

**GUIDELINES FOR THE MINIMUM CORE COURSE REQUIREMENTS FOR REGISTRATION IN THE CATEGORY:
PROFESSIONAL ENGINEERING SURVEYOR**

	Knowledge Area	Outcome	Topic / Themes	Credits	%
1	Mathematics and Applied Mathematics	Ability to apply mathematics and statistics in solving geomatics problems at a professional level	Differential and integral calculus of functions of one variable, differential equations, partial derivatives, Taylor series, mean value theorem, solving systems of linear and non-linear equations, trigonometric functions, hyperbolic functions, conic sections, complex numbers, vector geometry, matrix algebra, eigen vectors and values, linear transformations, space curves and surfaces, differential geometry. Series and polynomials. Intersections of 3D lines and planes, distances from points to 3D line and planes. Sines and polynomials. Statistics: distributions and probability density functions, other than those forming part of adjustment of observation courses, error theory, correlation, sampling and statistical testing. including sets, probability, permutations and combinations.	60	13
2	Physics	Understanding of the principles of physics as applied in geomatics practice, instrumentation and technology	Kinematics, Newton's laws of motion, work, energy, power, rotational dynamics, torque, angular momentum, gravity, periodic motion, simple harmonic motion, interference, wave motion, diffraction, refraction and reflection of waves, Doppler effect, electric charge and field, electric potential, capacitance, resistance, electric current, electromagnetic induction, magnetic field, electromagnetic spectrum. Optics	24	5
3	Surveying	Competency in survey theory and its practical applications as required at a professional level	Measurement science, distance measurement (optical, mechanical and electro-optical), angular measurement, surveying equipment (distance and angular, including sources and management of instrument errors, calibration); position determination using observed angles/directions, distances, or combinations of these, (intersection, resection, trilateration and triangulation), heighting; control surveys; setting out of pre-calculated positions and heights; Areas, volumes, interpretation of maps/plans, design and setting out of horizontal and vertical curves, cross and longitudinal sections, cut and fill calculations, mass-haul diagram, Topographic surveying and creation of maps/plans, 2-D coordinate transformations. Mobile mapping and Data fusion. Inertial navigation systems. Mobile mapping (gyroscopes, accelerometers) Interpreting specifications and technical communication. The history of surveying in SA and internationally.	60	13
4	Information Technology	Ability to apply Information technology to solving advanced geomatics problems	Introduction to computer hardware, operating systems, data communications (local and wide area cover networks), word processing, spread sheets, software development (scientific/engineering) and complementary programming, systems development (including systems analysis and design), databases and database management systems, use of information technology in surveying, CAD, security of systems and information.	30	6

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5	Geographic Information Systems (GIS)	Ability to apply Geo Spatial Information Systems (GIS) in solving survey related problems	Nature of geo-spatial information, geo-spatial information in planning and decision-making, GI system design, components of a GIS, data acquisition and manipulation, data structures (vector, raster, hybrid), data modelling, geo-spatial databases and DBMS, applications of geo-spatial data using spatial analysis, spatial modelling and spatial statistics, visualisation, representation of geo-spatial information (including digital cartography).	24	5
6	Photogrammetry and Remote Sensing	Understanding and implementation of the theory and principles of photogrammetry and remote sensing and its practical application as required at a professional level	Earth radiation model and electro-magnetic spectrum, satellite orbits, geometry of sensors and sensor systems (airborne, space borne and terrestrial), camera calibration , acquisition of images (including flight planning), image media and formats incl. image compression, principles of analogue and digital photography, photogrammetric measurement and data processing including geometry of images, relative and absolute orientation, 3D resection, 3D intersection, bundle adjustment and aero triangulation, ortho-rectification, mosaicing and georeferencing, digital elevation models . Determination of 3-D coordinates in close-range photogrammetry. Accuracy and reliability assessment of photogrammetrically derived data, image (photo) interpretation , image processing (including image enhancement, image feature extraction, classification, PC analysis,). creation of 3D computer model of landscapes settlements and buildings. Virtual globes. UAV photogrammetry and related applications. Planning and design of photogrammetry and remote sensing projects. Application of terrestrial and aerial laser scanning.	36	8
7	Coordinate Systems and Map Projections	Understanding of the principles and theory of co-ordinate systems and map projections and their practical application at a professional level.	Two- and three-dimensional coordinate systems, grid reference systems, shape of the Earth, Geoid, mathematical representations of the Earth, (including datums and reference ellipsoids) geographical coordinates, map projections, Including mathematical models and projection characteristics) reprojections,transformations, SA Survey co-ordinate system and UTM system. Spherical trigonometry.	18	4
8	Error Theory and Adjustments	Ability to determine best fit solutions for standard and complex surveys and understanding of advanced error theory and analysis	The nature of observations and data acquisition, types of errors, means, norms ,accuracy, precision, reliability, probability, confidence intervals, distribution- and probability density functions, estimation, auto- and cross-correlation, hypothesis testing, least squares theory, simple and multiple regression, distribution functions, law of error propagation, least squares adjustments of survey observations (parametric-, condition equation case, combined or general case, parametric case with conditions between the unknowns.), network adjustment (including free networks/generalised inverse),adjustment of 2 D and 3D coordinate transformations, design of survey networks, statistical analysis of results and interpretation of data. Data filtering (incl. Kalman filter).	36	8

