بسم الله الرحمن الرحيم

Technical English

for students of Surveying Engineering

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تقدیم به:

نقشه‌برداران پرتوان کشور

تقدیر و تشکر

سپاس خدایی را که سخنوران در ستودن او بمانند و شمارگان شمردن نعمت‌های او ندانند و کوشندگان، حق او را گزاردن نتوانند. خدایی که پای اندیشه تیزگام در راه شناسایی او لنگ است، و سر فکرت ژرف رو به دریای معرفتش بر سنگ. صفت‌های او تعریف ناشدنی است و به وصف درنیامدنی، و در وقت ناگنجیدنی، و به زمانی مخصوص نابودنی که به رحمتش بادها را بپراکنید، و با خرسنگ‌ها لرزه زمین را در مهار کشید.*

برخود لازم می‌دانیم از خانواده بزرگوار خود که همواره مشوق ما در تهیه و تدوین این کتاب بودند تقدیر و تشکر نماییم. از آقایان مهندس رحمانی‌زاده، مهندس پروین‌نژاد، مهندس داوری مجد، مهندس امامی و آقای مهندس حیدری و کلیه کسانی که در تهیه و تدوین این کتاب ما را یاری نمودند نیز تشکر و قدردانی می‌نماییم. هم‌چنین از دانشجویان آقایان پورمحمد و خدایی که در تهیه لغات انتهای کتاب همکاری داشته‌اند نیز تقدیر و تشکر می‌شود.

در انتها از آقایان مهندس غضنفری و مهندس یوسفی که در ویرایش این کتاب زحمات زیادی متحمل شده و با راهنمایی‌های ارزنده خود راه را بر ما هموار نمودند و از آقایان مهندس رفیعی، جلیلیان و نادرشاهی تشکر و قدردانی می‌نماییم.

از آن جهت که هیچ نوشته و سخنی عاری از خطا نبوده و با توجه به این مثل معروف "آن کس اشتباه نکند که هیچ انجام ندهد" این کتاب نیز از این قاعده مستثنی نبوده و دارای نقص‌هایی می‌باشد. امید است که خوانندگان گرامی نقائص و کمبودها و اشتباهات احتمالی را به دیده اغماض ننگرند و با مطلع ساختن مؤلفان این کتاب، ما را رهین منت خود سازند.

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* از سخنان گهربار مولا الموحدین حضرت علی علیه‌السلام

Contents

پیش‌گفتار

امروزه ژئودزی و ژئوماتیک جایگاه واقعی خود را پیدا کرده به‌گونه‌ای که متخصصان بسیاری از علوم به این اهمیت اذعان دارند و چه بسا بدون اطلاعات دریافتی از علم ژئوماتیک بسیاری از تحقیقات آن‌ها ناتمام مانده و یا اصلا انجام نمی‌گیرد. با توجه به چنین اهمیتی لازم است که متخصصان گرایش‌های مختلف ژئودزی و ژئوماتیک از اطلاعات به‌روز برخوردار بوده و همگام با متخصصان دنیا گام بردارند. این مهم تحقق نمی‌یابد مگر با آشنایی به زبان‌های دیگر به‌ویژه زبان‌های علمی دنیا. البته زبان خارجی با زبان تخصصی کمی تفاوت داشته و نیاز به اصطلاحاتی می‌باشد که عامه مردم از وجود چنین لغاتی بی‌اطلاعند. در این میان زبان انگلیسی کاربرد بیش‌تر داشته و اکثریت کتب تخصصی نیز به این زبان می‌باشد. بنابراین برآن شدیم تا با توجه به نیاز دانشجویان به زبان تخصصی و ضعف اکثریت دانشجویان در فهم زبان انگلیسی کتابی تألیف کنیم که دانشجویان را ترغیب به مطالعه نموده و آن‌ها را ملزم به چالش جهت یادگیری نماییم. البته از آن‌جهت که در یک کتاب مجال بیان کلیه مطالب زبان تخصصی انگلیسی مقدور نمی‌باشد درنتیجه بهتر است که دانشجویان و محققان به کتاب‌های مرجع این کتاب نیز مراجعه نمایند.

این کتاب به‌گونه‌ای طراحی شده که منطبق بر شیوه طراحی سوالات کنکور کارشناسی ارشد باشد. هر درس بحثی از مباحث ژئوماتیک را دربرمی‌گیرد که شامل سه متن بوده و در انتهای هر متن سوالاتی طرح شده تا دانشجو را به تفکر وادارد. در انتهای هر درس نیز تعداد ۱۰ لغت کاملا تخصصی قرار دارد که دانشجو باید با اطلاع از مفهوم لغات، جمله مربوط به هر لغت را بیابد. تست‌های کنکور کارشناسی ارشد سال‌های ۱۳۸۰ به بعد نیز در این کتاب گنجانده شده تا دانشجو را بیش از پیش با سوالات کنکور کارشناسی ارشد آشنا کند. در پایان نیز تعدادی لغات متداول در متون تخصصی در یک فصل مجزا افزوده شده تا دانشجویان در مواقع لزوم به آن‌ها مراجعه نمایند.

مقدمه ناشر

باسمه‌تعالی

بی تردید اولین پیش‌نیاز برای یادگیری و فهم هر دانشی، به‌ویژه دانش فنی و مهندسی علاقه وافر، کوشش مداوم و ایمان و اعتقاد به روش‌های علمی در حل مسائل و مشکلات است. با این فرض اگر دانشجویی به یک زبان خارجی، به‌ویژه در شاخه زبان تخصصی خود، آشنایی داشته باشد، نه تنها از عهده مشکلات به‌وجود آمده در مسائل علمی به‌خوبی برمی‌آید، که با علوم و اطلاعات تخصصی و به‌روز دنیا بیش‌تر آشنا خواهد شد. بنابراین مطالعه کتب تخصصی زبان اصلی برای دانشجویان و دانش پژوهان بسیار لازم می‌باشد.

متأسفانه در بیش‌تر مواقع حجم زیاد مطالب و کتب تخصصی به زبان اصلی (به‌طور عمده انگلیسی) و نبود هیچ‌گونه منبع موثق جهت راهنمایی جویندگان دانش، به سردرگمی دانشجو و درنتیجه خستگی از کتب زبان اصلی منجر گردیده، باعث می‌شود دانشجو تنها به جزوات و کتب فارسی بسنده نماید. بر این اساس، وجود کتاب‌هایی که هم راهنمون دانشجویان به مفاهیم اصلی رشته تخصصی آن‌ها باشد، و هم به افزایش دانش آن‌ها (در زبان انگلیسی) کمک نماید بسیار ضروری است.

کتاب حاضر با متن‌های کوتاه و دروس کم‌حجم به‌گونه‌ای تدوین گردیده که بتوان در هر جلسه کلاسی، حداقل یک مبحث از آن را تدریس کرد. درنتیجه کوتاه بودن متن‌ها از خستگی دانشجو جلوگیری نموده و دانشجو را به حرکت وامیدارد. امید است استادان محترم، این کتاب را به عنوان کتاب درسی زبان تخصصی انتخاب نمایند و دانشجویان رشته‌های علوم نقشه‌برداری با مطالعه این کتاب بینش تازه‌ای در مطالعه کتب تخصصی پیدا نموده، با علاقه بیش‌تر به مطالعه کتب زبان اصلی بپردازند.

برای تمامی دست‌اندرکاران تهیه این کتاب آرزوی توفیق مستمر داشته و امیدواریم که این سازمان بتواند با انجام این‌گونه اقدامات همچون سال‌های پیش، در ارتقای علوم ژئوماتیک گام‌های بلندتری بردارد.

محمود ایلخان
رئیس سازمان نقشه‌برداری کشور

Chapter 1: GIS

What is GIS?

An information system is an association of people, machines, data, and procedures working together to collect, manage, and distribution information of importance to individuals or organizations. The term "organization" is meant here in a wide sense that includes corporations[1] and governments as well as more diffuse[2] groupings, such as global colleges of scientists with common interests or a collection of people looking at the environmental impact of a proposed[3] new rail-link. The World Wide Web (WWW) is an example of an information system. The WWW comprises[4] data (web pages) and machines (web servers and web browsers), but also the many people across the world who use the WWW and the procedures for maintaining[5] information on the WWW.

A GIS is a special type of information system concerned with[6] geographically referenced data. Specifically:

A geographic information system is a computer-based information system that enables capture, modeling, storage, retrieval[7], sharing[8], manipulation[9], analysis, and presentation[10] of geographically referenced data.

We use the term geospatial to mean "geographically referenced" Geospatial data is a special type of spatial data that relates to the surface of the earth. The key components of a GIS are shown schematically in figure.

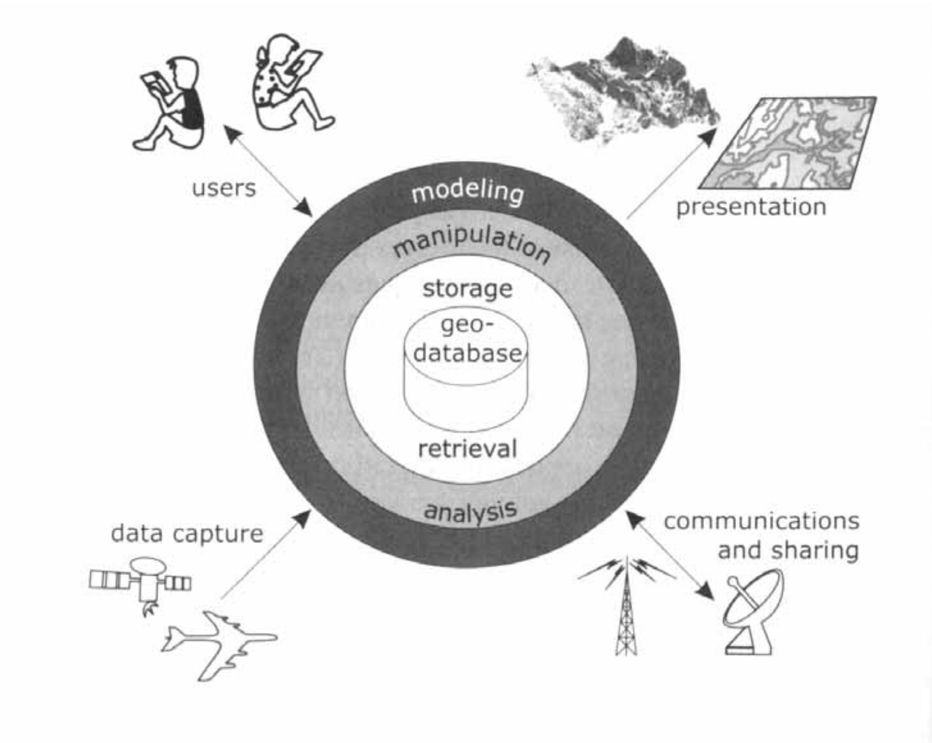

Figure 1: Schematic of a GIS

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. about	b. consist of
c. council	d. getting back
e. looking for	f. showing
g. spread over a large area	h. suggested
i. use together	j. work skillfully with

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. An information system is an organization for gathering important information.
2. A GIS is a special kind of information system about geographically referenced data.
3. The World Wide Web (WWW) consists of many people only.
4. A GIS is a computer-based information system.
5. Geospatial data is connected with the surface of the earth.

C. Read the passage and answer the questions.

1. An information system isn't an association of ….

a. procedures b. people c. importance d. data

2. An organization ….

   a. includes corporations and governments only
   b. includes interests only
   c. includes a collection of people only
   d. includes corporations, governments and a group of people

3. Which is data?

a. web servers b. web browsers
c. WWW d. Web pages

4. GIS dose not enable … of geographically referenced.

a. sharing b. distribution c. modeling d. analysis

5. In this passage, what is 'geospatial'?

a. special type	b. data
c. geographically referenced	d. surface of the earth

6. Which sentence isn't correct?

   a. GIS is computer-based.
   b. GIS is about geospatial data.
   c. GIS is about special type of spatial data.
   d. GIS is about key components.

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Data model

Data models are stepping-stones to the manipulation and processing of data. GIS software needs to have …1… complete functionality to provide the higher level …2… and decision support required within an application domain. For example, a GIS that is used for …3… applications will require network …4… operations. A GIS for …5… applications will require three-dimensional operations.

