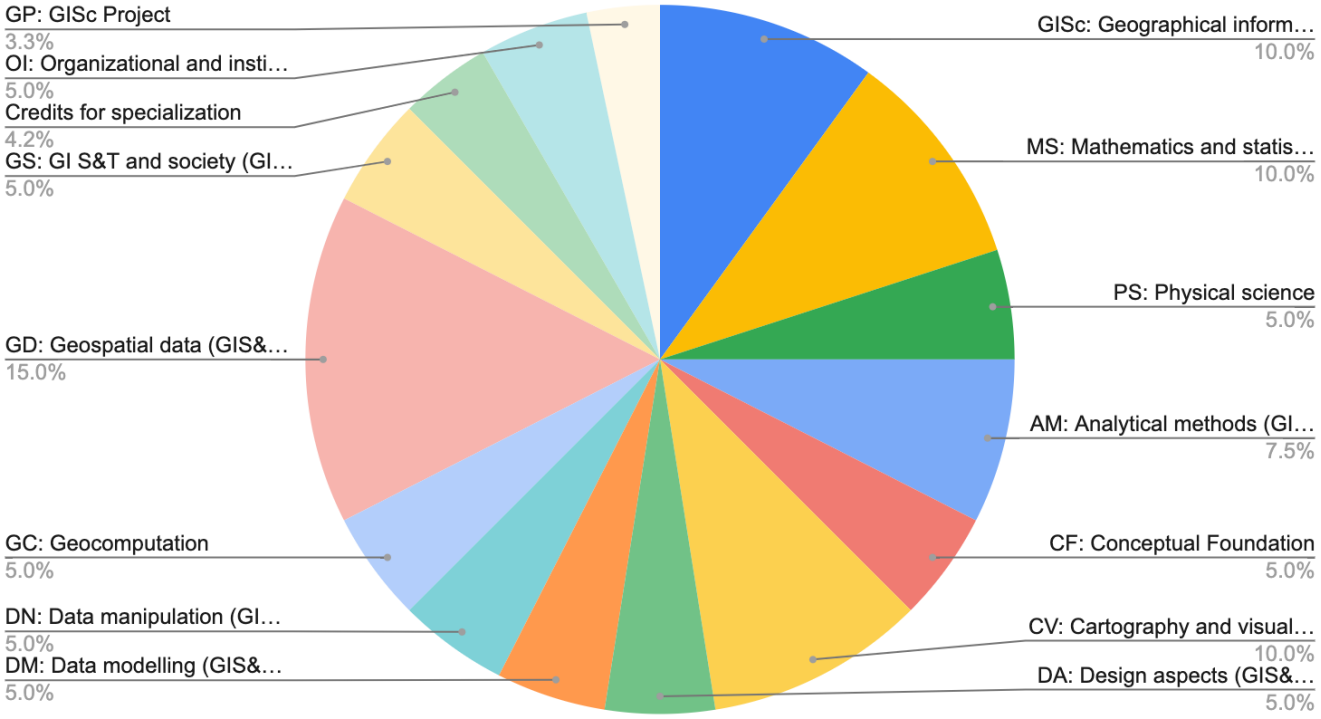
GISc Technologist (old)



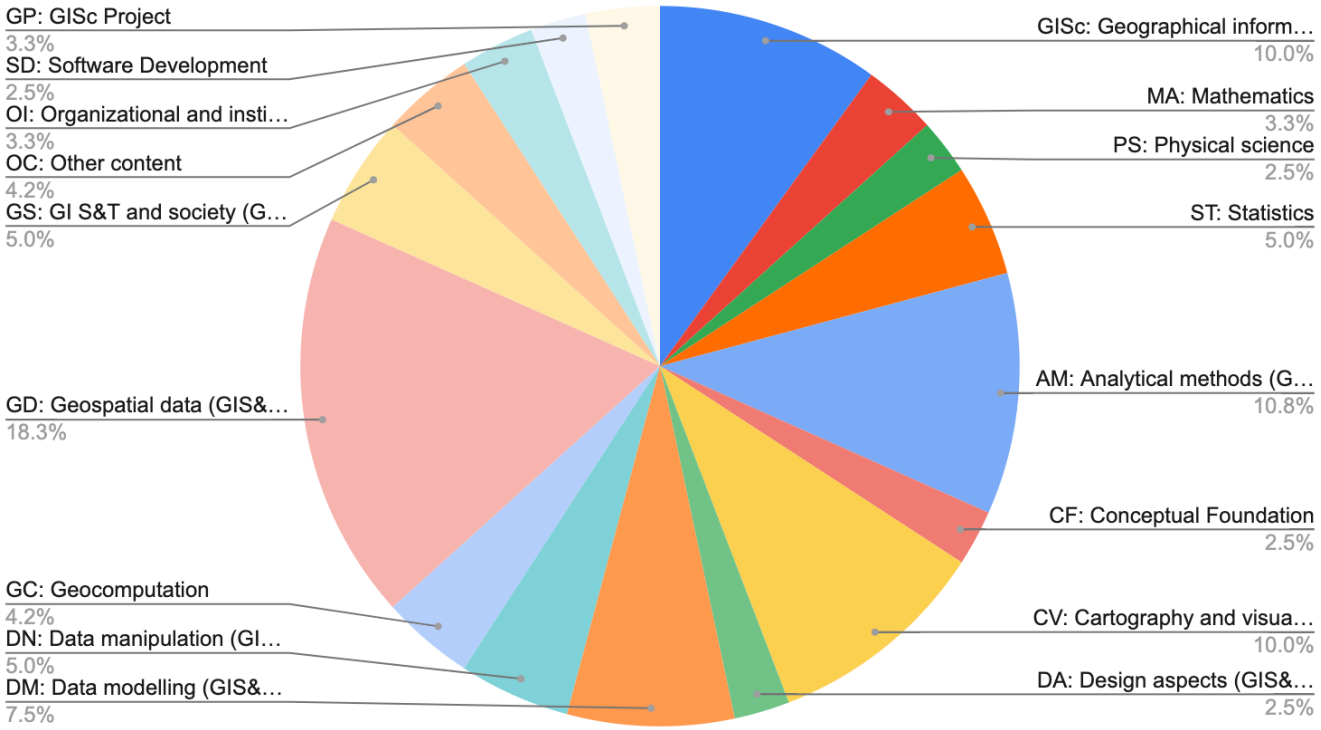
GISc Technologist (new)



