Nepal Engineering Council Registration Examination
Geomatics Engineering Syllabus (AGeE)

Chapters 1-6 focus on fundamentals and application aspects of Geomatics Engineering; chapters 7-8 focus on geospatial analysis and their applications; Chapter 9 puts emphasis on engineering survey; and the last (10th) chapter is related to project planning, design and implementation.

1. Fundamentals of Surveying **(AGeE01)**

1**.1 Introduction to surveying**: History; definitions; principles; classifications; applications; scale; linear and angular measurements; units; standardization and conversion. (AGeE0101)

1.2 Traditional methods of surveying: Chain and Tape (types and corrections); Plane Table; Compass; Theodolite; Tacheometry. (AGeE0102)

1.3 Horizontal control: Triangulation; Trilateration; Traversing (Principles, Methods, strength of figures, Computations, and Error Adjustments); applications. (AGeE0103)

1.4 Vertical control: Levelling and Types, Direct and Indirect Leveling (Spirit Levelling, Precise Levelling; Reciprocal Levelling and Trigonometric Leveling) Errors and Corrections, temporary and permanent adjustment in Levelling. (AGeE0104)

1.5 Topographical surveying: Planning, Reconnaissance, Monumentation, Control Survey, Detailing; Contouring, Mapping and Drafting. (AGeE0105)

1.6 Adjustment of observation: Introduction, Theory of measurements and errors, source of errors and types, Accuracy and Precision, Least Square Adjustments (principles; methods of observation equations, differences and correlates, linearization of nonlinear equations; intersection, resection, traverse, triangulation and trilateration adjustments); Propagation of Errors; variance, Co–variance, Correlation and Regression. (AGeE0106)

2. Photogrammetry, Remote Sensing and Image Processing **(AGeE02)**

2.1 Fundamentals of photogrammetry: Definition of Photogrammetry, principles, types, history of photogrammetry, scope and application of photogrammetry. (AGeE0201)

2**.2 Aerial photogrammetry**: Types of aerial photographs, Vertical scale of aerial photograph, Photogrammetry process, Flight plan, orientation (Interior and exterior orientation, Inner, Relative Absolute Orientation) Aerial triangulation, Block adjustment, Effect of relief and tilt displacement, Rectification, Oblique photography, Photo mosaics and photo maps, Pre-pointing and post pointing, Properties of ideal GCP. (AGeE0202)

2.3 Binocular vision and digital photogrammetry: Human eye and its characteristics, Stereoscopic Vision, Pseudoscopic Vision, Anaglyph Vision, Application of stereo vision and parallax in photogrammetry, Digital Photogrammetry Process, Image Matching; Area Based and Feature Based Image Matching. (AGeE0203)

2.4 Fundamentals of remote sensing: Introduction and brief history of Remote Sensing, types of sensor, Resolution (Spatial, Spectral, Radiometric and Temporal) and platform, Electromagnetic Radiation Spectrum, spectral reflectance curve, Interaction of EMR with Atmosphere and Earth Surface.
(AGeE0204)

2.5 Image processing and interpretation: Image Enhancement, Histogram, Filtering, Radiometric distortion and corrections, Geometric distortion and correction, Image classifications (Unsupervised and Supervised), Accuracy assessment and Image interpretation process. (AGeE0205)

2.6 Terrain models generation and ortho products: Methods (UAV, LiDAR, Stereo Imageries, HRSI, Basics of Microwave Remote Sensing, SAR and InSAR), Products (DTM, DEM, DSM), 2D and 3D products. (AGeE0206)

3. Geodesy and Gravity Field (AGeE03)

3.1 Basic geodesy: Definitions; shape of earth; coordinates; geoid vs ellipsoid; deflection of verticals; laplace equation. (AGeE0301)

3.2 Mathematical and geometrical concept of geodesy: Basic ellipsoidal geometry; Coordinates calculation on ellipsoidal surface; selection of ellipsoid; Normal section; meridional and prime vertical arc. (AGeE0302)

3.3 Datum, coordinate system and projections: Definition; Coordinate system (Reference Frame, system; terrestrial; celestial; orbital, ITRS/ITRF/ECEF, local and global spheroids); Transformation (Coordinate transformation, datum transformation; geocentric and geographic, local to global); Reflection and Rotation matrix. (AGeE0303)

3.4 Physical geodesy: Newton's Laws; Gravity Force; Gravity Potential; Theoretical, Measured and Normal Gravity; Gravity Anomaly; Undulations and Heights; Level surfaces and plumb lines. (AGeE0304)