1.	a. sufficient	b. sufficiently	c. sufficiency	d. suffice
2.	a. analyze	b. analytical	c. analyst	d. analysis
3.	a. utility	b. utilize	c. utilizable	d. utilization
4.	a. process	b. processed	c. processing	d. processor
5.	a. geology	b. geologist	c. geologically	d. geological

Description

A database can be seen as one or several files stored on some external memory device, such as a disk. Although it would be possible to write applications that directly access these files, such as architecture would raise a number of problems pertaining to security, concurrency, and complexity of data manipulation. A DBMS is a collocation of software that manages the database structure and controls access to data stored in a database. Generally speaking, a DBMS facilitates the process of

- Defining a database; that is, specifying the data types, structures, and constraints to be taken into account.
- Constructing the database; that is, storing the data itself into persistent storage.
- Manipulating the database.
- Querying the database to retrieve specific data.
- Updating the database (changing values).

A DBMS acts as a mediator between users or application programs and the devices where data resides. DBMS software consists of two parts. The upper part processes the user query. The lower part allow one to access both the data itself (denoted "stored database" in the figure) and the metadata necessary to understand the definition and structure of the database.

A DBMS hinges on the fundamental concept of data independence. User interacts with a representation of data independently of actual physical storage, and the DBMS is in charge of translating the user's manipulations into efficient operations on physical data structures. Note that this is quite different from file processing, in which the structure of a file, together with the operations on this file, are embedded in an access program.

This mechanism is achievable through the use of different level of abstraction. It is customary in the database community to distinguish three levels in a database environment. The physical level deals with the storage structures, the logical level defines the data representation proposed to the user, and the external level corresponds to a partial view of the database provided in particular application.

The distinction between physical and logical representation, is central to field of databases. This clearly separates the tasks devoted to the system from the simplified representation and manipulation functionality offered to the user. She can hence focus primarily on the adequate modeling and implementation of her application.

E. Read the passage and answer the questions.

1. Which of these <u>isn't</u> a DBMS facilitation?

    a. Specifying the data types, structures and constraints.
    b. Retrieving specific data.
    c. Updating the database.
    d. Manipulating the structures.

2. A DBMS acts as a … between users and the devices.

a. software b. mediator c. database d. metadata

3. The DBMS is responsible for ….

    a. translating the user's manipulations.
    b. processing files.
    c. separating the tasks.
    d. dealing with the structures.

4. In a database environment we <u>can not</u> ….

    a. deal with the storage structures.
    b. define the data representation suggested to the user.
    c. correspond to a partial view of the database.
    d. focus on the modeling and implementation.

5. The difference between physical and logical representation ….

    a. defines the data representation.
    b. separates the data representation.
    c. deals with the storage structures.
    d. simplifies representation and manipulation

6. In this passage, what is "metadata"?

    a. stored database
    b. data itself
    c. stored database for definition
    d. software to access stored data

7. A DBMS software ….

    a. process the user.
    b. permits one to access the data and metadata.
    c. allows one to access the data only.
    d. allows one to access the metadata only.

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. database management system (DBMS)	b. geographic database
c. georeference	d. geospatial
e. GIS	f. raster
g. spatial data	h. topology
i. vector data	j. vector display

1. The software for managing and manipulating the whole GIS including the graphic and tabular data.

2. A grid-type data format used to interpret gray-scale photographs and satellite imagery. Imagery stored as dots or pixels, each with a different shade or density.

3. To establish the relationship between pages coordinates on a paper map or manuscript and known real-world coordinates.

4. Efficiently stored and organized spatial data and possibly related descriptive data.

5. A term used to describe a class of data that has a geographic or spatial data.

6. A computer system of hardware and software that integrates graphics with databases and allows for display, analysis, and modeling.

7. Data pertaining to the location of geographical entities together with their spatial dimensions. Spatial data are classified as point, line, area, or surface.

8. The spatial relationships between connecting or adjacent coverage features (e.g., arcs, nodes, polygons, and points).

9. A coordinate-based data structure commonly used to represent map features. Each linear feature is represented as a list of ordered x, y coordinates. Attributes are associated with the feature (as opposed to a raster data structure, which associates attributes with a grid cell). Traditional of these structures include double-digitized polygons and arc-node models.

10. This on a computer screen is produced by drawing vectors on the screen. A raster display, in contrast, is produced on a screen as rows of dots of "on" or "off" which produce the picture.

Chapter 2: Astronomy

Azimuth by Gyro attachment

A gyro attachment consists of a gyro motor suspended by a thin metal tape from one end of a sealed[1] tube that can be mounted vertically on the standards of a theodolite or a total station system. The tube, enclosure, gyro motor, and suspension are so designed that, when the unit is attached to the horizontal axis[2] of a leveled theodolite, the metal tape holding the rotating gyro coincides[3] with the vertical axis of the instrument and also with the direction of gravity. Note the suspension strip that supports the gyro motor has an axis of rotation perpendicular to the vertical or plumb line. The gyro motor spinning at 22,000 revolutions per minute about this horizontal axis tries to maintain in space its initial[4] random spinning plane created by its moment of inertia. The gyro, fixed to the instrument that is earthbound, is pulled out of its original spinning plane by the earth's rotation. This interference causes the gyro to oscillate around the plumb line until the spin axis is oriented in the north-south plane and the rotation of the gyro corresponds to the rotation of the earth. The gyro does not stabilize[5] immediately in the north-south direction but oscillates[6] about the meridian plane. The oscillation can be observed optically through an eyepiece attached to the containing the gyro. These oscillations can be observed as a moving light mark projected on a scale that has a V-shaped central index and can be observed through the viewing eyepiece. The midposition of these oscillations can be located by measuring the size of the swing period of the oscillations. Figure 1a shows the gyro mark centered and Figure 1b shows the mark at one elongation[7], which is one-half the swing period from the central index. The gyro attachment is oriented on the instrument so that the gyro spin axis and the telescopic line of sight fall in the same vertical plane when the light mark is centered on the index. When this condition is achieved, the telescope is oriented toward true or astronomic north.

The telescope can be oriented approximately toward true north by following the swing of the gyro mark with the upper tangent[8] motion of the theodolite. When the gyro mark reaches an elongation point and reverses direction (a reversal point), the horizontal circle reading is recorded. Next, the gyro mark again is followed, using the upper tangent motion, until a second reversal point on the opposite side of the index is reached. At this time, a second horizontal circle reading is taken. When the average of these two circle readings is set on the horizontal circle, the telescope line of sight is directed approximately toward true north to within $\pm 3 - 4'$. To obtain a more precise direction, measure the time intervals of at least three transits of the gyro mark across the central index and amplitudes of elongation points on both sides are measured. An angular correction to the approximate north direction then can be determined as a function of these observed times and half-swings east and west of the central index.

(a) (b)

Figure 1: (a) Swing of the gyro mark of the scale.
(b) Gyro mark at elongation-transit method. (Courtesy of Leica, Inc.)

For the last three successive[9] transits, as the floating mark passes 0 (Figure 1a), the times are entered by pressing one key on the auxiliary keyboard. With these data entered, the angular correction is calculated automatically by onboard software and the azimuth is displayed on the azimuth display register. The entire operation requires from 20 to 30 min to complete and permits determination of azimuth with a standard deviation[10] of 20".

The gyro method of establishing an azimuth is applicable to any survey where the attainable precision is adequate. It is particularly useful for the transfer of azimuth in the surveys needed for underground tunneling and mining operations.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. become longer than normal	b. become unchanging
c. coming one after the other	d. first
e. imaginary line	f. meet in the same place
g. move back and forth regularly	h. noticeable difference
i. related	j. shut

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. The metal tape coincides with the vertical axis when the unit is attached horizontally.
2. The gyro stabilizes immediately in the north-south direction.
3. The telescope is oriented to north by following the swing of the gyro.
4. It takes an hour to determine the azimuth.
5. The gyro method of establishing an azimuth is not applicable to any survey.

C. Read the passage and answer the questions.

1. The metal tape holding the rotating gyro coincides with ….

a. horizontal axis b. direction of gravity
c. leveled theodolite d. enclosure

2. Which best describes the meaning of "perpendicular"?

a. vertical b. exactly vertical
c. horizontal d. exactly horizontal

3. … is pulled out of its original spinning plane by the earth's rotation.

a. The tube b. Enclosure
c. Suspension d. The gyro

4. The gyro … about the meridian plane.

a. stabilizes b. coincides
c. oscillates d. rotates

5. When is the telescope oriented toward true north?

   a. The gyro spin axis and the telescopic line of sight fall in the same vertical plane
   b. The swing of the gyro mark with the upper tangent motion of the attachment
   c. The moving light mark project on a scale that has a v-shaped central index
   d. The gyro oscillates around the plumb line until the spin axis is oriented in the north-south plane

6. The horizontal circle reading is first recorded if

    a. gyro mark reaches an elongation point
    b. gyro mark reaches a reversal point
    c. gyro mark reaches an elongation and reverses
    d. gyro mark reaches a second reversal point

7. To obtain a more precise direction, we should measure … transits of the gyro mark.

a. one b. two c. three d. four

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Civil time

Because of the elliptical shape of the earth's orbit, the apparent angular velocity of the sun that we see, called the true sun, is not …1…; during four periods of each year it is greater and during four …2… periods less than the average velocity. Hence, the days, as indicated by the apparent travel of the true sun about the earth, are not of uniform …3…. To make our solar days of uniform length, astronomers have invented the mean sun, a fictitious body imagined to move at uniform rate along the …4… equator, making a complete circuit from west to east in one year. The time interval as measured by one daily revolution of the mean sun is called a mean solar day, which is the same as the …5… day. The mean solar day begins at midnight, as does the civil day, and the mean solar time at any place is given by the hour angle of the mean sun plus 12^h. Thus, if the hour angle of the mean sun is $-1^h = 15^\circ$, the mean solar time is $-1^h + 12^h = 11^h$.

With regard to time, the terms mean and civil are interchangeable.

Civil time, has the same meaning as mean solar time or mean time or universal time and, in the form of standard time, is the time in general use by the public. Local civil time is that for the meridian of the observer. Civil time for any other meridian is designated by name; for example, Greenwich civil time. Civil time for any meridian can be converted into terms of civil time for any other meridian by computations involving the longitude of the two meridians, 1h civil time corresponds to 1^h or $15°$ of longitude.

1.	a. constant	b. varying	c. figurative	d. steady
2.	a. continual	b. intervening	c. separate	d. successive
3.	a. height	b. width	c. length	d. time
4.	a. celestial	b. interval	c. velocity	d. circuit
5.	a. normal	b. uniform	c. civil	d. solar

E. Read the passage and answer the questions.

DETERMINATION OF AZIMUTH BY OBSERVATION ON OTHER STARS

To determine azimuth by observation on any star other than a circumpolar star, one should determine when the star will be above the horizon and then learn to identify the star in the star field. Star charts and diagrams, which can be found in the Sokkia ephemeris and the Nautical Almanac, help in this procedure. Once a star and an observational time have been chosen, the approximate position of the star at a specified time is determined.

The observational procedure is essentially the same as that followed for solar observation by the hour-angle method. The same rules for sighting the star apply as for Polaris, except that other stars, which are at lower declinations than Polaris, move in a manner similar to the sun. Therefore, the rules for night operations apply but the time must be recorded with a higher degree of precision than for Polaris observations. The time module or stopwatch must be set to WWW and DUT correction should be noted and applied to yield UT1 time. When the star is brought within the field of view, the vertical cross hair sighted on the star, the time is registered, and the horizontal angle from a backsight to a terrestrial point to the star is read and recorded. Where a high degree of precision is required, several repetitions of the horizontal angle with the telescope in direct and reversed positions should be observed, recording a time with each measurement to the star. The procedure for reducing the data and calculating the azimuth is similar to that outlined for solar observations and for observation of Polaris by the hour-angle method.

Most of the stars recommended for azimuth determination have declinations about the same as the sun. Consequently, azimuths calculated from observations on these stars have accuracies comparable to the accuracies for solar azimuth by the hour-angle method. In general, the accuracy of azimuths by star shots should be somewhat higher than for solar shots, because stars offer an excellent target on which to center and the atmosphere through which the sight is taken is much less turbulent than for sights on the sun.

1. A star and its observational time are listed in ….

    a. circumpolar stars
    b. star charts and diagrams
    c. almanac
    d. ephemeris

2. Observational procedure is by ….

    a. solar observation
    b. approximate position
    c. rules for sighting
    d. hour-angle method

3. Stars which are … than Polaris don’t move in amanner similar to the sun

a. lower b. higher c. the same d. slower

4. When the star is visible, … is sighted on the star.

a. terrestrial point b. horizontal angle
c. reversed position d. vertical cross hair

5. For high precision, several repetitions of … with telescope should be observed.

a. terrestrial point b. horizontal angle
c. reversed position d. vertical cross hair

6. Most stars for azimuth determination have declinations … the sun.

a. lower than b. higher than
c. the same as d. slower than

7. Star shots accuracy of azimuths should be … than for solar shots.

a. lower b. higher c. the same d. slower

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Celestial equator	b. East and west points
c. Hour angle (HA)	d. Obliquity
e. Prime vertical	f. Right ascension
g. Sensible horizon	h. Solstices
i. Terrestrial poles	j. Zenith and nadir

1. The points of intersections of prime vertical with the horizon. These points may obtained by intersections of the equator and horizon.