GISc Technician (old)



GISc Technician (new)



Revised Academic Framework (Detailed) for GISc:

South African Geomatics Council (SAGC)

GUIDELINES FOR MINIMUM QUALIFICATION REQUIREMENTS FOR GISc REGISTRATION

To be used in conjunction with knowledge area (KA) content specifications.
One credit is considered to be 10 hours of notional learning.
A knowledge area is not necessarily aligned with courses or modules in a curriculum; its content may be covered by multiple courses or modules over multiple years of study.
A knowledge area for which credits are not specified is assessed qualitatively, e.g., as a graduate attribute or overall degree outcome based on outcomes embedded in all the knowledge areas in the curriculum.
10% leeway per KA is allowed as long as there is no material impact on the qualification.
Note: Themes and keywords in this framework draw on the UCGIS Geographic Information Science and Technology Body of Knowledge, see http://gistbok.ucgis.org/, the Project Management Body of Knowledge (PMBoK), see https://www.pmi.org/, and the IEEE Software Engineering Body of Knowledge (SWEBoK), https://www.computer.org/education

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
GISc: Geographic information science	Understanding geographic information science and its application fields	GISc1 Foundations	Basic concepts and terminology. Broader understanding of what GISc, including remote sensing, is and what it involves. Historical perspective. Geography as a foundation for GIS. Understand different fields contributing and forming part of GISc. Components of a GIS. Functionality, analysis and processes involved. Geographic phenomena, geographic information, and geographic tasks are described in terms of space, time, and properties. Elements of geographic information, i.e. discrete entities, events and processes vs fields in space and time, integrated models. Reading, analysis and interpretation of spatial information. Examples of application fields. Note: Identical for all categories.	12	Basic concepts and terminology. Broader understanding of what GISc, including remote sensing, is and what it involves. Historical perspective. Geography as a foundation for GIS. Understand different fields contributing and forming part of GISc. Components of a GIS. Functionality, analysis and processes involved. Geographic phenomena, geographic information, and geographic tasks are described in terms of space, time, and properties. Elements of geographic information, i.e. discrete entities, events and processes vs fields in space and time, integrated models. Reading, analysis and interpretation of spatial information. Examples of application fields. Note: Identical for all categories.	12	Basic concepts and terminology. Broader understanding of what GISc, including remote sensing, is and what it involves. Historical perspective. Geography as a foundation for GIS. Understand different fields contributing and forming part of GISc. Components of a GIS. Functionality, analysis and processes involved. Geographic phenomena, geographic information, and geographic tasks are described in terms of space, time, and properties. Elements of geographic information, i.e. discrete entities, events and processes vs fields in space and time, integrated models. Reading, analysis and interpretation of spatial information. Examples of application fields. Note: Identical for all categories.	12

