

**FUNDAMENTALS OF SURVEYING (FS)
EXAMINATION SPECIFICATIONS**

Effective October 2005

	Approximate Percentage of the Examination
Knowledge	
I. Algebra and Trigonometry	11%
II. Higher Math (beyond trigonometry)	4%
III. Probability and Statistics, Measurement Analysis, and Data Adjustment	5%
IV. Basic Sciences	4%
V. Geodesy, Survey Astronomy, and Geodetic Survey Calculation	6%
VI. Computer Operations and Programming	6%
VII. Written Communication	6%
VIII. Boundary Law, Cadastral Law and Administration	13%
IX. Business Law, Management, Economics, Finance, and Survey Planning Process and Procedures	6%
X. Field Data Acquisition and Reduction	10%
XI. Photo/Image Data Acquisition and Reduction	4%
XII. Graphical Communication, Mapping	6%
XIII. Plane Survey Calculation	10%
XIV. Geographic Information System (GIS) Concepts	4%
XV. Land Development Principles	5%

Note: The examination contains 170 questions.

The fifteen knowledge areas on the FS examination and typical surveying activities associated with them are as follows.

I. Algebra and Trigonometry

(units of measurement; formula development; formula manipulation; solving systems of equations; basic mensuration formulas for length, area, volume; quadratic equations; trigonometric functions; right triangle solutions; oblique triangle solutions; spherical triangle solutions; trigonometric identities)

- Perform astronomic measurements.
- Perform trigonometric leveling.
- Perform differential leveling.
- Compute survey data.
- Compute areas and volumes.
- Determine and prepare lot and street patterns for land division.
- Design horizontal and vertical alignment for roads within a subdivision.

II. Higher Math (beyond trigonometry)

(analytic geometry; linear algebra; equation of a line, circle, parabola, ellipse; differentiation of functions; integration of elementary functions; infinite series; mathematical modeling)

- Perform geodetic surveys using conventional methods.
- Perform geodetic and/or plane surveys using GPS methods.
- Perform astronomic measurements.
- Compute survey data.
- Analyze and adjust survey data.
- Design horizontal and vertical alignment for roads within a subdivision.

III. Probability and Statistics, Measurement Analysis, and Data Adjustment

(standard deviation; variance; standard deviation of unit weight; tests of significance; concept of probability and confidence intervals; error ellipses; data distributions and histograms; analysis of error sources; error propagation; control network analysis; blunder trapping and elimination; least squares adjustment; calculation of uncertainty of position; accuracy standards; analysis of historical measurements)

- Determine levels of precision and order of accuracy.
- Perform geodetic and/or plane surveys using GPS methods.
- Compute survey data.
- Analyze and adjust survey data.
- Determine levels of precision and order of accuracy.
- Perform geodetic and/or plane surveys using conventional surveys.
- Perform geodetic and/or plane surveys using GPS methods.
- Perform astronomic measurements.
- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
- Perform hydrographic surveys.
- Perform trigonometric leveling.
- Perform differential leveling.
- Perform photogrammetric control surveys.

- Produce survey data using photogrammetric methods.
- Perform boundary surveys.
- Perform route and right-of-way surveys.
- Perform topographic surveys.
- Perform flood plain surveys.
- Perform construction surveys.
- Perform condominium surveys.
- Compute survey data.
- Analyze and adjust survey data.
- Reconcile survey and record data.
- Convert survey data to an appropriate datum.
- Prepare work sheets for analysis of surveys.
- Determine locations of boundary lines and encumbrances.
- Determine and prepare lot and street patterns for land division.
- Design horizontal and vertical alignment for roads within a subdivision.
- Develop and/or provide data for LIS/GIS.

IV. **Basic Sciences**

(light and wave propagation; basic electricity; optics; gravity; refraction; mechanics; forces; kinematics; temperature and heat; biology; dendrology; geology; plant science)

- Calibrate instruments.