2. The angle between the planes of the ecliptic and equator.

3. The vertical circle whose plane is perpendicular to the plan of the observer's meridian and which contains east and west points of the horizon.

4. The equatorial angular distance measured eastward from the declination circle of the first point of Aries to the declination circle of celestial body.

5. The points on the ecliptic at which the north or south declination is maximum.

6. The angular distance along the arc of the horizon measured from the observer's meridian westward to declination circle of body.

7. The points on the surface of the earth where the earth's axis of rotation when produced intersects the surface of the earth.

8. the small circle obtained by passing a plan through the observer's station tangential to the earth's surface and perpendicular to the zenith-nadir line at the point of observation.

9. The great circle of the celestial sphere, formed by the intersection of a plan perpendicular to the axis of rotation of the earth with the celestial sphere.

10. The point on the celestial sphere vertically above the observer's station and the point vertically below.

Chapter 3: *Cadastre*

CITY SURVEYING

The term city survey refers to an extensive coordinated survey of the area in and near a city to fix reference monuments[1], locate property lines and improvements, and determine the configuration and physical features of the land for a city lot. Such a survey is of value for a wide variety of purposes, particularly for planning city improvements. Briefly, the work consists of the following:

1. Selecting an appropriate geographic or land information system (GIS or LIS) so that all subsequent field and office work can be organized in a manner compatible[2] with the selected information system. If the city already has a GIS or LIS in place, every effort must be made to design the data acquisition and processing methods to accommodate this system.
2. Establishing horizontal and vertical control, as described for topographic surveying. The primary horizontal control is usually by static GPS survey, supplemented[3] as desired by precise total station traversing. Secondary horizontal control is established by total station traversing of appropriate precision. Photogrammetric methods for establishing horizontal control are feasible for setting control points in the secondary network. All horizontal control should be tied to the state plane coordinate system. Primary vertical control is by precise leveling and should be referred to the North American vertical datum 1988.

3. Making a topographic survey and a topographic map. Usually, the scale of the map may range from (1:100 to 1:2500 in the metric system) with contour intervals from 0.5 m to 2 m (1 ft to 5 ft). Photogrammetric methods for map compilation[4] should be utilized.
4. Monumenting a system of selected points at suitable locations such as street corners, for reference in subsequent[5] surveys. These monuments are referred to the state plane coordinate system and the national datum.
5. Making a property map. The survey for the map consists of collecting recorded information regarding property[6], determining the location on the ground of street intersections, angle points, and curve points; monumenting the points so located; determining the coordinates of the monuments. Usually, the scale of the property map is 1:500 in metric units (1:600 or 50 ft/in.) The property map shows the length and bearing of all street lines and boundaries of public property, coordinates of governing[7] points, control, monuments, important structures, natural features of the terrain, and so forth, all with appropriate legends and notes.
6. Making a small-scale map, which shows essentially[8] the same information as the topographic map but drawn to a smaller scale; the scale should be no less than 1:25,000 (2000 ft per in. or 1:24,000).
7. Making a map of underground utilities[9]. Usually, the scale and the size of the map sheets are the same as those for the property map. The underground map shows street and easement lines, monuments, surface structures and natural features affecting underground construction, and underground structures and utilities (with dimensions), all with appropriate legends and notes.

All map data should stored in the GIS or LIS in digital format so that a given section or sections of the city with the desired attributes[10] (topography, property lines, underground utilities, and so on) can be retrieved and either displayed on a video screen (individually or as overlays) or automatically plotted as a hard-copy line map.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. added	b. agree
c. basically	d. building or land
e. making from different parts	f. memorial
g. next	h. quality
i. ruling	j. services

B. Read the passage and answer the questions.

1. In city surveying we should select ….

a. GIS b. LIS
c. both a and b d. either a or b

2. Primary horizontal control is by ….

a. total station b. static GPS
c. photogrammetry d. traversing

3. All are included in establishing horizontal and vertical control except ….

a. GIS b. GPS
c. precise leveling d. photogrammetry

4. In making topographic maps … are utilized.

   a. national datum
   b. photogrammetric methods

c. vertical datum
d. contour

5. Topographic maps are … than small-scale maps.

a. smaller	b. bigger
c. more accurate	d. less accurate

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Cadastral Surveying

Cadastral surveying is a general term referring to extensive surveys relating to land boundaries and subdivisions made to create units suitable for transfer or to define limitations of title. The expression is derived from the word cadastre, meaning …1… of the real property of a political subdivision with details of area, …2… and value. The term is applied to the U.S. public-land surveys by the U.S. Bureau of Land Management and also may be used to describe …3… surveys outside the public lands. However, the term property, land, or boundary surveys usually is used by preference.

A cadastral map shows individual tracts of land with the corners, …4… and azimuth or bearing of boundaries, acreage, ownership, and sometimes the cultural and drainage features. The surveying methods are the …5… as those described for topographic surveying for maps of intermediate and large scale.

1.	a. record	b. register	c. trade	d. regard
2.	a. belong	b. ownership	c. buy	d. possess
3.	a. corresponding	b. correspond	c. corresponded	d. to correspond
4.	a. longitude	b. long	c. longer	d. length
5.	a. like	b. opposite	c. different	d. same

D. Read the passage and answer the questions.

Descriptions for Condominiums

In general, the term condominium refers to a method of ownership. This term may be applied to a multiunit building or to a unit or units within the building. Therefore, the owner of an individual unit or of several units within a multiunit building is called a condominium owner. The limits of ownership of a condominium owner are the top surface of the floor, the surfaces of the walls, and the bottom surface of the ceilings of the specified unit. Condominium ownership also includes a fractional interest in the common elements associated with each unit such as swimming pools, tennis courts, and other common areas in the building. A grant of interest also may be made for items such as garage, patio, and storage space.

Because the potential condominium owner is buying a volume of space as just defined, it is necessary to provide a description of the unit in three dimensions. To describe each condominium unit in three dimensions by a metes and bounds description would be a challenging task, to say the least. A simpler approach is to prepare a map of the land on which the building is located and a set of plans of the building referenced to the map. These plans of the building show each individual unit with an identifying label. In this way, any specified unit can be described by the identifying label and a reference to the map.

The land on which the condominium building is constructed can be described by a metes and bounds description, a lot or parcel on a map already recorded, or by a new subdivision plan of one or more lots. The most convenient instrument of record is a map that shows the boundaries of the land and the position of the exterior walls of the condominium building with respect to these boundaries. The condominium property acts of some states require that this type of map be recorded to establish a condominium. Along with the map there should be a set of plans of the building. These plans show all horizontal dimensions of the interior walls and the relationships of these walls with the exterior walls of the structure. Elevations also are required for the top of floor and bottom of ceiling of each unit. These elevations can be shown on the plans, indicated on a cross section of the building, or tabulated for each unit. All elevations should be based on benchmarks referred to a specified datum.

The dimensions shown on the plan should be certified by the surveyor as conforming to the physical building. Therefore, the surveyor needs to perform an as-built survey of the structure after it is completed. If this is not possible and measurements in the field are made to the unfinished elements of the structure, the interior dimensions can be based on the architect's plans, which must be indicated on the plans. When the building is finished, the surveyor should resurvey the building, including the interior horizontal and vertical dimensions. Any differences between dimensions determined from this final as-built survey and those projected from the architect's plans should be indicated on the plans. If major differences occur, a new plan should be filed.

1. Condominium is a kind of ….

a. owing b. possession c. owl d. power

2. Any condominium should have … dimensions by a metes.

a. one b. no c. two d. three

3. To establish a condominium … should be showed.

a. interior walls b. exterior walls
c. a metes d. lot or parcel

4. Which word best describes the meaning of "elevation"?

a. length b. height c. volume d. value

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Color of title
b. Corner accessory
c. DXF
d. Fee simple
e. Local scale factor (LSF)
f. Low-water mark
g. Parol
h. Patent
i. Planimeter
j. Raster

1. An estate of inheritance

2. Data in a grid cell format of pixels

3. A term used to distinguished contracts which are made verbally.

4. Essentially, it is a part of the monument.

5. A mechanical or electronic device used to measure areas by tracing the outline of the area on the map or plan.

6. Drawing exchange format for transferring graphics data.

7. It is that part of the shore of the sea to which the waters recede when the tide is lowest, that is, the line to which the ebb tide usually recedes.

8. The mathematical factor by which any distance on the ground is multiplied to produce the projection length on the map projection.

9. The title deed by which a government, either state or federal, conveys its lands.

10. For the purposes of adverse possession under the statute of limitations, is that which has the semblance of title, legal or equitable, but which in fact is no title.

Chapter 4: Geodesy

General procedure

Geodetic methodology[1] is a set of procedures adopted for the evaluation of quantities that contribute directly or indirectly to the description[2] of the geometry of the earth and its gravity field. Every experiment or project should be designed around specifications placed on the quantities that are being investigated. The design thus comprises the determination of the kind and amount of data that need be collected, as well as their accuracies[3]. These data are then procured, screened[4], and analyzed to see whether they actually fulfil the prescribed accuracy specifications. Once scrutinized[5], these data are processed, and solutions are obtained for the quantities of insert. Finally, the results are evaluated and presented. Although the methodology used in geodesy is similar to other experimental sciences certain circumstances in geodesy place constraints[6] upon both the kind and the number of assumptions[7] that can be made and thereby dictate the specific procedures that must be adopted.

The most significant factor affecting the practice of geodesy, as with other sciences, is economics. Often, geodetic operations involve expensive instrumentation and extensive field operations that resulting large expenditures[8]. For example, the establishment of a signal geodetic network of continental extent (whether it be a gravity, horizontal, or height network) can cost tens of millions of dollars. Thus the remeasurement of networks cannot be undertaken as readily as can some laboratory experiments. Consequently[9], to maximize the return on the investment, geodetic procedure must include optimization[10] of design and planning, careful collection of data, and rigorous evaluation of the results. Another factor peculiar to geodesy is that usually more data is collected than is needed for a unique determination of the desired quantities. This is done on purpose to have a means of assessing the accuracy and reliability of the results.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. check	b. exactness
c. examine very carefully	d. improvement
e. limit	f. something that you think is true
g. spending	h. therefore
i. the set of principles	j. what something is like

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. Geodetic methodology is a set of procedures for description of the geometry and gravity.
2. The data are obtained, checked and analyzed to fulfil the prescribed accuracy specifications.
3. Certain circumstances in geodesy place limits on both the kind and the number of assumptions.
4. Geodetic operations include inexpensive instrumentation.
5. In geodesy not enough data is usually collected for a unique determination of the desired quantities.

C. Read the passage and answer the questions.

1. Quantities that are … to the description of the geometry of the earth and its gravity field.

a. directly b. indirectly
c. directly and indirectly d. directly or indirectly

2. The design includes … of data that need to be collected.

   a. the determination of the kind
   b. kind and amount
   c. accuracies
   d. the determination of the kind, amount and accuracies

3. The most significant factor affecting geodesy is ….

a. other sciences b. economics
c. geodetic operations d. field operations

4. Geodetic operations does not involve ….

   a. expensive instrumentation
   b. extensive field operations
   c. continental extent
   d. large expenditures

5. Which of the following best represents the meaning of "meticulous"?

a. exact b. very small c. not easy d. very large

6. Another factor peculiar to geodesy is that usually ...data is collected.

a. enough b. too much
c. more than needless d. too many

7. This passage is about....

a. geodetic procedures b. methodology
c. evaluation d. quantities

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Measured gravity coverage is by no means complete. There are many large regions on the continents where gravity …1… are lacking or available only in small quantities. Gravity data for ocean areas has always been …2…, however, Satellite Altimetry has overcome this deficiency. In regions where an …3… number of gravity measurements exists, some other approach must be used to obtain or predict the mean gravity anomalies for the areas.

Correlations exist between variations in the gravity anomaly field and corresponding variations in geological, …4…, and upper mantle structure, regional and local topography various other types of related geophysical data. In many areas where gravity information is sparse or missing, geological and geophysical data is available. Therefore, the various …5… methods take into account the actual geological and geophysical cause of gravity anomalies to predict the magnitude of anomalies.

1.	a. measured	b. measurements	c. measure	d. measuring
2.	a. sparse	b. abundant	c. obtained	d. special
3.	a. sufficient	b. enough	c. insufficient	d. enormous
4.	a. core	b. mantle	c. crustal	d. physical
5.	a. prediction	b. assumption	c. definition	d. description

Ellipsoids

Ellipsoids each have a name, often the name of the geodesist that originally calculated and published the figure, accompanied by the year in which it was established or revised.