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		GISc2 Application fields	Any field in which GISc can be applied, including but not limited to geography, climatology, geomorphology, geomorphometry, hydrology, geology, engineering geology, soil science, forestry, environmental management, environmental science, development studies, urban systems and human settlement, planning, land management, civil engineering, mining, health, economics, disasters management, sustainable development, natural environmental systems (water, atmospheric, oceanographic, fauna/flora etc.), tourism, agriculture, ecology, biodiversity, conservation (natural or heritage), climate change. Note: Identical for all categories.	12	Any field in which GISc can be applied, including but not limited to geography, climatology, geomorphology, geomorphometry, hydrology, geology, engineering geology, soil science, forestry, environmental management, environmental science, development studies, urban systems and human settlement, planning, land management, civil engineering, mining, health, economics, disasters management, sustainable development, natural environmental systems (water, atmospheric, oceanographic, fauna/flora etc.), tourism, agriculture, ecology, biodiversity, conservation (natural or heritage), climate change. Note: Identical for all categories.	12	Any field in which GISc can be applied, including but not limited to geography, climatology, geomorphology, geomorphometry, hydrology, geology, engineering geology, soil science, forestry, environmental management, environmental science, development studies, urban systems and human settlement, planning, land management, civil engineering, mining, health, economics, disasters management, sustainable development, natural environmental systems (water, atmospheric, oceanographic, fauna/flora etc.), tourism, agriculture, ecology, biodiversity, conservation (natural or heritage), climate change. Note: Identical for all categories.	12
MA: Mathematics	Applying mathematics in GISc	MA1 Applied mathematics relevant to GISc and problem solving.	Applied mathematics including topics such as in differential and integral calculus, partial derivatives, trigonometric functions, conic sections, vector geometry, matrix algebra, linear transformations, differential geometry. Note: Identical for all categories.	12	Applied mathematics including topics such as in differential and integral calculus, partial derivatives, trigonometric functions, conic sections, vector geometry, matrix algebra, linear transformations, differential geometry. Note: Identical for all categories.	12	Applied mathematics including topics such as in differential and integral calculus, partial derivatives, trigonometric functions, conic sections, vector geometry, matrix algebra, linear transformations, differential geometry. Note: Identical for all categories.	8
PS: Physical science	Understanding the principles of physics in geomatics practice, instrumentation and technology related to GISc	PS1 Physics principles	Applied physics including topics such as Kinematics, Newton's laws of motion, gravity, periodic motion, interference, diffraction, refraction and reflection of waves, electromagnetic spectrum. Optics. Note: Identical for all categories.	6	Applied physics including topics such as Kinematics, Newton's laws of motion, gravity, periodic motion, interference, diffraction, refraction and reflection of waves, electromagnetic spectrum. Optics. Note: Identical for all categories.	6	Applied physics including topics such as Kinematics, Newton's laws of motion, gravity, periodic motion, interference, diffraction, refraction and reflection of waves, electromagnetic spectrum. Optics. Note: Identical for all categories.	6

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
ST: Statistics	Applying statistics in GISc	ST1 Applied Statistics	Distributions and probability density functions, distribution functions, normal distribution, means, norms, probability, reliability, confidence intervals, distributions and probability density functions, precision of an observation, precision of the mean or best estimate, correlation, sampling and statistical testing. Confidence limits, rejection criteria, T-Test, Fishers F-Test, Chi Square Test. Sets, probability, permutations and combinations. Note: Identical for all categories.	12	Distributions and probability density functions, distribution functions, normal distribution, means, norms, probability, reliability, confidence intervals, distributions and probability density functions, precision of an observation, precision of the mean or best estimate, correlation, sampling and statistical testing. Confidence limits, rejection criteria, T-Test, Fishers F-Test, Chi Square Test. Sets, probability, permutations and combinations. Note: Identical for all categories.	12	Distributions and probability density functions, distribution functions, normal distribution, means, norms, probability, reliability, confidence intervals, distributions and probability density functions, precision of an observation, precision of the mean or best estimate, correlation, sampling and statistical testing. Confidence limits, rejection criteria, T-Test, Fishers F-Test, Chi Square Test. Sets, probability, permutations and combinations. Note: Identical for all categories.	12
AM: Analytical methods (GIS&T BoK)	Understanding and applying different analytical methods related to GISc	AM3 Geometric measures	Distances and lengths; direction; shape; area; volume; proximity and distance decay; adjacency and connectivity. Note: Identical for all categories.	4	Distances and lengths; direction; shape; area; volume; proximity and distance decay; adjacency and connectivity. Note: Identical for all categories.	4	Distances and lengths; direction; shape; area; volume; proximity and distance decay; adjacency and connectivity. Note: Identical for all categories.	4
		AM4 Basic analytical operations	Buffer; overlay; neighborhoods; map algebra. Note: Identical for all categories.	4	Buffer; overlay; neighborhoods; map algebra. Note: Identical for all categories.	4	Buffer; overlay; neighborhoods; map algebra. Note: Identical for all categories.	4
		AM5 Basic analytical methods	Point pattern analysis; Kernels and density estimation; Spatial cluster analysis; Spatial interaction; Analyzing multidimensional attributes; Cartographic 14odelling; Multi-criteria evaluation; Spatial process models; Geostatistics; Network analysis. Note: Identical for all categories.	4	Point pattern analysis; Kernels and density estimation; Spatial cluster analysis; Spatial interaction; Analyzing multidimensional attributes; Cartographic 14odelling; Multi-criteria evaluation; Spatial process models; Geostatistics; Network analysis. Note: Identical for all categories.	4	Point pattern analysis; Kernels and density estimation; Spatial cluster analysis; Spatial interaction; Analyzing multidimensional attributes; Cartographic 14odelling; Multi-criteria evaluation; Spatial process models; Geostatistics; Network analysis. Note: Identical for all categories.	4
		AM6 Analysis of surfaces	Calculating surface derivatives, interpolation of surface, surface features. Note: Identical for all categories.	6	Calculating surface derivatives, interpolation of surface, surface features. Note: Identical for all categories.	6	Calculating surface derivatives, interpolation of surface, surface features. Note: Identical for all categories.	6
		AM7 Spatial statistics	Graphical methods; Stochastic processes; The spatial weights matrix; Global measures of spatial association; Local measures of spatial association; Outliers; Bayesian methods. Note: Identical for all categories.	4	Graphical methods; Stochastic processes; The spatial weights matrix; Global measures of spatial association; Local measures of spatial association; Outliers; Bayesian methods. Note: Identical for all categories.	4	Graphical methods; Stochastic processes; The spatial weights matrix; Global measures of spatial association; Local measures of spatial association; Outliers; Bayesian methods. Note: Identical for all categories.	4