V. **Geodesy, Survey Astronomy, and Geodetic Survey Calculation**

(reference ellipsoids; gravity fields; geoid; geodetic datums; direction and distance on the ellipsoid; conversion from geodetic heights to elevation; orbit determination and tracking; determination of azimuth using common celestial bodies; time systems; calculation of position on a recognized coordinate system such as latitude/longitude; state plane coordinate systems; UTM coordinate systems; coordinate transformations; scale factors; meridian convergence)

- Select appropriate vertical and/or horizontal datum and basis of bearings.
- Perform geodetic surveys using conventional methods.
- Perform geodetic and/or plane surveys using GPS methods.
- Perform astronomic measurements.
- Perform hydrographic surveys.
- Perform differential leveling.
- Analyze and adjust survey data.
- Convert survey data to an appropriate datum.
- Determine levels of precision and order of accuracy.
- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
- Perform trigonometric leveling.
- Perform photogrammetric control surveys.
- Produce survey data using photogrammetric methods.
- Perform boundary surveys.
- Perform route and right-of-way surveys.
- Perform topographic surveys.
- Perform flood plain surveys.

- Compute survey data.
- Prepare work sheets for analysis of surveys.
- Determine locations of boundary lines and encumbrances.
- Develop and/or provide data for LIS/GIS.

VI. Computer Operations and Programming

(operating systems; graphical user interfaces (Windows); data flow; bits and bytes; internet, computer architecture; programming a computer in a compiled language; order of arithmetic operations; programming concepts such as decision statements, flow charts, looping, arrays; spreadsheet operations)

- Compute survey data.
- Analyze and adjust survey data.
- Convert survey data to an appropriate datum.
- Utilize computer-aided drafting systems.

VII. Written Communication

(written communication; grammar; sentence structure; punctuation; bibliographical referencing)

- Evaluate project elements to define scope of work.
- Prepare and negotiate proposals and/or contracts.
- Consult and coordinate with allied professionals and/or regulatory agencies.
- Consult with and advise clients and/or their agents.
- Facilitate regulatory review and approval of project documents and maps.
- Determine and secure entry rights.
- Gather parol evidence.
- Perform boundary surveys.
- Advise clients regarding boundary uncertainties.
- Review documents with clients and/or attorneys.
- Prepare sketches and/or preliminary plats.
- Prepare survey maps, plats, and reports.
- Prepare land descriptions.

VIII. Boundary Law, Cadastral Law and Administration

(land descriptions; real property rights; concepts of land ownership; case law; statute law; conveyancing; official records; land record sources; legal instruments of title; U.S. Public Land Survey System; colonial/metes and bounds survey system; subdivision survey system; other cadastral systems; rules of evidence relative to land boundaries and court appearance; boundary control and legal principles; order of importance of conflicting title elements; possession principles; conflict resolution; riparian/littoral water boundaries; boundary evidence; simultaneous and sequential conveyance)

- Facilitate regulatory review and approval of project documents and maps.
- Determine and secure entry rights.
- Research and evaluate evidence from private record sources.
- Research and evaluate evidence from public record sources.
- Research and evaluate court records and case law.
- Gather and evaluate parol evidence.
- Perform boundary surveys.

- Perform condominium surveys.
- Reconcile survey and record data.
- Identify and evaluate field evidence for possession, boundary line discrepancies, and potential adverse possession claims.
- Identify riparian and/or littoral boundaries.
- Apply Public Land and other Survey System principles.
- Evaluate the priority of conflicting title elements.
- Determine locations of boundary lines and encumbrances.
- Advise clients regarding boundary uncertainties.
- Testify as an expert witness.
- Review documents with clients and/or attorneys.
- Determine subdivision development requirements and constraints.
- Determine and prepare lot and street patterns for land division.
- Perpetuate and/or establish monuments and their records.
- Document potential possession claims.
- Prepare and file record of survey.
- Identify pertinent physical features, landmarks, and existing monumentation.
- Perform route and right-of-way surveys.
- Prepare survey maps, plats, and reports.
- Prepare land descriptions.

IX. Business Law, Management, Economics, Finance, Survey Planning Processes and Procedures

(sole proprietorships, corporations, partnership structures; contract law; tax structure; employment law; liability; operation analysis and optimization; land economics; appraisal science; critical path analysis; human resource management principles; cost/benefit analysis of a project or operation; econometric modeling; time value of money; budgeting; techniques for planning and conducting surveys including boundary surveys, control surveys, hydrographic surveys, topographic surveys, route surveys, aerial surveys, construction surveys; issues related to professional liability, ethics, and courtesy)

- Evaluate project elements to define scope of work.
- Prepare and negotiate proposals and/or contracts.
- Consult and coordinate with allied professionals and/or regulatory agencies.
- Consult with and advise clients and/or their agents.
- Facilitate regulatory review and approval of project documents and maps.
- Determine and secure entry rights.
- Advise clients regarding boundary uncertainties.
- Testify as an expert witness.
- Review documents with clients and/or attorneys.
- Document potential possession claims.
- Prepare survey maps, plats, and reports.
- Develop and/or provide data for LIS/GIS.