For example, Alexander R. Clarke used the shape of the Earth he calculated from surveying measurements in France, England, South Africa, Peru, and Lapland, including Friedrich Georg Wilhelm Struve's work in Russia Colonel Sir George Everest's in India, to establish his Clarke 1866 ellipsoid. Even though Clarke never actually visited the U.S., that ellipsoid became the standard reference model for North American Datum 1927 (NAD27) during most of the 20th century. Despite the familiarity of Clarke's 1866 ellipsoid, it is important to specify the year when discussing it. The same British geodesist is also known for his ellipsoids of 1858 and 1880. There are just a few of the reference ellipsoids out there.

Supplementing this variety of regional reference ellipsoids are the new ellipsoids with wider scope, such as the Geodetic Reference system 1980 (GRS80). It was adopted by the International Association of Geodesy (IAG) during the General Assembly 1979 as a reference ellipsoid appropriate for worldwide coverage. However, as a practical matter such steps do not render regional ellipsoids irrelevant any more than GPS measurements make it possible to ignore the coordinates derived from classical triangulation surveys. Any successful GIS require a merging of old or new data, and an understanding of legacy coordinate system is, therefore, essential.

It is also important to remember that while ellipsoidal models provide the reference for geodetic datums, they are not the datums themselves. They contribute to the datum's definition. For example, the figure for the OSGB36 datum in Great Britain is the Airy 1830 ellipsoid just as the figure for the NAD83 datum in the U.S. is the GRS80 ellipsoid. The reference ellipsoid for the European Datum 1950 is International 1924. The reference ellipsoid for the German DHDN datum is Bessel 1841. Just to make it more interesting, there are several cases where an ellipsoid was used for more than one regional datum; for example, the GRS67 ellipsoid was foundation for both the Australian Geodetic Datum 1966 (now superseded by GDA94), and the south American Datum 1969.

E. Read the passage and answer the questions.

1. The name of an ellipsoid contains ….

   a. The name of the geodesist
   b. Year of establishment
   c. Year of revision
   d. a , b , c

2. Alexander R. Clark had visited ….

a. Russia b. India c. The U.S. d. France

3. Clark’s first ellipsoid was in ….

a. 1927 b. 1866 c. 1858 d. 1880

4. Clark’s is from ….

a. Lapland b. India c. England d. France

5. … is appropriate for worldwide coverage.

a. NAD27 b. GRS80 c. GRS67 d. OSGB36

6. The reference ellipsoids are used for … regional datum.

a. one b. two
c. more than one d. worldwide

7. Supersede means:

a. replace b. complete c. use d. improve

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Departure	b. Ecliptic
c. Equinoxes	d. ETRS
e. Geoid undulation	f. International Terrestrial Reference System (ITRS)
g. MSL	h. Geoid
i. Position	j. WGS84

1. The mathematical correction applied to any distance on the ground to produce the equivalent sea level value.

2. The 3-D coordinates of a point, usually given in the form of Latitude, Longitude, and Altitude, though it may be provided in the 3-D Cartesian form, or any other transformed map or geodetic reference system.

3. European terrestrial reference system. Coordinate system based on ETRF.

4. The most precise, geocentric, globally-defined coordinate system or datum on the earth's surface. It is a more accurate and more convenient a Satellite-Based Datum than the WGS84 Datum.

5. The first point of Aries and the first point of Libra which are six months apart in time.

6. The change in easterly displacement (ΔE) of a line.

7. The fundamental surface in Geodesy. It is defined as the equipotential surface of the gravity field that most closely approximates the Mean Sea Level.

8. The difference between the geoid surface and the ellipsoid surface.

9. The great circle of the celestial sphere which sun appears to describe with earth as centre in the course of one year.

10. Global coordinate system for GPS.

Chapter 5: *Map Projections*

Mercator projections

The Mercator projection is a projection on a cylinder tangent[1] to the earth at the equator. It is a *mathematical* projection, however, and not geometric in order to enforce[2] the conformality conditions. The projection was created by Mercator in 1569 as a result of his efforts to have the *rhumb* line, or *loxodrome*, or the line of constant bearing on the globe, appear as a straight line on the map. With true scale at the equator and taking the equator as the zero Y value in the map, the mapping equations are

$$X = a\lambda$$

$$Y = aq$$

where λ is the longitude and q the isometric latitude given by Equation. With these, the conformality conditions are satisfied, the meridians[3] are equally spaced vertical straight lines, and parallels are unequally spaced horizontal lines. The parallel spacing increases toward the poles, which in this projection are at infinity on the map. Therefore, although the scale at any one point of intersection[4] of a meridian and a parallel is *equal in all directions around the intersection* (which is the basis of conformality), the scale expands rapidly at high latitude. If s is the scale number at the equator and s_ϕ is the scale number at any latitude ϕ, then

$$s_\phi = s \cos \phi$$

As an example, if the scale at the equator is 1:20,000, it would be 1:10,000 at a latitude $\phi = 60^\circ$ because

$$s_{\phi} = s \cos 60^{\circ} = (20{,}000)(0.5) = 10{,}000.$$

Aside from conformality, the particular feature of the Mercator projection is that the rhumb line on the earth is plotted as a straight line on the map, a property that renders[5] it invaluable[6] for navigation. The shortest course between two points is determined by drawing on a gnomonic chart a great circle, which appears there as a straight line. Selected points, at convenient distances apart, of this great circle then are plotted on the Mercator chart, after making any necessary corrections on account of shoals, wind, currents, and the like. The rhumb line connecting any two adjacent[7] points indicates the true bearing of the course, which is read by means of a protractor. This true bearing, corrected for magnetic declination, gives the compass bearing to be used in steering.

Owing to[8] the rapid variation of scale, maps constructed on the Mercator projection give very inaccurate information as to relative sizes of areas in widely different latitudes. For example, on the map Greenland appears larger than South America, whereas in fact South America is nine times as large as Greenland. Consequently[9], such a map is not suited[10] to general use, although because of its many other advantages it is widely published.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. acceptable	b. because of
c. express	d. extremely useful
e. imaginary line	e. junction
g. make	g. next to
i. therefore	j. touching

B. Read the passage and answer the questions.

1. The Mercator projection is a ….

a. on a cylinder b. equator
c. mathematical projection d. geometric

2. Meridians are … spaced … lines.

a. unequally - vertical b. equally - horizontal
c. unequally - horizontal d. equally - vertical

3. Parallels are … spaced … lines.

a. unequally - vertical b. equally - horizontal
c. unequally - horizontal d. equally - vertical

4. "Latitude" means ….

   a. the distance north of the equator
   b. the distance south of the equator
   c. a and b
   d. a or b

5. Which <u>is not</u> a feature of rhumb line?

   a. plotted as a straight line on the map
   b. expands rapidly at high latitude
   c. the shortest course between two points
   d. connects any two adjacent points

6. Maps on Mercator projection are very inaccurate because of ….

a. relative sizes of areas b. widely different latitudes
c. rapid variation of scale d. many other advantages

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

General

A map projection is a means of …1… the lines of latitude and longitude of the globe on a flat sheet of paper. Any such representation is a projection. In plotting a map of a small and limited area, the curvature of the earth need not be considered. Large scale maps of such areas, are generally plotted by means of a system of rectangular coordinates, considering the level surface of the earth to be a plane.

For maps of larger area, usually on smaller scales, the above simple system of rectangular coordinates, is not satisfactory because the curvature of the earth can no longer be ignored. The geometric shape of the earth is a spheroid with a polar diameter about one-third of 1 per cent shorter than the equatorial dimensions, the ellipse is very nearby a circle. Consequently the earth is assumed to be a sphere to make easier to visualize the map projections discussed here.

Regardless of whether the earth is considered to be a sphere or spheroid, it is not possible to develop its surface exactly on to a plane. Whatever procedure is used to represent a large area on a map, there will always be some distortion. To minimize the distortion as well as to develop several possibilities, points on the map are represented in terms of parallels of latitude and meridians of longitude. Position on the earth in terms of latitude and longitude, is transformed into scaled linear dimensions on the map. This is accomplished by using the dimensions of the earth and a selected set of criteria for representing the curved earth on the flat map. Such a transformation from latitude and longitude to a map's coordinates, is the function of map projections.

Although, it is impossible to make a correct map of any part of the earth, it is by no means difficult to maintain certain define qualities in a projection. These qualities are as follows:

1. Preservation of area
2. Preservation of shape (orthomorphism)
3. Preservation of scale
4. Preservation of bearing
5. Ease of drawing

On an ideal map without distortion, the following conditions must be satisfied:

1. All distances and areas on the map would have correct relative magnitude.
2. All azimuths and angles would be correctly shown.
3. All great circles on the earth would appear as straight lines.
4. Geodetic latitudes and longitudes of all points would be correctly shown.

It is impossible to satisfy all of these conditions because of the shape of the earth, in the same map. It is possible, however, as stated above, to satisfy one or more of four conditions.

Different projection systems satisfy different conditions as bellow:

1. …2… projection results in a map showing the correct angle between any pair of short intersecting lines, thus making small areas appear in correct shape. As the scale varies from point to point, the shapes of larger areas are correct.
2. …3… projection results in a map showing all areas in proper relative size although these areas may be much out of shape and the map may have other defects.
3. …4… projection represents distances correctly, from one central point to other points on the maps.
4. …5… projection shows the correct direction or azimuth of any point relative to one central point.

1.	a. representing	b. represent	c. represente	d. represents
2.	a. conformal	b. equal-area	c. azimuthal	d. equidistant
3.	a. conformal	b. equal-area	c. azimuthal	d. equidistant
4.	a. conformal	b. equal-area	c. azimuthal	d. equidistant
5.	a. conformal	b. equal-area	c. azimuthal	d. equidistant

D. Read the passage and answer the questions.

Conversion of SPCS 27 coordinates to SPCS 83 coordinates

When coordinates computed and adjusted on the 1927 datum are to be converted to the 1983 datum, two major methods are appropriate. In the first method, the surveyor should select the local network of control points on the SPCS 27 that provides the strongest control survey around the under consideration. It is very important that the most reliable points be chosen and that control points previously adjusted in the National Geodetic Survey network of control on the 1927 datum be included. Then the original measurements (angles, directions, distances, etc.) should be submitted to the NGS in the Bluebook format as specified in FGCS (1994). The measurements should satisfy first-order horizontal accuracy standards and second-order, Class II vertical accuracy standards. With these data, the NGS will adjust the control points on the 1983 datum and return to the user, adjusted SPCS 83 coordinates that are consistent with the national network. The surveyor then can use these basic control points to adjust the entire local network by the method of least squares. Another option in this procedure is to include points in the network that have coordinates in a high-accuracy reference network (HARN). A HARN consists of control points in the national network in a given state where state agencies and private surveyors have densified the network under the direction of the NGS, which then performs the final adjustment to produce coordinates in this high-precision horizontal control network. The surveyor uses these HARN points as control points to adjust the local network. The resulting adjusted coordinates, in the SPCS 83 system, then are submitted by the surveyor to the NGS. When the surveys performed for this task satisfy horizontal and vertical accuracy standards, as just outlined, the NGS will accept the points and include them in the database for the national network.

The second method consists of using the North American datum conversion (NADCON) program that was developed and is distributed by the NGS. NADCON employs a model of shift values in latitude and longitude for a large area, such as the conterminous United States. These values are used to get estimates for a local model. Local modeling then is performed to determine shift corrections to NAD 27 coordinates. Minimization of curvature (Dewhurst, 1990) is used to calculate the actual shifts. Input to and output from the program are in latitude and longitude and conversion is possible from NAD 27 to NAD 83 or from NAD 83 to NAD 27. For certain specified states, NADCON can convert coordinates to the high-accuracy reference network.

1. This passage is about ….

   a. conversion of 1927 to 1983
   b. conversion of coordinates
   c. conversion of coordinates of 1927 to 1983
   d. conversion of coordinates of 1983 to 1927

2. In the first method, it is very important to ….

   a. submit to the NGS in the Bluebook format
   b. choose the most reliable points
   c. to satisfy first order horizontal accuracy standards
   d. adjust SPCS 83 coordinates

3. SPCS 83 coordinates are … with the national network.

a. equal b. parallel c. consistent d. submitted

4. The second method <u>does not</u> include ….

   a. high-accuracy reference network
   b. national geodetic survey network
   c. horizontal control network
   d. vertical control network

5. NADCON uses … in latitude and longitude for a large area.

a. shift values b. a model of shift values
c. datum conversion d. NGS program ages

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Datum	b. Geographic meridian
c. *Grid*	d. Latitude
e. Line and grade	f. Map projection
g. OS	h. TRF
i. Scale factor	j. Universal Transverse Mercator (UTM)

1. Horizontal and vertical position.

2. The change in northerly displacement (ΔN) of a line.

3. Ordnance Survey, the British national mapping organization.

4. The factor used to convert sea-level distances to plan-grid distances.

5. A line on the surface of the earth joining the poles, i.e., a line of longitude.

6. Terrestrial reference frame. The basis of a coordinate system

7. A grid coordinate system that projects global sections onto a flat surface to measure position in specific zones. These zones are 6° wide and are stepped along the equator such that each zone corresponds to a north-south strip of the earth.