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		AM13 Big data and geospatial analysis	Pattern recognition and matching, artificial neural networks, artificial intelligence approaches, spatial data mining, machine learning approaches. Note: Identical for all categories.	8	Pattern recognition and matching, artificial neural networks, artificial intelligence approaches, spatial data mining, machine learning approaches. Note: Identical for all categories.	8	Pattern recognition and matching, artificial neural networks, artificial intelligence approaches, spatial data mining, machine learning approaches. Note: Identical for all categories.	4
CF: Conceptual Foundation	Understanding the information technology environment	CF1 Introduction to information technology	Computer hardware, operating systems, data communications (local and wide area cover networks), word processing, spread sheets, internet, data storage. Note: Identical for all categories.	6	Computer hardware, operating systems, data communications (local and wide area cover networks), word processing, spread sheets, internet, data storage. Note: Identical for all categories.	6	Computer hardware, operating systems, data communications (local and wide area cover networks), word processing, spread sheets, internet, data storage. Note: Identical for all categories.	6
CV: Cartography and visualization (GIS&T BoK)	Understanding and applying cartography and visualization techniques	CV2 Data considerations	Source materials for mapping; Data abstraction: classification, selection, and generalization; Projections as a map design issue. Note: Identical for all categories.	6	Source materials for mapping; Data abstraction: classification, selection, and generalization; Projections as a map design issue. Note: Identical for all categories.	6	Source materials for mapping; Data abstraction: classification, selection, and generalization; Projections as a map design issue. Note: Identical for all categories.	6
		CV3 Principles of map design	Map design fundamentals; Basic concepts of symbolization; Color for cartography and visualization; Typography for cartography and visualization; Visual perception, graphicacy, cartographic communication (including information sense-making, information use and information-knowledge transformation), graphic space, symbology (point, line, area, pictorial, 3-D), colour, cartographic design, typonomy, generalisation, map use, general purpose maps. Note: Identical for all categories.	8	Map design fundamentals; Basic concepts of symbolization; Color for cartography and visualization; Typography for cartography and visualization; Visual perception, graphicacy, cartographic communication (including information sense-making, information use and information-knowledge transformation), graphic space, symbology (point, line, area, pictorial, 3-D), colour, cartographic design, typonomy, generalisation, map use, general purpose maps. Note: Identical for all categories.	8	Map design fundamentals; Basic concepts of symbolization; Color for cartography and visualization; Typography for cartography and visualization; Visual perception, graphicacy, cartographic communication (including information sense-making, information use and information-knowledge transformation), graphic space, symbology (point, line, area, pictorial, 3-D), colour, cartographic design, typonomy, generalisation, map use, general purpose maps. Note: Identical for all categories.	8
		CV4 Graphic representation techniques	Basic thematic mapping methods, multivariate displays, dynamic and interactive displays, representing terrain, Web mapping and visualizations, visualization of spatio-temporal data, visualization of uncertainty. User interface and user experience design, mobile maps and responsive design, usability engineering and evaluation, geovisual analytics. Note: Identical for all categories.	6	Basic thematic mapping methods, multivariate displays, dynamic and interactive displays, representing terrain, Web mapping and visualizations, visualization of spatio-temporal data, visualization of uncertainty. User interface and user experience design, mobile maps and responsive design, usability engineering and evaluation, geovisual analytics. Note: Identical for all categories.	6	Basic thematic mapping methods, multivariate displays, dynamic and interactive displays, representing terrain, Web mapping and visualizations, visualization of spatio-temporal data, visualization of uncertainty. User interface and user experience design, mobile maps and responsive design, usability engineering and evaluation, geovisual analytics. Note: Identical for all categories.	6