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9	Earth and Environmental Studies	Understanding the relevance of geomatics with respect to the environment	A combination of any of the following: Climatology, Geomorphology, structural geology, engineering geology, interpretation of geological maps, integrated environmental management, environmental impact assessment, development science and theory, urban systems and human settlement, sustainable development, natural environmental systems (water, atmospheric, oceanographic, fauna/flora etc.), conservation (natural or heritage).	24	5
10	Business and Project Management	Understanding of general and financial management principles, including related legislation, and their application in the Geomatics Industry	Management functions (planning, controlling, organising, decision-making), human resource management, financial management and management accounting, marketing and client relations, taxation, project planning, costing, resource allocation, project control and reporting, business communication, report writing, contract law.	12	3
11	Professional Practice	Understanding of practice management, professionalism, professional ethics and related legislation	Professionalism, professional ethics, different types of professional practices, partnerships and partnership law, labour law, structuring a practice, client relationships, SA survey profession and SA Geomatics Council (including legislation and rules), social responsibility. Access to Information Act, Spatial Data Infrastructures, role of national and international associations and societies in geomatics. Intellectual property rights and copyright, privacy rights, information economics.	12	3
12	Research project	Proficiency in independently completing a geomatics project and reporting thereon	Engagement with a geomatics-related problem to demonstrate the ability to design, execute and report on a project in a written and oral presentation format	36	8
13	Cadastral studies	Understanding property law	Fundamentals of Roman-Dutch law, land law immovable property and real rights; land parcels, boundaries, rights and tenure; rights diagrams and deeds (servitudes, leases, sectional titles, 3D rights, off-shore rights, communal rights and rights to mineral and petroleum resources).	12	3
14	Geodesy and Satellite Surveying (GNSS)	Understanding of geodetic and GNSS concepts and theory and ability to carry out and analyse GNSS surveys at a professional level	Earth gravity field, earth rotation dynamics and reference systems, geocentric coordinate systems, gravity observations, geoidal studies, tidal effects and determination of sea level, advance theory of earth motions and time, datum and datum transformations, geodetic surveying, global navigation satellite systems theory and practice (instrumentation, data acquisition and processing for cadastral, engineering, GIS and geodetic purposes), satellite orbits, time systems, 3-D positioning, transformation between ellipsoids. Height systems, Direct and indirect geodetic problems.	24	5

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15	Land management and Planning	Understanding of land management paradigms, challenges and solutions; understanding of planning principles and applications at a professional level	Urban dynamics and development, land use systems and types, land use planning and control, socio-economic influences, environmental and physical influences, planning legislation and constraints on township development, community dynamics, social compacts, layout design, engineering considerations for services, integrated environmental management, environmental impact analysis, land development objectives of local government, land management and administration, land valuation.	12	3
16	Precise Engineering Surveying	Ability to plan and execute precise surveying projects as required at a professional level	Specialised instrumentation (including sources of errors, calibration, mitigation and expected precision), precise engineering surveying methods, precise heighting methods, design and optimisation of networks, precision surveys for construction and industrial applications (including precision alignment), deformation surveys and monitoring, mathematical models of deformation analysis and interpretation of results. best fitting geometric shapes, permanent monitoring instrumentation, design of monitoring projects for dams, bridges, mines and geological phenomena. Setting out of tunnels , bridges, dams, tall buildings and industrial structures, including supervision and monitoring; gyroscopes, accelerometers.	48	10
17	3D modelling/digital cartography	Ability to process and present spatial data in 2 and 3D formats	Visual perception, cartographic communication , graphic space, symbology (point, line, area, pictorial, 3-D), colour, cartographic design, typology, generalisation, map use, 2-D and 3-D visualisation, general purpose maps, relief representation, thematic maps (including statistical mapping), image maps; 3D modelling from point clouds and 3D mesh creation.	12	3
			TOTAL	480	100