8. A map coordinate system that projects the surface of the earth onto a flat surface such as a "map", using square zones for position measurements.

9. System of converting positions on the globe to the flat paper map.

10. This is a means by which coordinates determined by any means may be related to a well-defined Reference Frame. The Reference Frame may be visualized as a 3-D Cartesian coordinate system consisting, as a minimum, of information concerning the origin of the axes, and the directions of two principal axes fixed to the earth.

Chapter 6: *Photogrammetry*

Finding Co-ordinates of the Perspective Centre for Independent Model Aerial Triangulation

By the technique of independent model aerial triangulation we want to do a similarity[1] transform on each model in order to have them all in the co-ordinate system of projection[2] centre S1. In order to do the similarity transform we use tie-points in the model and the co-ordinates of the projection centers.

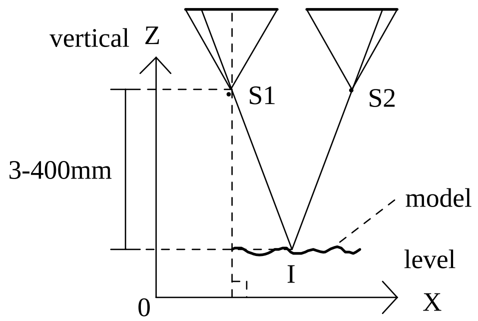

Figure 1: system of projection in plotters photogrammetry

When a plotting instrument is set up[3] or calibrated[4] it is leveled horizontally; If the left hand space rod[5] is set vertical then the X,Y co-ordinates of I will be equal to the X,Y co-ordinates of S1. The same goes for the right hand projector. The space rods can be set vertically using a bubble and verticality may be checked by winding[6] the floating mark up and down in Z. If the rod is truly vertical there will be no movement of the mark relative to the principle point marked on the stage plate.

The Z co-ordinates of the projection centers are found during instrument calibration; The (x,y,z) model co-ordinates of two points on a grid plate are measured at the upper and lower range of Z in the instrument. The Z co-ordinate of S1 is then found by computing the vectors[7] $\vec{AS}1$ and $\vec{BS}1$ and solving them to find the intersection S1.

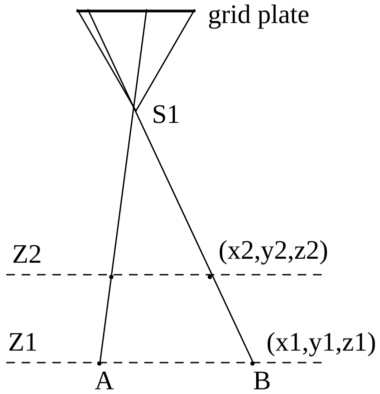

Figure 2: finding coordinates of projection centre

In practice it is best to use more than two points and then apply a least squares solution. In some plotters the co-ordinates of S1 and S2 change when an absolute orientation[8] is carried out (using Bx, By, Bz, or common ϕ). Provided[9] only ϕ1,κ1,ω2,ϕ2,κ 2 are used then they remain unchanged. It may therefore be necessary to re-calculate the co-ordinates of S1 and S2 every time an aerial triangulation[10] is carried out.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. a long thin bar	b. calculation
c. establish	d. likeness
e. marked	f. matrix
g. measuring the lines and angles of a triangle	h. the angle or position
i. turn	j. will be possible if

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. To do the similarity transform, we only use tie-points in the model.
2. A plotting instrument is leveled vertically.
3. The right hand projector is similar to the left hand projector.
4. In practice it is best to use two points and then apply a least squares solution.
5. If an absolute orientation is carried out, the co-ordinates of S1 and S2 remain unchanged.

C. Read the passage and answer the questions.

1. …. are used in similarity transform.

    a. coordinates of the projection centers.
    b. tie points in the model
    c. both a and b
    d. either a or b

2. Verticality can be checked by….

    a. winding the floating mark up and down in Z
    b. winding the floating mark up and down in X
    c. winding the floating mark up and down in Y
    d. winding the floating mark up and down in S1

3. There will be no movement of the mark if ….

    a. the mark relative to the principle point
    b. the principle point marked on the stage plate
    c. the rod is truly vertical
    d. the Z coordinates of the projection centers are found

4. The upper and lower ranges of Z are for measuring….

   a. coordinates of two points
   b. points on a grid plate
   c. model coordinates
   d. x,y,z model coordinate of two points on a grid plate

5. The vectors $\overrightarrow{AS1}$ and $\overrightarrow{BS1}$ are for finding ….

a. Z coordinates of S1 b. lower range of Z
c. upper range of Z d. instrument calibration

6. In plotters the coordinates of S1 and S2 are recalculated in ….

a. absolute orientation b. aerial triangulation
c. intersection S1 d. similarity transform

7. In plotters the coordinates of S1 and S2 … change.

a. never b. often c. sometimes d. always

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

The Project Manager shall consult with Surveys and the DPC on the need for photogrammetry products and services as the work plan is being developed. To make this …1…, the Project Manager shall meet with all the functional units that will be …2… in the project to gather the information necessary to determine if photogrammetric mapping will be required and to accurately define the scope of that …3…. The Project Manager shall provide complete project information such as scope, products, the use of the products, and schedule to the DPC so that existing …4… data can be researched and utilized, and/or a Photogrammetric Service Request can be prepared and …5… to OoP.

1.	a. determine	b. determined	c. determination	d. determining
2.	a. participate	b. participated	c. participation	d. participating
3.	a. map	b. mapped	c. mapping	d. mappation
4.	a. terrain	b. naval	c. aerial	d. space
5.	a. received	b. forwarded	c. transformed	d. gathered

Airborne GPS photogrammetry Surveys

An airborne GPS photogrammetry survey (ABGPS) utilizes Global Positioning System (GPS) technology to determine the three dimensional position of the camera at the instant of each photographic exposure. This results in an 80% reduction in the number of photo control and a corresponding increase in safety for the field surveyors. The safety improvement is created by the almost complete elimination of photo control within the right-of-way. The reduction in the photo control also provides economic and project timeline benefits by decreasing the scope and duration of the work required by Surveys.

The researchers, in part, conclude and recommend that ABGPS projects reduce the base station and airplane GPS data with postprocessed kinematic GPS methods. This process establishes 3D values at the photo center of the photographs, which will then be used in the Aero triangulation (AT) process. The researchers also recommend that the final AT values be moved to the project vertical datum by imposing a project created geoid separation. The project geoid separation is created from 4 (or more) photo targets that have differentially leveled orthometric heights. Specifications will be revised as more

ABGPS projects are performed and evaluated and/or the creation of new ABG

E. Read the passage and answer the questions.

1. This passage mainly discusses about ….

a. reduction of the camera b. increase in the safety
c. ABGPS photogrammetry d. photogrammetry survey

2. The tree dimensional position of camera is determined by ….

    a. each photographic exposure
    b. global positioning system
    c. airborne GPS photogrammetry survey
    d. GPS technology

3. Elimination of photo control results in ….

    a. the right-of-way
    b. safety improvement
    c. 80% reduction
    d. increase in field surveyors

4. Economic and project time line benefits can be obtained by ….

    a. production in photo control
    b. increasing duration of the work
    c. surveys
    d. decreasing the scope and duration of the work

5. The project geoid separation moves … to the project vertical datum.

a. GPS data b. At values c. 3D values d. photo targets

6. "Specifications" refers to….

a. details b. photos c. heights d. projects

7. The project geoid separation is created from … photo targets.

a. 4 b. 4 or 5 c. 4 or less d. 4 or more

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Block	b. Bridging
c. Control Layout	d. Digital Terrain Model (DTM) Limits
e. Drift	f. End lap
g. Fiducial Marks	h. Grain
i. Neat Model	j. Wing Point

1. A type of control scheme employed in the production of photogrammetric products. There are a variety of control schemes used by OoP for the production of various photogrammetric products. The appropriate control scheme, or combination of control schemes, is determined by what photogrammetric products will be produced and the required accuracy of those products.

2. Index marks rigidly connected with the camera lens through the camera body and forming images on the negative which generally define the principle point of the photograph. If these fiducial marks are not present, photogrammetric measurements cannot be made.

3. Triangulation for the extension of horizontal and/or vertical control accomplished by means of aerial photographs, including such procedures as stereotriangulation, radial triangulation, stereotemplets, and analytic triangulation.

4. The extent of requested project's three dimensional digital surface. These limits may vary from mapping limits.

5. The lateral shift or displacement of an aircraft from its course, due to the action of wind or other causes.

6. The amount by which one photograph includes the same area as covered by another photograph along a single flight line, customarily expressed as a percentage.

7. A photo control point located at each of the four corners of the model.

8. The area common to two photographs lying between the principal points of each photograph.

9. One of the discrete silver particles resulting from the development of an exposed light sensitive material.

10. A set of flight lines processed simultaneously to cover an area not possible with one flight line.

Chapter 7: SURVEYING

DEFINITION

Surveying may be defined as the science of determining[1] the position, in three dimensions, of natural and man-made features on or beneath the surface of the Earth. These features may then be represented in analog form as a contoured[2] map, plan or chart, or in digital form as a three-dimensional mathematical model stored in the computer. This latter format is referred to as a digital ground model (DGM).

In engineering surveying, either or both of the above formats may be utilized in the planning, design and construction of works, both on the surface and underground. At a later stage, surveying techniques are used in the dimensional control or setting out[3] of the designed constructional elements and also in the monitoring of deformation[4] movements.

In the first instance[5], surveying requires management and decision making in deciding the appropriate[6] methods and instrumentation required to satisfactorily complete the task to the specified accuracy and within the time limits available. This initial[7] process can only be properly executed after very careful and detailed[8] reconnaissance of the area to be surveyed.

When the above logistics are complete, the field work – involving the capture and storage of field data – is carried out using instruments and techniques appropriate to the task in hand.

The next step in the operation is that of data processing. The majority, if not all, of computation will be carried out by computer, ranging in size from pocket calculator to mainframe. The methods adopted will depend upon the size and precision of the survey and the manner of its recording; whether in a field book or a data logger. Data representation in analog or digital form may now be carried out by conventional cartographic plotting or through a totally automated system using a computer-driven flat-bed plotter. In engineering, the plan or DGM is used for the planning and design of a construction project. This project may comprise a railroad, highway, dam, bridge, or even a new town complex. No matter what the work is, or how complicated, it must be set out on the ground in its correct place and to its correct dimensions, within the tolerances specified. To this end, surveying procedures and instrumentation are used, of varying[9] precision and complexity, depending on the project in hand.

Surveying is indispensable to the engineer in the planning, design and construction of a project, so all engineers should have a thorough[10] understanding of the limits of accuracy possible in the construction and manufacturing processes. This knowledge, combined with an equal understanding of the limits and capabilities of surveying instrumentation and techniques, will enable the engineer to successfully complete his project in the most economical manner and shortest time possible.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. change in shape	b. complete
c. different	d. establish
e. example	f. find out
g. first	h. suitable
i. with curves	j. very exact

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. Surveying is establishing the position of natural or man-made parts on or beneath the surface of the Earth.
2. In engineering surveying only digital format may be used.
3. Field work involves the capture and storage of field data.
4. In engineering, the plan or digital ground model is used for the planning and design of a construction project.
5. Surveying isn’t essential to the engineer in the planning, design of a project.

C. Read the passage and answer the questions.

1. Surveying determines the position of features ….

   a. only on the surface
   b. only beneath the surface
   c. either on or beneath the surface
   d. on or beneath the surface

2. DGM is a ….

   a. digital form
   b. digital 3 dimensional model
   c. digital 3 dimensional mathematical model
   d. digital mathematical model

3. In engineering surveying … may be utilized in planning.

   a. only analog form
   b. only digital form
   c. either analog or digital form
   d. either or both of analog & digital forms

4. The field work is carried out ….

   a. capture and storage
   b. field data
   c. using suitable instruments and techniques
   d. the task in hand

5. Data representation is carried out by ….

a. cartographic plotting b. flat – bed plotter
c. a or b d. none of them

6. The term “tolerances” refers to ….

a. degrees b. plans c. work d. formats

D. Close:

Control Survey

A control survey provides a framework of survey points, whose relative position, in two or three …1…, are known to prescribe degrees of accuracy. The areas covered by these points may …2… over a whole country and from the basis for the national maps of that country. Alternatively, the area may be relatively small, …3... a construction site for which a large-scale plan is required. Although the areas covered in construction are usually quite small, the …4… may be required to a very high order. The types of engineering project …5… are the construction of long tunnels and/or bridges, deformation surveys for dams and reservoirs, three-dimensional tectonic ground movement for landslide prediction, to name just a few.