x. Field Data Acquisition and Reduction

(field notes and electronic data collection; measurement of distances, angles and directions; modern instruments and their construction and use; tapes; levels; theodolites; total stations; EDMs; GPS; hydrographic data collection instruments; construction layout instruments and procedures for routes and structures; historical measurement methods)

- Determine levels of precision and order of accuracy.
- Recover horizontal/vertical control.
- Identify pertinent physical features, landmarks, and existing monumentation.
- Calibrate instruments.
- Perform geodetic and/or plane surveys using conventional methods.
- Perform geodetic and/or plane surveys using GPS methods.
- Perform astronomic measurements.
- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
- Perform hydrographic surveys.
- Perform trigonometric leveling.
- Perform differential leveling.
- Perform photogrammetric control surveys.
- Perform field verifications of photogrammetric maps.
- Produce survey data using photogrammetric methods.
- Perform boundary surveys.
- Perform route and right-of-way surveys.
- Perform topographic surveys.
- Perform flood plain surveys.
- Perform construction surveys.
- Perform condominium surveys.
- Perpetuate and/or establish monuments and their records.

xi. Photo/Image Data Acquisition and Reduction

(cameras; image scanners; digitizers; stereo plotters; photo and stereomodel orientation; ortho-photo production; georectification; image processing; raster/vector data conversions)

- Determine levels of precision and order of accuracy.
- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
- Perform photogrammetric control surveys.
- Perform field verifications of photogrammetric maps.
- Produce survey data using photogrammetric methods.
- Utilize survey data produced from photogrammetric methods.
- Perform topographic surveys.
- Perform flood plain surveys.
- Prepare survey maps, plats, and reports.

XII. Graphical Communication, Mapping

(principles of effective graphical display of spatial information; preparation of sketches; scaled drawings; survey plats and maps; interpretation of features on three-dimensional drawings; principles of cartography and map projections; computer mapping; use of overlays)

- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
- Produce survey data using photogrammetric methods.
- Utilize survey data produced from photogrammetric methods.
- Prepare work sheets for analysis of surveys.
- Utilize computer-aided drafting systems.
- Determine and prepare lot and street patterns for land division.
- Design horizontal and vertical alignment for roads within a subdivision.
- Prepare sketches and/or preliminary plats.
- Prepare and file record of survey.
- Prepare survey maps, plats, and reports.
- Develop and/or provide data for LIS/GIS.

XIII. Plane Survey Calculation

(computation and adjustment of traverses; COGO computation of boundary lines, route alignments, construction layout, and subdivision plats; calculation of route curves and volumes)

- Determine levels of precision and order of accuracy.
- Calibrate instruments.
- Perform geodetic and/or plane surveys using conventional methods.
- Perform geodetic and/or plane surveys using GPS methods.
- Perform astronomic measurements.
- Perform record or as-built surveys.
- Perform ALTA/ACSM surveys.
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xiv. Geographic Information System (GIS) Concepts

(spatial data storage, retrieval, and analysis systems; relational database systems; spatial objects; attribute value measurement; data definitions; schemas; metadata concepts; coding standards; GIS analysis of networks; buffering; overlay; spatial data accuracy standards)

- Utilize computer-aided drafting systems.
- Perpetuate and/or establish monuments and their records.
- Prepare and file records of surveys.
- Prepare survey maps, plats, and reports.
- Develop and/or provide data for LIS/GIS.

xv. Land Development Principles

(land planning and practices; laws controlling land use; drainage systems; construction methods; geometric and physical aspects of site analysis; design of land subdivisions; street alignment calculations; application of subdivision standards)

- Prepare sketches and/or preliminary plats.
- Prepare survey maps, plats, and reports.
- Prepare land descriptions.
- Evaluate project elements to define scope of work.
- Prepare and negotiate proposals and/or contracts.
- Consult and coordinate with allied professionals and/or regulatory agencies.
- Consult with and advise clients and/or their agents.
- Facilitate regulatory review and approval of project documents and maps.
- Determine subdivision development requirements and constraints.
- Determine and prepare lot and street patterns for land division.
- Perpetuate and/or establish monuments and their records.
- Design horizontal and vertical alignment for roads within a subdivision.