3.5 Gravimetry and gravity field of earth: Laplace equation and spherical coordinates; Spherical Harmonics; Clairut's Formula; Gravimeters; Isostatics and Non-Isostatic Gravity Reduction. (AGeE0305)

3.6 Field astronomy and time systems: Celestial sphere; Celestial systems; spherical triangle; Napier rule; Sidereal Time and Universal Time; Local and Standard time; time conversion; Motions of heavenly bodies (precession, nutation, polar motion, aberration, parallax and refraction); Dependent and Independent Coordinate System; Star Almanac. (AGeE0306)

4. Cadaster, Land use, and Land Management (AGeE04)

4.1 Introduction to cadastre: History, Principles, Components of Cadastre; International practices; Cadastral survey methods- Analog and Digital, Projection system and sheet numbering; Cadastral System of Nepal; Procedure and Update of Records. (AGeE0401)

4.2 Land administration: Definition; functions; Land Reform; Land Taxation; Land Market (BGeE0402)

4.3 Land tenure and land registration: Land laws; Tenure Security; Tenure System; Land registration and their types; merits and demerits of land registration systems. (AGeE0403)

4.4 Land information system: Components; Stakeholders; Data; Procedure; Data maintenance and Dissemination. (AGeE0404)

4.5 Land use and land valuation: Concepts of Land use and land use planning; Participation and Implementation in planning; Land Consolidation and Land Pooling; Land Governance; Land Conflicts and Resolutions; Basics of land valuation; Legal basis for land valuation; Land valuation in Nepal. (AGeE0405)

4.6 Land related Policies, Acts, Rules and Regulation: Land Act; National Land Use Policy; National Land Policy; Land Use Act and Regulations; Land (Survey and Measurement) Act, Rules. (AGeE0406)

5. Global Navigation Satellite System (GNSS) (AGeE05)

5.1 Fundamentals and principles of GNSS: GNSS Observable (carrier phase, code pseudo ranges and doppler frequency), antenna and receiver characteristics. (AGeE0501)

5.2 Mathematical models: Coordinate Reference System for GNSS; Point positioning; Relative Positioning; mathematical model for GNSS satellite orbit. (AGeE0502)

5.3 GNSS signals and processing: Fundamentals of GNSS signals, Linear Carrier Phase Combinations (Single Differencing, Double Differencing, Triple Differencing, Carrier Smoothing of the Code), System Biases and Error (Multipath, Timing and Orbital Biases, Troposphere, Ionosphere). (AGeE0503)

5.4 Satellite geometry and DOP: Fundamentals of satellite geometry, Survey Planning and Dilution of Precision (DOP), GNSS Survey Specifications and Quality Assurance. (AGeE0504)

5.5 Static and kinematic positioning: Fundamentals of Static and kinematic positioning, Static Positioning Performance and Applications, Rapid Static Performance and Applications, Kinematic Positioning Performance and Applications Pseudo-Kinematic (Pseudo-Static) Positioning, Semi (or Stop and Go) Kinematic Positioning, Real-time Positioning and Continuously Operating Reference Stations (CORS) (AGeE0505)

5.6 Positioning by inertial navigation system (INS): Fundamentals of INS, Mathematical Model, Kalman Filtering. (AGeE0506)

6. Cartography and Geo-Visualization **(AGeE06)**

6.1 Fundamentals of cartography and visualization: Basic definitions and development, Classification of maps, Types of Maps, Map Scale, Enlargement and Reduction of Map, Uses of Map. (AGeE0601)

6.2 Map projection and map sheet numbering: Introduction, Classification of Map Projection, Map distortion and Scale Factor, Choice of Map Projection (National & International Practices), Map sheet numbering (National & International Practices), Map Sheet Numbering for Topographic Base Maps in Nepal. (AGeE0602)

6.3 Cartographic visualization: Principles and Objectives of map design; Map Symbols; Visual Hierarchy; Measurement Scales; Graphic Visual Variables and their association; Thematic map presentation. (AGeE0603)

6.4 Generalization, typography and color theory: Generalization definition, types and guidelines; Typographic grammar; General and Specific typographic guidelines, Toponymy, Color Theory, Color Guidelines, Color Models. (AGeE0604)

6.5 Digital cartography and web cartography: Introduction to digital cartography, Raster and Vector Data Model, Steps of Digital Method of Map Making, Conventional and Digital Cartography, Digital Landscape Model (DLM) and Digital Cartographic Model (DCM), Classification; Client Server architecture, OGC Standards, Dynamic maps and Dynamic Visual Variables. (AGeE0605)