1.	a. degrees	b. dimensions	c. maps	d. plans
2.	a. extend	b. progress	c. lie	d. cover
3.	a. encompass	b. encompassed	c. encompassing	d. to encompassing
4.	a. accuracy	b. details	c. project	d. accurate
5.	a. envisage	b. envisaging	c. to envisage	d. envisaged

Earthworks

Estimation of areas and volumes is basic to most engineering schemes such as route alignment, reservoirs, tunnels, etc. The excavation and hauling of material on such schemes is the most significant and costly aspect of the work, on which profit or loss may depend. Areas may be required in connection with the purchase or sale of land, with the subdivision of land or with the grading of land.

Earthwork volumes must be estimated to enable route alignment to be located at such lines and levels that cut and fill are balanced as far as practicable; and to enable contract estimates of time and cost to be made for proposed work; and to form the basis of payment for work carried out.

The tedium of earthwork computation has now been removed by the use micro-and mainframe computers. Digital ground models (DGM), in which the ground surface is defined mathematically in terms of x, y and z coordinates, are now stored in the computer memory. This data bank may now be used with several alternative design schemes to produce the optimum route in both the horizontal and vertical planes. In addition to all the setting-out data, cross-sections are produced, earthwork volumes supplied and mass-haul diagrams drawn. Quantities may be readily produced for tender calculations and project planning. The data banks may be updated with new survey information at any time and further facilitate the planning and management not only of the existing project but of future ones.

However, before the impact of modern computer technology can be realized, one requires knowledge of the fundamentals of areas and volumes, not only to produce the software necessary, but to understand the input data required and to be able to interpret and utilize the resultant output properly.

E. Read the passage and answer the questions.

1. ... is essential to most engineering schemes.

   a. estimation
   b. areas and volumes
   c. estimation of areas
   d. estimation of areas and volumes

2. On … profit or loss may depend.

   a. costly aspect of the work
   b. the excavation and hauling
   c. materials
   d. schemes

3. Areas may not be required in connection with ….

   a. subdivision of land b. grading of land
   c. purchase of lan d. route alignment of land

4. Digital ground models (DGM) is defined ….

   a. mathematically
   b. in terms of x and y coordinates
   c. in terms of coordinates
   d. mathematically in terms of x , y and z coordinates

5. The word “further” refers to ….

   a. next b. moreover c. but d. other

6. One requires the knowledge of … of areas and volumes.

    a. estimation of areas and volumes isn’t important
    b. data bank may be updated
    c. earthwork computation has now been removed
    d. DGM is about computer memory

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Bearing	b. Face left
c. Flying leveling	d. Manhole
e. Optical plummet	f. Orientation of surveys
g. Planimeter	h. TIN
i. Travers	j. Tribrach

1. A mechanical or electronic device used to measure areas by tracing the outline of the area on the map or plan.

2. Base of surveying instrument.

3. A procedure in leveling whereby the unknown elevation of a remote point is computed from the elevation of a known point through a series of back sights and foresights only.

4. Direction of a line given by the acute angle from a meridian and accompanied by a cardinal compass direction.

5. A structure which provides access to underground service.

6. A continuous series of measured (angle and distances) lines.

7. Observing position of the theodolite with the vertical circle on the left of the telescope.

8. The procedure used to relate a survey to a known direction (some form of north).

9. Method of defining a terrain model for contouring

10. Device for centering a theodolite over a survey mark.

Chapter 8: GPS

TECHNIQUES USED IN EXTRATERRESTRIAL POSITIONING

An extraterrestrial[1] positioning system is a system for establishing position of points on or near the surface of the earth witch utilizes[2] electromagnetic radiation either emitted[3] or reflected from an object in orbit about the earth or at some greater distance. Included under this definition is traditional positional astronomy[4] used for both geodetic and navigational purposes. All other extraterrestrial techniques rely on space technology and have been developed since 1957. Currently used space techniques include the Transit[5], Argos, and GPS radio positioning systems, satellite and lunar[6] laser ranging, and very long baseline interferometry. In addition to providing positional information, these techniques contribute a variety of useful geodetic and geophysical information, including the coefficients[7] describing the earth's gravity field and the orientation of the earth's crust with respect to its rotation[8] axis.

Other space techniques have been used in the past to obtain useful positions. These techniques include satellite photography, C- and S-band radar systems, and the GRARR (Goddard Range and Range Rate), SECOR (Sequential collation[9] of Range), and Minitrack systems. Some of these latter techniques, although not presently achieving useful terrestrial positions, are still utilized for spacecraft tracking and orbit determination. Although not directly providing terrestrial coordinates, the techniques of satellite altimetry[10] and satellite-to-satellite tracking should also be mentioned. These techniques provide useful information about the sea surface, the geoid, and the external gravity field of earth.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. arrangement	b. height
c. moving	d. out side the Earth
e. relating to the moon	f. send out
g. study of stars and planets	h. the number by which something is multiplied
i. turn with a circular movement	j. use

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. Extraterrestrial positioning system is for establishing positions of points only on the earth.
2. Positional astronomy is used for geodetic and navigation purposes.
3. Satellite altimetry provides information about the sea surface.

C. Read the passage and answer the questions.

1. Extraterrestrial positioning system uses ….

a. positions b. electromagnetic radiation
c. orbits d. great distances

2. All other extraterrestrial techniques depend on ….

a. geodetic purposes b. navigation purposes
c. space technology d. positional astronomy

3. Space techniques does not include ….

a. transit b. Argos
c. GPS d. positional astronomy

4. …describe the earth's gravity field and the orientation of the earth's crust with respect to its rotation axis.

a. geodetic information b. coefficients
c. positional information d. positional information

5. Which of these techniques are still utilized for space craft tracking and orbit determination?

   a. GRARR, satellite photography and lunar laser ranging
   b. SECOR, mini track and Argos
   c. mini track and GRARR
   d. C and S-band radar systems and transit

6. ... dose not directly provide terrestrial coordinates.

a. Satellite photography b. SECOR
c. Satellite altimetry d. GRARR

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

GPS has been available for civil and military use for more than two decades. That …1… of time has witnessed the creation of numerous new GPS applications. Because it …2… high-accuracy positioning in a cost-effective manner, GPS has found its way into many industrial …3…, replacing conventional methods in most cases. For example, with GPS, machineries can be automatically …4… and controlled. This is especially useful in hazardous areas, where human lives are …5…. Even some species of birds are benefiting from GPS technology, as they are being monitored with GPS during their immigration season. This way, help can be presented as needed.

1.	a. during	b. period	c. when	d. often
2.	a. provides	b. prepares	c. supplies	d. makes
3.	a. requirements	b. techniques	c. applications	d. processes
4.	a. started	b. fixed	c. repaired	d. guided
5.	a. secured	b. endangered	c. saved	d. survived

GPS segments

GPS consists of three segments: the space segment, the control segment, and the user segment. The space segment consists of the 24-satellite constellation. Each GPS satellite transmits a signal, which has a number of components: two sine waves (also known as carrier frequencies), two digital codes, and a navigation message. The codes and the navigation message are added to the carriers as binary biphase modulations. The carriers and the codes are used mainly to determine the distance from the user's receiver to the GPS satellites. The navigation message contains, along with other information, the coordinates (the location) of the satellites as a function of time. The transmitted signals are controlled by highly accurate atomic clocks onboard the satellites.

The control segment of the GPS system consists of a worldwide network of tracking stations, with a master control station (MCS) located in the United States at Colorado Springs, Colorado. The primary task of the operational control segment is tracking the GPS satellites in order to determine and predict satellite locations, system integrity, behavior of the satellite atomic clocks, atmospheric data, the satellite almanac, and other considerations. This information is then packed and uploaded into the GPS satellites through the S-band link.

The user segment includes all military and civilian users. With a GPS receiver connected to a GPS antenna, a user can receive the GPS signals, which can be used to determine his or her position anywhere in the world. GPS is currently available to all users worldwide at no direct charge.

E. Read the passage and answer the questions.

1. GPS is composed of … segments.

a. 4 b. 3 c. 2 d. 1

2. … <u>is not</u> a GPS segment.

   a. space segment
   b. user segment
   c. signal segment
   d. control segment reduction of the camera

3. Each GPS satellite signal has …... components.

a. 2 b. 3 c. 4 d. 5

4. …are used to determine the distance between the receiver and GPS satellites.

a. carriers and codes b. navigation messages
c. bi phase modulations d. sine waves

5. The transmitted signals are controlled by ….

a. the satellites b. atomic clocks
c. navigation message d. coordinates

6. The control segment <u>is not</u> responsible for ….

a. satellite location b. atmospheric data
c. satellite almanac d. receiving GPS signals

7. constellation in line 3 means:

a. period b. group c. special d. individual

8. The user segment includes ….

a. only military users
b. only civilian users
c. either military or civilian users
d. both military and civilian users

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

Almanac	Cutoff Angle
Dilution of Precision	Doppler Shift
Kinematic Positioning	Pseudo-Random Noise
Selective Availability (SA)	Spherical Error Probable (SEP)
Standard Positioning Service (SPS)	Track (TRK)

1. Intentional degradation of the Absolute Positioning performance capabilities of the NAVSTAR satellite system for civilian use (the Standard Positioning Service) by the U.S. military, accomplished by artificially "dithering" the clock error in the satellites. Has generally been mitigated through the use of Relative Positioning techniques. It was activated on 25 March 1990, and was removed on the 1st May 2000 (midnight Washington D.C. time).

2. The direction of movement relative to a ground position. Commonly associated with navigation applications.

3. The civilian Absolute Positioning accuracy obtained by using the pseudo-range data obtained with the aid of a standard single-frequency C/A-Code GPS receiver. Under "Selective Availability" the horizontal accuracy is stated to be 100m 2drms (or 95% of the time).

4. The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

5. A statistical measure of the 3-D positioning precision. The SEP value is defined as a sphere's radius, when centered at the true position, encloses 50% of the data points in a 3-D scatter

plot. Thus, half the data points are within a 3-D SEP sphere and half are outside the sphere.

6. A binary signal with random noise-like properties. It is generated by mathematical algorithm or "code", and consists of repeated pattern of 1's and 0's. This binary code can be modulated on the GPS carrier waves using Binary Shift-Key (BSK) modulation. The C/A-Code and the P-Code are examples of PRN codes. Each satellite transmits a unique C/A-Code and P-Code sequence (on the same L1 and L2 frequencies), and hence a satellite may be identified according to its "PRN number", e.g. PRN2 or PRN14 are particular GPS satellites.

7. An indicator of satellite geometry for a unique constellation of satellites used to determine a position. Positions tagged with a higher DOP value generally constitute poorer measurement results than those tagged with lower DOP. There are a variety of these indicators, such as GDOP (Geometric DOP), PDOP (Position DOP), HDOP (Horizontal DOP), VDOP (Vertical DOP), etc.

8. The minimum acceptable satellite elevation angle (above the horizon) to avoid blockage of line-of-sight, Multipath errors or too high Troposphere or Ionosphere Delay values. May be preset in the receiver, or applied during data post-processing. For navigation receivers may be set as low as 5°, while for GPS Surveying typically a cutoff angle of 15° is used.

9. It refers to applications in which the position of a non-stationary object (vehicle, ship, and aircraft) is determined.

10. A data file that contains the approximate orbit information of all satellites, which is transmitted by each satellite within its Navigation Message. It is transmitted by a GPS satellite to a GPS receiver, where it facilitates rapid satellite signal acquisition within GPS receivers. Almanac data is kept current within a GPS

receiver to facilitate "hot starts" by permitting the Doppler Shift of each satellite signal to be determined and configuring each tracking channel for this Doppler-shifted carrier frequency.