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		CV6 Map use and evaluation	The power of maps; Map reading; Map interpretation; Map analysis; Evaluation and testing; Impact of uncertainty. Note: Identical for all categories.	4	The power of maps; Map reading; Map interpretation; Map analysis; Evaluation and testing; Impact of uncertainty. Note: Identical for all categories.	4	The power of maps; Map reading; Map interpretation; Map analysis; Evaluation and testing; Impact of uncertainty. Note: Identical for all categories.	4
DA: Design aspects (GIS&T BoK)	Understanding and designing geospatial applications, models and data	DA2 Project definition	Application/user assessment; Requirements analysis. Note: Identical for GISc Professional and GISc Technologist.	8	Application/user assessment; Requirements analysis. Note: Identical for GISc Professional and GISc Technologist.	8		
		DA4 Database design	Modeling tools (e.g. ERD vs UML vs XML), conceptual models, logical models, physical models. Design and create conceptual models in a modelling tool. Create logical and physical models from a given conceptual model. Note: Identical for GISc Professional and GISc Technologist.	8	Modeling tools (e.g. ERD vs UML vs XML), conceptual models, logical models, physical models. Design and create conceptual models in a modelling tool. Create logical and physical models from a given conceptual model. Note: Identical for GISc Professional and GISc Technologist.	8	Modeling tools (e.g. ERD vs UML vs XML), conceptual models, logical models, physical models. Create logical and physical models from a given conceptual model.	6
DM: Data modelling (GIS&T BoK)	Understanding and applying DBMS and data modelling	DM2 Database management systems	Spatial Database Management Systems, Use of Relational DBMSs, Object-Oriented DBMSs, Relational DBMS (and extensions), Structured Query Language (SQL), Topological Relationships, Database Administration, Conceptual Data Models, Logical Data Models, Physical Data Models, NoSQL Databases. Spatial Indexing, Space-driven Structures: Grid, linear quadtree, and z-ordering tree files, Data-driven structures: R-trees and cost models, Spatial Joins. Note: Identical for all categories.	16	Spatial Database Management Systems, Use of Relational DBMSs, Object-Oriented DBMSs, Relational DBMS (and extensions), Structured Query Language (SQL), Topological Relationships, Database Administration, Conceptual Data Models, Logical Data Models, Physical Data Models, NoSQL Databases. Spatial Indexing, Space-driven Structures: Grid, linear quadtree, and z-ordering tree files, Data-driven structures: R-trees and cost models, Spatial Joins. Note: Identical for all categories.	16	Spatial Database Management Systems, Use of Relational DBMSs, Object-Oriented DBMSs, Relational DBMS (and extensions), Structured Query Language (SQL), Topological Relationships, Database Administration, Conceptual Data Models, Logical Data Models, Physical Data Models, NoSQL Databases. Spatial Indexing, Space-driven Structures: Grid, linear quadtree, and z-ordering tree files, Data-driven structures: R-trees and cost models, Spatial Joins. Note: Identical for all categories.	8
		DM3 Tessellation data models	Grid representations; The raster model; Grid compression methods; The hexagonal model; Triangulated Irregular Network (TIN) model; Spatial resolution and cell size; Hierarchical data models. Note: Identical for GISc Professional and GISc Technologist.	8	Grid representations; The raster model; Grid compression methods; The hexagonal model; Triangulated Irregular Network (TIN) model; Spatial resolution and cell size; Hierarchical data models. Note: Identical for GISc Professional and GISc Technologist.	8	Grid representations; The raster model; Grid compression methods; Triangulated Irregular Network (TIN) model; Spatial resolution and cell size; Hierarchical data models.	4

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		DM4 Vector and object data models	Geometric primitives; The spaghetti model; The topological model; Classic vector data models; The network model; Linear referencing. Note: Identical for all categories.	6	Geometric primitives; The spaghetti model; The topological model; Classic vector data models; The network model; Linear referencing. Note: Identical for all categories.	6	Geometric primitives; The spaghetti model; The topological model; Classic vector data models; The network model; Linear referencing. Note: Identical for all categories.	6
DN: Data manipulation (GIS&T BoK)	Implementing data manipulation in a GISc environment.	DN1 Representation transformation	Impacts of transformations; Data model and format conversion; Interpolation; Vector-to-raster and raster- to-vector conversions; Raster resampling; Coordinate transformations; Data fusion. Note: Identical for GISc Professional and GISc Technologist.	8	Impacts of transformations; Data model and format conversion; Interpolation; Vector-to-raster and raster- to-vector conversions; Raster resampling; Coordinate transformations; Data fusion. Note: Identical for GISc Professional and GISc Technologist.	8	Impacts of transformations; Data model and format conversion; Interpolation; Vector-to-raster and raster- to-vector conversions; Raster resampling; Coordinate transformations.	6
		DN2 Generalization and aggregation	Scale and generalization, caveats of generalising algorithms (Douglas-Peuker) and auto-snap-up routines; Approaches to point, line, and area generalization; Classification and transformation of attribute measurement levels; Aggregation of spatial entities. Note: Identical for all categories.	6	Scale and generalization, caveats of generalising algorithms (Douglas-Peuker) and auto-snap-up routines; Approaches to point, line, and area generalization; Classification and transformation of attribute measurement levels; Aggregation of spatial entities. Note: Identical for all categories.	6	Scale and generalization, caveats of generalising algorithms (Douglas-Peuker) and auto-snap-up routines; Approaches to point, line, and area generalization; Classification and transformation of attribute measurement levels; Aggregation of spatial entities. Note: Identical for all categories.	6
GC: Geocomputation	Sovling GISc problems by programming	GC10 Basics of computer programming	Problem solving techniques (formulate problem, analyse problem, design solution), imperative programming (e.g. Python, Java, C#), functional programming (e.g. MATLAB), algorithms and complexity. Note: Identical for all categories.	16	Problem solving techniques (formulate problem, analyse problem, design solution), imperative programming (e.g. Python, Java, C#), functional programming (e.g. MATLAB), algorithms and complexity. Note: Identical for all categories.	16	Problem solving techniques (formulate problem, analyse problem, design solution), imperative programming (e.g. Python, Java, C#), functional programming (e.g. MATLAB), algorithms and complexity. Note: Identical for all categories.	8
		GC11 Advanced programming techniques	This unit was replaced by AM13	0	This unit was replaced by AM13	0	This unit was replaced by AM13	0
		GC12 Computing infrastructures	Computing infrastructures for geospatial data, such as cloud computing, high performance computing and GPUs.	4	Computing infrastructures for geospatial data, such as cloud computing, high performance computing and GPUs.	4	Computing infrastructures for geospatial data, such as cloud computing (e.g. Google Earth Engine), high performance computing and GPUs.	2
GD: Geospatial data (GIS&T BoK)	Understanding working with geospatial data	GD1 Earth geometry	Earth's shape; geoid, spheres and ellipsoids. Note: Identical for all categories.	2	Earth's shape; geoid, spheres and ellipsoids. Note: Identical for all categories.	2	Earth's shape; geoid, spheres and ellipsoids. Note: Identical for all categories.	2