6.6 Map element, and reproduction techniques: Data Classification Techniques; Map layout prerequisites and elements; layout balance, Introduction to map reproduction, Contact Photography, Concept of thickening and thinning, Plate Making Process (positive, negative and digital plate making system), Map Printing (Flat Bed Printing, Rotary offset printing and digital printing). (AGeE0606)

7. Spatial Data Management System and Spatial Data Infrastructure **(AGeE07)**

7.1 Fundamentals of SDBMS: Terminologies; components and functions; Database Access Language. (AGeE0701)

7.2 Spatial data infrastructure: principle and components; standards; metadata; data accessibility; data interoperability. (AGeE0702)

7.3 Data model: Components; types (Relational, Network, Hierarchical, Entity Relationship, UML). (AGeE0703)

7.4 Structured query language: SQL Overview; RDBMS; Constraints and Keys; SQL Syntax; Data Types. (AGeE0704)

7.5 Spatial database technology: OODBMS and ORDBMS; Spatial Data Types and Models; Operation on spatial data; Spatial Joining and indexing; Spatial Data Mining; Spatial Query Language; OGIS Standards; Basics of PostGIS and PostgreSQL; Spatial storage and access. (AGeE0705)

7.6 NSDI: Organizational structure; Policy; Metadata; Clearing house; Client server architecture and application. (AGeE0706)

8. Geographic Information System (AGeE08)

8.1 Fundamentals of GIS: Components; Historical development; Georeferencing, data formats; data quality, topology and spatial relationship. (AGeE0801)

8.2 Data source and spatial data model: Data Source, Metadata and Standards; Vector and Raster data model; Field based and Object based model; TIN and Grid. (AGeE0802)

8.3 Geometric transformation and geospatial analysis: Database Query; Overlay Analysis; Network Analysis; Geospatial Measurement; Geovisualization, Data driven techniques, Styled Layer Descriptor (SLD). (AGeE0803)

8.4 Surface modeling: Surface Curvature; Surface Intersection; Hillshade; Viewshed; Watershed; Slope and Aspect, algorithm and their applications. (AGeE0804)

8.5 Spatial interpolation and application of DTM: Interpolation and Resampling Methods; Spatial dependence and Semivariogram; Ordinary and Universal Kriging; point based moving average model; DSM; DEM; Breaklines. (AGeE0805)

8.6 Open GIS: Open - source GIS Software, GeoServer; Web Map Service (WMS); Web Feature Service (WFS), Web Coverage Service (WCS); Data Visualization and application. (AGeE0806)

9. Engineering Survey (AGeE09)

9.1. Introduction: Preliminary, feasibility, construction; objectives; scope; methodology; horizontal and vertical controls. (AGeE0901)

9.2 Hydrographic, hydropower and Irrigation survey: Introduction; objectives; scope; methodology; depth measurement equipment and working principle, discharge measurement; river profile and cross-section; Bridge survey; Gauge station, Project components (Reservoir, Dam/weir, Intake, conveyance system, penstock, powerhouse, tailrace. (AGeE0902)

9.3 Underground surveying: Introduction; objectives; scope; methodology; underground survey equipment's; terminologies; connecting surface and underground survey; tunnel survey; tunnel convergence monitoring and instrumentation general introduction; Geophysical survey: Electrical Resistivity Tomography survey general introduction. (AGeE0903)

9.4 Route surveying: Introduction; objectives; scope; methodology for surveying transmission line, sewer, pipeline, road, railway, cable car; curves (Types; elements; setting out of simple circular curve and vertical curves; transition curves and applications; super elevation). (AGeE0904)

9.5. Basic civil engineering: General Introduction to civil engineering structures (Building, Bridges, Dam, Weir, Tunnel, Road); Stakeout (Introduction and Survey Technique). (AGeE0905)

9.6. Quantity survey: Construction materials; Estimation, Area and volume calculation, methodology, mass haul diagram and properties). (AGeE0906)

10. Project Planning, Design and Implementation **(AALL10)**

10.1 Engineering drawings and its concepts: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing. (AALL1001)

10.2 Engineering Economics: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal. (AALL1002)

10.3 Project planning and scheduling: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling. (AALL1003)

10.4 Project management: Information system; project risk analysis and management; project financing, tender and its process, and contract management. (AALL1004)

10.5 Engineering professional practice: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA). (AALL1005)

10.6 Engineering Regulatory Body: Nepal Engineering Council (Acts & Regulations). (AALL1006)