Chapter 9: *Construction*

Total Station System

Use of system, with direct readout of direction and distance and equipped with a tracking mode and data collectors in conjunction with[1] coordinate geometry, make construction layout from randomly[2] located control points feasible[3]. To perform this operation, horizontal and vertical control points are positioned at locations appropriate[4] for layout. These locations can be outside the area of construction but must provide good visibility[5] for construction layout. All random control points must be coordinated and part of a closed survey network. It also is advantageous to have elevations on these control points. The accuracy maintained is a function of type of work being done. The points to be staked also must be coordinated. It stakes on right-angle offsets from the corner of a building or offsets from the catch point in slope staking are to be set, the offset point is coordinated. Next, the inverse[6] solution between the random control point and coordinated offset point is computed to yield distance and direction (azimuth or bearing). Most surveying organizations have standard computer programs and all data collectors contain menu-driven routines for this computation, given the coordinates for both ends of the line. The minimum amount of data provided for field operations consists of azimuth or bearing and horizontal distance from the random control point to the offset point. When offset stakes are to be set for alignment[7] and grade (as for slope stakes in highway excavation), azimuth and zenith or vertical angle, slope distance, horizontal distance, and elevation of the offset point are given.

Data usually are precalculated and furnished to field personnel as a file to be downloaded to a data collector or in the from of a hard-copy listing.
In the field, the operation consists of occupying the designated random control point, taking a backsight on an intervisible random control station, turning off the direction, and measuring the distance to set the specified offset stake. Ideally, a series of offset stakes are set from a single well-located random control point. To verify[8] calculations and fieldwork, the locations of the stakes as set are checked by measuring distance and direction from another random control point or by measurements between offset stakes on the site. Obviously[9], the locations for random control stations must be chosen carefully to achieve the maximum benefits from this method. In preparation for layout from random stations, enough inverse data must be generated from several control stations to provide for checking and to guard against lack of visibility along certain lines. In case insufficient[10] inverses are generated to complete the job, data collectors provide enough computing power to allow calculation of the necessary inverses on the site.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. being in a line parallel	b. by chance
c. clearly	d. confirm
e. happening with	f. not enough
g. opposite	h. possible
i. possible to see	j. suitable

B. Read the passage and answer the questions.

1. The locations … out side the area of construction.

a. must be b. can't be c. can be d. are never

2. When offset stakes are to be set for alignment, which of following <u>is not</u> given?

a. slope distance b. right-angle offsets
c. vertical angle d. horizontal distance

3. The locations of the stakes are checked by ….

   a. measurements between offset stakes on the site
   b. a series of offset stakes from a single well-located random control point
   c. a file to be downloaded to a data collector
   d. occupying the designated random control point

4. The word "generate" as used in the text means ….

a. create b. increase c. activate d. check

5. To guard against lack of visibility … must be generated.

a. offset stakes b. menu-driven routines
c. inverse solution d. inverse data

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Railroads

Construction surveys for railroads are similar to those for highways. Prior to construction, the located center line is rerun, missing stakes are …1… control station hubs are referenced, borrow pits are staked out, slope stakes are set, and lines and grades for structures are established on the ground. When rough grading is completed, final grade stakes are set to …2… at the outer edges of the roadbed, as a guide in trimming the slopes.
The foregoing operations can also be performed from …3… control points or using a random offset line. When the roadbed has been graded, alignment is established precisely by setting tacked stakes along the center line at full stations on tangents and usually at …4… stations on horizontal and vertical curves. Spiral curves are staked out at this time. An additional line of hubs is set on one side of the track and perhaps 1 m (3 ft) from the …5… line of the rail, with the top of the hub usually at the elevation of the top of the rail. Track usually is laid on the subgrade and is lifted into position after the ballast has been placed and compacted around the ties.

1.	a. replaced	b. replace	c. to replace	d. replacing
2.	a. calculate	b. control	c. grade	d. make
3.	a. exact	b. random	c. layout	d. final
4.	a. general	b. horizontal	c. vertical	d. fractional
5.	a. proposed	b. established	c. staked	d. compacted

D. Read the passage and answer the questions.

As-built surveys

The as-built survey is performed on completion of a construction project for the purpose of reestablishing the principal horizontal vertical controlling points and to locate the positions of all structures and improvements. As-built surveys should be performed after the construction of highways, railroads, airports, bridges, buildings (including private homes), dams and underground facilities.

Essentially, the as-built survey consists of rerunning center lines or property lines, setting permanent monuments at controlling points, and locating all improvements relative to these lines. These data are plotted on a map to provide a permanent record or inventory of the work done and its precise location.

Static and kinematic GPS surveys, total station systems, and photogrammetric surveys can be used to advantage in the establishment of controlling points and the acquisition of data that define the as-built facilities. These systems permit acquisition of data in data collectors and on film or as digitized images for transfer to a GIS that provides the ideal tool for subsequent reduction, processing, retrieval, review, and automatic plotting of the final map, which can be a digital map or the standard line map on paper.

Vehicle-mounted systems that combine GPS, inertial surveying system (INS), and photogrammetric sensors (solid-state CCD cameras) into one integrated system are now under development (Li, 1994). This type of system, which yields real-time positions and an electronic file of locations of all objects visible as the vehicle travels along a route, has potential for as-built surveys, especially along highways and railroads. Final output would consist of a digital or line map.

1. The as-built survey is for ….

    a. locating of all structures
    b. rerunning principal points
    c. establishing horizontal points
    d. reestablishing vertical points

2. The as-built survey dose NOT include ….

    a. rerunning property lines
    b. setting monuments
    c. locating improvements
    d. total station systems

3. Which best describes the meaning of "inventory"?

a. new b. stock
c. making things d. produce

4. A digital map can be provided by ….

    a. only GPS surveys
    b. photogrammetric surveys
    c. as-built facilities
    d. total station systems

5. Along highways and railroads … have potential for as built as built surveys.

a. GPS b. INS
c. CCP cameras d. all of them

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Alignment	b. Clearing
c. Deck	d. Gabion
e. Interlining	f. Layout survey
g. Optical plummet	h. Sag
i. Stripping	j. Wing wall

1. Device for centering a theodolite over a survey mark.

2. An abutment extension designed to retain the approach fill.

3. The error caused by using a taped that is supported only at the ends.

4. The floor of a bridge.

5. The location of the centerline of a survey or a facility.

6. The removal of topsoil from a construction site.

7. The cutting and removal of trees from a construction site.

8. A trial-and-error technique of establishing a theodolite on a line between two points that themselves are not intervisible.

9. Establishing property or construction locations.

10. A wire basked filled with fragmented rocks or concrete.

Chapter 10: *Route Surveying*

Planning the route alignment: General

The expression "route surveying" used in a very general sense can be applied to the surveys required to establish[1] the horizontal and vertical alignment for transportation facilities. In the most general case, the transportation facilities are assumed to comprise a network that includes the transport of people or goods on or by way of highways, railways, rapid transit guide[2] ways, canals, pipelines, and transmission[3] lines. For the past three decades in the United States, highways have been the most highly developed from of transportation facility in the overall network. As a result, route surveys for highways are well defined and widely practiced. Most of the methods that have been developed for highways surveys are equally applicable to the other specified means of transport.

Surveys of some type are required for practically all phases of route alignment planning, design, and construction work. For small projects involving widening or minor improvement of an existing facility[4], the survey may be relatively simple and may include only the obtaining of sufficient[5] information for the design engineer to prepare plans and specifications defining the work to be done. For more complex projects involving multilane highways on new locations, the survey may require a myriad of details, including data from specialists in related field to determine the best location; to prepare plans, specifications, and estimates for construction; and to prepare[6] deed descriptions and maps for appraisal[7] and acquisition of the necessary rights of way.

However, it is the function[8] of the survey or project engineer to plan the surveys and gather particular project. This process includes obtaining the necessary information regarding terrain and land use, making surveys to determine detailed topography, and establishing horizontal and vertical control required for construction layout.

In order to plan and perform[9] the surveys needed to acquire these types of data, the survey engineer must be familiar with (1) the geometry of horizontal and vertical curves and how they are used in the route alignment procedure, (2) the methods of acquiring terrain data utilized in the route design procedure, (3) the procedures followed in processing data to obtain earthwork volumes, and (4) the earthwork distribution[10] processes.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. ability	b. accompany
c. accomplish	d. activity
e. adequate	f. adjust
g. apportionment	h. assessment
i. broadcast	j. Create

B. Read the passage and answer the questions.

1. In the U.S. … have been the most developed from of transportation forms.

a. railways	b. rapid transit ways
c. highways	d. canals

2. Multilane highways on new locations ….

    a. have simple survey
    b. don't need to get data from specialists
    c. need many detailed data
    d. don't need to get right of way

3. What <u>is not</u> a project engineer's function?

    a. getting information about land use
    b. establishing horizontal and vertical control
    c. determining detailed topography
    d. getting right of way

4. Which best describes the meaning of "define"?

a. determine b. detail c. describe d. develop

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Shrinkage and Swell

Shrinkage is small in granular soils (sands and gravels) but can be substantial (up to 30 percent) in fine-grained silts and clays. Shrinkage occurs when …1… soils are compacted into fills. Thus, 1 cubic unit of excavated material will not provide 1 cubic unit of compacted fill. In contrast to fine-grained soils, rock when excavated will …2… a larger volume in fill than when in place. In this case swell occurs and 1 cubic unit of excavated rock will occupy more than 1 cubic unit of fill. Swell of up to 30 percent is possible in excavated rocky materials.

When excavated materials have uniform shrinkage or swell factors, compensation is accomplished by increasing the calculated fill quantities before computing the mass diagram ordinates. For example, if the excavated material …3… 20 percent when placed in fill, 125 m^3 of cut is required to provide 100 m^3 of fill. Consequently, all fills must be increased by 20 percent to have a proper balance.

When excavated materials are nonhomogeneous and several …4… shrinkage factors are involved, the proper factor is applied to each cut volume and actual fill are utilized. Thus, if the shrinkage factor is 20 percent, a measured cut of 100 m^3 will occupy a fill of 80 m^3 when placed in fill. Compensation is achieved by …5… all cut volumes by 20 percent prior to computing the cumulated cuts fills and the ordinate of the mass diagram represents actual volumes of fill and volumes of cut available for fill.

1.	a. excavating	b. excavate	c. excavated	d. to excavate
2.	a. fill	b. occupy	c. occur	d. measure
3.	a. increases	b. decreases	c. shrinks	d. cuts
4.	a. same	b. different	c. proper	d. cubic
5.	a. decreasing	b. increasing	c. excavating	d. occurring

D. Read the passage and answer the questions.

Cross-section data from a digital terrain model

Briefly, a DTM is a mathematical representation of the earth’s surface in which X, Y coordinates and elevations are given for all intersections of all lines in a rectangular or triangular network covering the study area. The data used to form the DMT are collected from various sources, including (1) the photogrammetric stereomodel, (2) digitized topographic maps, and (3) GPS and total station surveys to acquire terrain data. The techniques for obtaining terrain data for cross sections (each of which creates an individual DTM) provide data that may be merged to form the final and most complete DTM.

The terrain surface formed from the DTM consists of triangles that have spatial coordinates (X, Y, and elevation) at each vertex. The files that contain this information are called triangulated irregular networks (TIN). A TIN such as might be used for the alignment of a portion of a highway. When a DTM is formed, it is possible to determine cross sections by linear interpolation between vertices of triangles for any alignment that falls within the DTM.

The process requires a workstation consisting of a high-resolution video display screen and a high-speed computer with adequate storage capacity to hold the operating system, programs for manipulating the data, and the data files. The terrain data (already preprocessed after field collection or downloaded from the map digitizer or analytical plotter) are entered into the computer and the DTM is formed and displayed. Following menu-driven prompts, the user can specify parameters for horizontal and vertical alignments for the proposed route. On command at the terminal, this alignment can be superimposed on the DTM and displayed on the video screen. Then, cross sections and profiles may be obtained, displayed, and stored in the database for future evaluation of earthwork. If changes in alignment are made, the profile and cross sections reflect these changes.

The DTM provides a flexible, powerful tool for obtaining terrain data for route location and design. It consolidates data from all sources into compact package that is easily accessed and manipulated.

1. DTM is a mathematical representation in which coordinates and … are given.

a. rectangulars	b. triangulars
c. elevations	d. X and Y

2. In DTM, data are collected from the following except ….

a. GPS	b. total station surveys
c. topographic maps	d. photographs

3. DTM consists of … that have spatial coordinates.

a. rectangulars b. triangles
c. vertex d. elevations

4. DTM can determine ….

a. cross sections b. linear interpolation
c. vertex of triangles d. stereoemodel

5. DTM can be used by ….

a. maps b. computers c. videos d. diagrams

6. DTM is a tool for getting ….

a. terrain data b. rectangular vertex
c. triangular vertex d. digital photos

7. Prompt means …

a. quiet b. quite c. quick d. quality

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Compound curve	b. Culvert
c. Fill	d. Freeway
e. Grade sheet	f. Spiral curve
g. Super elevation	h. Tangent
i. Toe of slope	j. Transition curve

1. A transition curve of constantly changing radius, placed between a high-speed tangent and a central curve, which permits a gradual speed adjustment.