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		GD3 Georeferencing systems	Geographic coordinate system; Plane coordinate systems; Linear referencing systems. Two- and three- dimensional coordinate systems, grid reference systems, geographical coordinates; SA Survey co- ordinate system and UTM system. Note: Identical for all categories.	4	Geographic coordinate system; Plane coordinate systems; Linear referencing systems. Two- and three- dimensional coordinate systems, grid reference systems, geographical coordinates; SA Survey co- ordinate system and UTM system. Note: Identical for all categories.	4	Geographic coordinate system; Plane coordinate systems; Linear referencing systems. Two- and three- dimensional coordinate systems, grid reference systems, geographical coordinates; SA Survey co- ordinate system and UTM system. Note: Identical for all categories.	4
		GD4 Datums	Horizontal datums; Vertical datums. Reference datums. Note: Identical for all categories.	2	Horizontal datums; Vertical datums. Reference datums. Note: Identical for all categories.	2	Horizontal datums; Vertical datums. Reference datums. Note: Identical for all categories.	2
		GD5 Map projections	Map projection types and characteristics; Georeferencing; mathematical models of projection and projection properties; Reprojections. Note: Identical for GISc Professional and GISc Technologist.	8	Map projection types and characteristics; Georeferencing; mathematical models of projection and projection properties; Reprojections. Note: Identical for GISc Professional and GISc Technologist.	8	Map projection types and characteristics; Georeferencing; projection properties;	6
		GD6 Data quality	Primary and secondary sources, Geometric accuracy; Thematic accuracy; Logical consistency, Resolution (spatial, spectral, radiometric, thematic and temporal); Scale; Precision; Metadata. Completeness and temporal quality. Note: Identical for all categories.	6	Primary and secondary sources, Geometric accuracy; Thematic accuracy; Logical consistency, Resolution (spatial, spectral, radiometric, thematic and temporal); Scale; Precision; Metadata. Completeness and temporal quality. Note: Identical for all categories.	6	Primary and secondary sources, Geometric accuracy; Thematic accuracy; Logical consistency, Resolution (spatial, spectral, radiometric, thematic and temporal); Scale; Precision; Metadata. Completeness and temporal quality. Note: Identical for all categories.	6
		GD7 Land surveying and GNSS	Measuring and positioning on the Earth's surface. Survey theory, electro-optical methods (e.g. laser/lidar scanning), Global Navigation Satellite Systems (e.g. GPS, GLONASS, Galileo, BeiDou). Note: Identical for all categories.	8	Measuring and positioning on the Earth's surface. Survey theory, electro-optical methods (e.g. laser/lidar scanning), Global Navigation Satellite Systems (e.g. GPS, GLONASS, Galileo, BeiDou). Note: Identical for all categories.	8	Measuring and positioning on the Earth's surface. Survey theory, electro-optical methods (e.g. laser/lidar scanning), Global Navigation Satellite Systems (e.g. GPS, GLONASS, Galileo, BeiDou). Note: Identical for all categories.	8
		GD8 Digitizing	Digitising and editing of data.	2	Digitising and editing of data.	2	Digitising and editing of data.	2

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
		GD10 Aerial imaging and photogrammetry	Principles of analogue and digital photography, photogrammetric measurement and data processing including geometry of images, relative and absolute orientation. Bundle adjustment and aero triangulation, ortho-rectification, mosaicking, digital elevation models. Accuracy and reliability assessment of photogrammetrically derived data, image (photo) interpretation, creation of 3D computer model of landscapes, settlements and buildings. Virtual globes. Note: Identical for GISc Professional and GISc Technologist.	12	Principles of analogue and digital photography, photogrammetric measurement and data processing including geometry of images, relative and absolute orientation. Bundle adjustment and aero triangulation, ortho-rectification, mosaicking, digital elevation models. Accuracy and reliability assessment of photogrammetrically derived data, image (photo) interpretation, creation of 3D computer model of landscapes, settlements and buildings. Virtual globes. Note: Identical for GISc Professional and GISc Technologist.	12	Principles of analogue and digital photography, photogrammetric measurement and data processing including geometry of images, relative and absolute orientation.	6
		GD11 Satellite and shipboard remote sensing	Earth radiation model and electro-magnetic spectrum, electro-magnetic energy in remote sensing, sensor systems (airborne, space borne and terrestrial), satellite orbits, geometry of sensors and sensor systems (airborne and satellite), acquisition of images, image media and formats incl. image compression. Nature of multispectral image data; Platforms and sensors; Algorithms and advanced image processing; Ground verification and accuracy assessment; Applications and settings; image processing (including image enhancement, image feature extraction, classification). Application of terrestrial and aerial laser/lidar scanning. Hyperspectral; radar remote sensing and other new techniques of remote sensing that may emerge. Note: Identical for GISc Professional and GISc Technologist.	16	Earth radiation model and electro-magnetic spectrum, electro-magnetic energy in remote sensing, sensor systems (airborne, space borne and terrestrial), satellite orbits, geometry of sensors and sensor systems (airborne and satellite), acquisition of images, image media and formats incl. image compression. Nature of multispectral image data; Platforms and sensors; Algorithms and advanced image processing; Ground verification and accuracy assessment; Applications and settings; image processing (including image enhancement, image feature extraction, classification). Application of terrestrial and aerial laser/lidar scanning. Hyperspectral; radar remote sensing and other new techniques of remote sensing that may emerge. Note: Identical for GISc Professional and GISc Technologist.	16	Knowledge of photogrammetric and satellite sensors, methods and products.	8

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
GS: GI S&T and society (GIS&T BoK)	Professional and ethical conduct in the GISc environment	GS1 Legal aspects	Legislation regulating the profession (Geomatics Profession Act and supporting legislation). Intellectual property rights and copyright, privacy rights. South African legislation: interpretation of statutory legislation, Constitution of South Africa, Copyright Act, Promotion of Access to Information Act, Protection of Personal Information Act. Note: Identical for all categories.	6	Legislation regulating the profession (Geomatics Profession Act and supporting legislation). Intellectual property rights and copyright, privacy rights. South African legislation: interpretation of statutory legislation, Constitution of South Africa, Copyright Act, Promotion of Access to Information Act, Protection of Personal Information Act. Note: Identical for all categories.	6	Legislation regulating the profession (Geomatics Profession Act and supporting legislation). Intellectual property rights and copyright, privacy rights. South African legislation: interpretation of statutory legislation, Constitution of South Africa, Copyright Act, Promotion of Access to Information Act, Protection of Personal Information Act. Note: Identical for all categories.	6
		GS6 Ethical aspects of geospatial information and technology	Professional and practical ethics of GIS&T (definitions, professional and practical ethics, moral reasoning, practical application); Codes of ethics for geospatial professionals (purpose, examples from geomatics profession in other countries and from other professions in South Africa). Ethical issues related to geospatial information and technologies, including critical ethics (data politics, power-knowledge), risks of a surveillance society. Location privacy (definitions, importance, reasons for privacy concerns surrounding GIS&T, privacy laws & government information, handling personal data in the GIS&T community). Note: Identical for all categories.	4	Professional and practical ethics of GIS&T (definitions, professional and practical ethics, moral reasoning, practical application); Codes of ethics for geospatial professionals (purpose, examples from geomatics profession in other countries and from other professions in South Africa). Ethical issues related to geospatial information and technologies, including critical ethics (data politics, power-knowledge), risks of a surveillance society. Location privacy (definitions, importance, reasons for privacy concerns surrounding GIS&T, privacy laws & government information, handling personal data in the GIS&T community). Note: Identical for all categories.	4	Professional and practical ethics of GIS&T (definitions, professional and practical ethics, moral reasoning, practical application); Codes of ethics for geospatial professionals (purpose, examples from geomatics profession in other countries and from other professions in South Africa). Ethical issues related to geospatial information and technologies, including critical ethics (data politics, power-knowledge), risks of a surveillance society. Location privacy (definitions, importance, reasons for privacy concerns surrounding GIS&T, privacy laws & government information, handling personal data in the GIS&T community). Note: Identical for all categories.	4
		GS8 GI S&T project planning and management	Project initiating, planning, executing and closing processes. Project management (integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder management). Note: Identical for all categories.	6	Project initiating, planning, executing and closing processes. Project management (integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder management). Note: Identical for all categories.	4	Project initiating, planning, executing and closing processes. Project management (integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder management). Note: Identical for all categories.	2
OC: Other content	Specialization in any of the listed Kas	OC1 Specialization content	Specialized content in any of the knowledge areas, except CF (Conceptual Foundations). Note: Identical for all categories.	138	Specialized content in any of the knowledge areas, except CF (Conceptual Foundations). Note: Identical for all categories.	50	Specialized content in any of the knowledge areas, except CF (Conceptual Foundations). Note: Identical for all categories.	10

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
OI: Organizational and institutional aspects (GIS&T BoK)	Operating in the Geomatics Industry	OI5 Institutional and interinstitutional aspects	Spatial data infrastructures; Adoption of standards; Metadata; Content standards as prescribed by SASDI. Data transfer and exchange; Spatial data sharing among organizations; Data warehousing. Data governance (people, processes, and information technology required to create a consistent and proper handling of an organization's data across the business enterprise). Openness; Balancing data access, security, and privacy; Implications of distributed GI S&T; Inter-organisational and vendor GI systems (software, hardware and systems). Note: Identical for GISc Professional and GISc Technologist.	8	Spatial data infrastructures; Adoption of standards; Metadata; Content standards as prescribed by SASDI. Data transfer and exchange; Spatial data sharing among organizations; Data warehousing. Data governance (people, processes, and information technology required to create a consistent and proper handling of an organization's data across the business enterprise). Openness; Balancing data access, security, and privacy; Implications of distributed GI S&T; Inter-organisational and vendor GI systems (software, hardware and systems). Note: Identical for GISc Professional and GISc Technologist.	8	Understanding of spatial data infrastructures; Adoption of standards; Metadata; Content standards as prescribed by SASDI. Data transfer and exchange; Spatial data sharing among organizations; Data warehousing. Data governance (people, processes, and information technology required to create a consistent and proper handling of an organization's data across the business enterprise).	6
		OI6 Coordinating organisations (National and international)	National and international organisations and programs; State and regional coordinating bodies; Professional organizations; Publications; The geospatial community; The geospatial industry. Note: Identical for all categories.	2	National and international organisations and programs; State and regional coordinating bodies; Professional organizations; Publications; The geospatial community; The geospatial industry. Note: Identical for all categories.	2	National and international organisations and programs; State and regional coordinating bodies; Professional organizations; Publications; The geospatial community; The geospatial industry. Note: Identical for all categories.	2
SD: Software Development	Software requirements	SD1 Software requirements	Software requirements (requirements fundamentals, requirements analysis, requirements specification, requirements validation). Software construction (fundamentals, practical considerations, tools). Software engineering process (software process definition (incl. process design), software life cycles, software engineering process tools incl. workflows, UML activity diagrams). Software design (software structure and architectures, user interface design, software design strategies and methods). As specified in the IEEE SWE BoK. Note: Identical for all categories.	12	Software requirements (requirements fundamentals, requirements analysis, requirements specification, requirements validation). Software construction (fundamentals, practical considerations, tools). Software engineering process (software process definition (incl. process design), software life cycles, software engineering process tools incl. workflows, UML activity diagrams). Software design (software structure and architectures, user interface design, software design strategies and methods). As specified in the IEEE SWE BoK. Note: Identical for all categories.	12	Software requirements (requirements fundamentals, requirements analysis, requirements specification, requirements validation). Software construction (fundamentals, practical considerations, tools). Software engineering process (software process definition (incl. process design), software life cycles, software engineering process tools incl. workflows, UML activity diagrams). Software design (software structure and architectures, user interface design, software design strategies and methods). As specified in the IEEE SWE BoK. Note: Identical for all categories.	6

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
GP: GISc Project	Ability to demonstrate technical proficiency in the application of relevant technologies and producing a related report	GP1 Portfolio of evidence	Project and Report – Portfolio of evidence demonstrating practical skills in the application of relevant competencies applied in the GISc field, including reports in a written format and through oral presentation. Note: Identical for all categories.	20	Project and Report – Portfolio of evidence demonstrating practical skills in the application of relevant competencies applied in the GISc field, including reports in a written format and through oral presentation. Note: Identical for all categories.	20	Project and Report – Portfolio of evidence demonstrating practical skills in the application of relevant competencies applied in the GISc field, including reports in a written format and through oral presentation. Note: Identical for all categories.	8
		GP2 Research project	Mini thesis demonstrating application of research methodology and techniques in GISc. Written report and oral presentation.	30		0		0
PC: Professional communication (not based on credits)	Ability to present oneself, communicate and interact professionally in the work environment	PC1 Professional communication	Literacy (reading, writing and oral communication in the general context of everyday life), written communication (all mediums including professional communication via electronic communication and social media; grammar, spelling, formatting), oral communication (reporting, client liaison, presentation), information literacy (finding, accessing, understanding, collating, interpreting and referencing information), technical and professional project report writing, communicating and reporting in multidisciplinary teams, negotiation. Etiquette and social interaction. Note: Identical for all categories.		Literacy (reading, writing and oral communication in the general context of everyday life), written communication (all mediums including professional communication via electronic communication and social media; grammar, spelling, formatting), oral communication (reporting, client liaison, presentation), information literacy (finding, accessing, understanding, collating, interpreting and referencing information), technical and professional project report writing, communicating and reporting in multidisciplinary teams, negotiation. Etiquette and social interaction. Note: Identical for all categories.		Literacy (reading, writing and oral communication in the general context of everyday life), written communication (all mediums including professional communication via electronic communication and social media; grammar, spelling, formatting), oral communication (reporting, client liaison, presentation), information literacy (finding, accessing, understanding, collating, interpreting and referencing information), technical and professional project report writing, communicating and reporting in multidisciplinary teams, negotiation. Etiquette and social interaction. Note: Identical for all categories.	

Knowledge area (KA)	Outcome	Unit	GISc Professional Themes and key words	Credits	GISc Technologist Themes and key words	Credits	GISc Technician Themes and key words	Credits
SS: Soft skills			Soft skills for all categories: Spatial thinking and spatial problem solving skills; Using scientific rules and methods to solve problems; Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems (critical thinking). Soft skills for GISc Professionals and GISc Technologists: Considering the relative costs and benefits of potential actions to choose the most appropriate one; Understanding the implications of new information for both current and future problem-solving and decision-making; Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions (complex problem solving). Note: Identical for GISc Professional and GISc Technologist.		Soft skills for all categories: Spatial thinking and spatial problem solving skills; Using scientific rules and methods to solve problems; Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems (critical thinking). Soft skills for GISc Professionals and GISc Technologists: Considering the relative costs and benefits of potential actions to choose the most appropriate one; Understanding the implications of new information for both current and future problem-solving and decision-making; Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions (complex problem solving). Note: Identical for GISc Professional and GISc Technologist.		Soft skills for all categories: Spatial thinking and spatial problem solving skills; Using scientific rules and methods to solve problems; Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems (critical thinking).	
		Total:		**480**		**360**		**240**