2. Material used to raise the construction level; also, the measurement up from a grade mark.

3. A parabolic curve used in the horizontal plane to effect a smooth change from a straight section of road or railway to a curved section.

4. Two or more circular arcs turning in the same direction having common tangent points and different radii.

5. A straight line often referred to with respect to a curve.

6. A structure designed to provide an opening under road, etc., usually for the transportation of storm water.

7. Bottom of slope.

8. The banking of a curved section of road to help overcome the effects of centrifugal force.

9. A construction report giving line and grade, i.e., offsets, and cuts/fills at each section.

10. A highway designed for traffic mobility, with access restricted to interchanges with arterials and other freeways.

Chapter 11: *Underground Surveying*

Mine orientation surveys: basic principles and classification

If the mine is accessible by means of adits[1] or include[2] transportation roads, the orientation process is comparatively simple and limited to running a traverse[3] between the surface geodetic network and points of the underground control net. Very often, however, the access to the mine is by way of vertical shafts and then direct traversing from the surface is impossible. In these cases, one of the following three methods of mine orientation can be applied:

1. Shaft plumbing with two or lines in one vertical shaft.
2. Shaft plumbing through two or more vertical shafts with one plumb line in each shaft.
3. Gyro orientation with one plumb line.

The process of orientation is supposed to give coordinates of at least one point and azimuth of one line of the underground network in the surface coordinate system. In the first two methods, the two plumb lines serve for a simultaneous[4] transfer of the coordinates and of the azimuth directly from the surface, assuming that the plumb lines are truly vertical. This assumption is particularly critical in the first method in which the distance between the two plumb lines is comparatively short. This distance is usually not longer than 2 to 4 m even when the diameter of the shaft is larger because there are always many obstacles in the shaft such as cages, pipes, cables, etc. In this case two small random deflections[5], e_1 and e_2, one for each plumb line separated by a distance b, will produce an error ε'' of the transferred azimuth, A:

$$\varepsilon''_A = \frac{206.265''}{b}\sqrt{e_1^2 + e_2^2}$$

For example, random deflections, $e_1 = e_2 = 1\,mm$, of the plumb lines which are separated by a distance of 3 m will produce an error of $\varepsilon''_A = 97''$. Therefore, the method of shaft plumbing orientation through one vertical shaft requires the utmost[6] care and experience in establishing the plumb lines in the shaft.

The error of shaft plumbing caused by the possible deflections of the plumb lines is, of course, much smaller when two plumb lines are used in the two separate shafts. In that case the distance *b* in the equation is usually several hundred meters long and even large errors in the verticality of the plumb lines may be tolerated[7]. The method of orientation through two or more vertical shafts is also called the *fitted traverse method.* This method usually gives much higher accuracy of mine orientation than shaft plumbing through one vertical shaft, and very often it may also give a better accuracy than the gyro orientation. Unfortunately, not every mine has an access to the surface through two or more vertical shafts from the mining levels which require the orientation.

Use of the gyro attachments has revolutionized[8] mine orientation surveys. In this method, the shaft plumbing is used only for the transfer of one point, and an error of even a few centimeters can be tolerated the transfer the azimuth, which is critical for the orientation of the underground network, is done independently of the shaft plumbing. Although shaft-plumbing methods may be considered obsolete[9] in modern mine surveying under certain favorable conditions, shaft plumbing even through one vertical shaft can be competitive with gyro orientation. Examples of conditions favorable to shaft plumbing are shallow shafts, or the orientation of subway or hydro-development projects. Besides, precision shaft plumbing is still needed in the process of sinking new shafts (control of the shaft construction) and in periodic deformation measurements of shafts, which is mandatory in many mines.

There are no general specifications for the accuracy requirements for mine orientation. In each individual case the chief surveyor has to decide, depending on importance of the orientation, what accuracy is needed. Generally, the relative position of the underground points in respect to[10] the surface and other mining levels should be known with an accuracy better than 1 m. The accuracy requirements may be much higher, of the order of 0.2 m, when two mine workings from two different levels, or when two different mines are supposed to meet each other. The process of mine orientation is one of the most responsible tasks of the mine surveyor and should not be entrusted to persons who do not have good experience and knowledge in all aspects of mine orientation, including error analysis.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. allowed	b. cross
c. change completely	d. horizontal passage
e. greatest	f. happen at the same time
g. move away	h. out of date
i. related to	j. sloping

B. Decide whether each of the following sentences are true (T) or false (F) according to the passage.

1. If there are adits, direct traversing from the surface is possible.
2. In shaft plumbing there are not any errors.

3. Shaft plumbing with two or more plumb lines in one shaft is called fitted traverse method.
4. In gyro orientation, the transfer of azimuth is done independently of the shaft.

C. Read the passage and answer the questions.

1. A traverse runs between ….

    a. adits and inclined roads
    b. adits and vertical shafts
    c. surface network and underground
    d. surface and underground control net

2. In … the two plumb lines are used for the transfer of the coordinates and of the azimuth.

a. the first method b. the second method
c. the first two methods d. the all third method

3. The plumb lines should be truly vertical. This is very important in the ….

a. first method b. second method
c. first two methods d. third method

4. Which best describes the meaning of 'azimuth'?

    a. horizontal direction expressed as the angular distance
    b. angular distance expressed as the horizontal direction
    c. vertical direction expressed as the angular distance
    d. angular distance expressed as the vertical direction

5. … gives much higer accuracy of mine orientation.

a. first method b. second method
c. first two methods d. third method

6. ... has changed mine orientation surveys deeply.

a. first method b. second method
c. first two methods d. third method

7. Examples of conditions favorable to shaft plumbing are ….

a. deep shafts b. shallow shafts
c. vertical shafts d. high shafts

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Gyroscopic methods of mine orientation: Introduction

Orientation may be determined by means of the gyrotheodolite. The basic theory of gyro attachment is applicable to the gyro theodolite. There are two basic approaches for azimuth determination, one in which the gyro is ...1... to precess about the meridian while the observer reads the horizontal circle of the theodolite or the time of ...2… and the amplitude of the swing. With this technique the …3… of the gyro movement is very small and the gyro usually spins about 22,000 rev /min. The other approach is to use the torque acting on the spinning gyro when it is not …4…aligned in the meridian and, form several observations of this torque, east and west of the meridian, …5… the azimuth. This principle is applied in the P.I.M.

1.	a. allow	b. allowing	c. allowed	d. to allow
2.	a. oscillation	b. movement	c. torque	d. spin
3.	a. damping	b. spinning	c. precessing	d. acting
4.	a. allowed	b. aligned	c. applied	d. developed
5.	a. precess	b. read	c. spin	d. determine

Design of horizontal control networks in underground mines

Control networks consist of traverses (frequently open-end traverses) that must follow the existing net of mining workings and excavations. Since open-end traverses may often serve as basic control, they must be executed with the utmost care and are usually independently checked by a second resurvey.

Distances between the survey stations are generally very short, ranging from 10 to 20 ft (a few meters) to an average of 160 ft (50 m). Only in the main transportation roads may the distances be increased to about 1000 ft or a few hundred meters. The control network consists of (1) first-order loops which serve as basic control and are run in the permanent mine workings, (2) second-order traverses run into headings and development areas, and (3) third-order stations (short traverses) used for detailed mapping of excavated areas and daily checks of mining progress in stopes and headings.

The establishment of the underground control network is done in a reversed sequence from that used on the higher-order control once the developed area allows for longer sights and for a loop closure of traverses.

Typically, the following maximum errors in relative positions of the control points are permitted:

first-order control (a) 1:10000 in small and medium-size mines

(b) 1:20000 in large mines extended over areas of several kilometers in diameter

second-order control	1:5000
third-order control	1:1000

The relative accuracies given above are usually interpreted as the ratio of the semi-major axis of the relative error ellipse. At the 95 percent probability level, to the distance between the points of interest.

E. Read the passage and answer the questions.

1. … must follow the existing net of mining working and excavations.

a. Control network b. Traverses
c. Survey stations d. Transportation roads

2. … are run in the permanent mine workings.

a. First order loops b. First order traverses
c. Second order loops d. Second order traverses

3. … are used in slopes and headings.

a. First order loops b. First order traverses
c. Third order stations d. None

4. … is establish first in underground control network.

a. First order loops b. Second order traverses
c. Third order stations d. None

5. … is called higher-order control.

a. First order loops b. Second order traverses
c. Third order stations d. None

6. Which best describes the meaning of “reversed”?

a. turn b. opposite c. other side d. change

7. Which control point has the lower errors?

a. First order loops b. Second order traverses
c. Third order stations d. None

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Adit	b. Cage
c. Chute	d. Dip
e. Entry	f. Headframe
g. Pillars	h. Rib
i. Sump	j. Waste

1. An excavation made at the bottom of a shaft to collect water.

2. An elevator for workers and material in a mine shaft.

3. Manway, haulage way, or ventilation way below ground, of a permanent nature (i.e., not in an ore to be removed).

4. Natural rock or ore supports, left in sports to avoid or to decrease the roof subsidence as mining progresses.

5. Mined rocks that do not contain useful mineral.

6. Wall in an entry, also simply wall.

7. The angle at which a bed, stratum, or vein is inclined from the horizontal.

8. A channel or trough underground or inclined trough above ground, through which ore falls or is shot by gravity from a higher to a lower level.

9. A horizontal or nearly horizontal passage driven from the surface for working or dewatering a mine.

10. A construction at top of a shaft which houses hoisting equipment.

Chapter 12: *Physical Geodesy*

Conversion of disturbing potential into other field parameters

We have three basic gravity field parameters that are used in geodesy: the gravity anomaly, the deflection[1] of the vertical, and the geoidal height. We are now going to show the different species of these parameters that can be defined and used.

The gravity anomaly is defined as the scalar, whose value is equal to the difference on the geocentric ellipsoid, γ_0

$$\Delta g = g_0 - \gamma_0$$

When Δg is defined in this way, it is called the gravity anomaly on the geoid, or just the geoidal gravity anomaly. Often when the meaning is clear from the context, the word 'geoidal' is left out.

It is evident that on land, g_0 has to be generally deduced from the value g_A observed on the earth's surface. Analogically[2], gravity observed on the sea bottom has to be converted to g_0 by applying a suitable correction. According to the way observed gravity is reduced to the geoid, there are several species of geoidal gravity anomaly of which the free air variety is one. There are different vertical gravity gradients assumed[3] to be valid between the earth's surface and the geoid. These lead to the different reduction procedures, and hence different gravity anomalies.

A counterpart[4] to the geoidal anomaly is the surface gravity anomaly $\Delta\tilde{g}$, which is defined as the different between the magnitude of the observed gravity taken on the earth's surface and the normal gravity taken on the telluroid

$$\Delta\tilde{g} = g_A - \gamma_{A'} .$$

This kind of gravity anomaly does not require[5] the knowledge of the vertical gradient of the actual gravity within the earth. The exact value of the normal gravity on the telluroid needed for this anomaly can be obtained when the normal height H^N is used instead of h. Hence[6], there are no different species of the surface anomaly, as there were of geoidal anomaly, because the computation of $\gamma_{A'}$ is unique, and there is no need to reduce the observed gravity g_A.

A similar situation exists with the deflections of the vertical. The one species of deflection was defined as the spatial angle between the normal gravity vector on the reference ellipsoid and the actual gravity vector on the geoid. This species of θ is called the geoidal deflection. It can also be interpreted[7] as the maximum slope of the geoid with respect to the reference ellipsoid at the point of interest.

If the angle in reckoned[8] between the normal gravity vector on the reference ellipsoid and the actual gravity vector on the earth's surface, then we speak about the surface deflection and denote it by θ'. These two deflections differ by an amount dictated by the curvature[9] of the actual plumb line.

The third species of deflection used in geodesy is defined as the angle between the actual gravity vector on the earth's surface and the normal gravity vector on the telluroid. This angle is called Molodenskij's deflection and will be denoted[10] by $\tilde{\theta}$. Comparing θ' with $\tilde{\theta}$, one quickly comes to the conclusion that the different between these two is given by the amount of curvature of the plumb line of the normal field, i.e., the curvature of the normal plumb line between the reference ellipsoid and the telluroid.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. Believe	b. Calculate
c. Changing direction	d. Equal
e. For this reason	f. Need
g. Show	h. Similarly
i. Think that something is true	j. To be a curve

B. Read the passage and answer the questions.

1. The gravity anomaly is … than the actual gravity on the geoid.

a. greater b. smaller
c. more different d. clearer

2. Gravity on the sea bottom is ….

a. equal to go b. greater than go
c. smaller than go d. converted to go

3. Surface gravity anomaly doesn't require ….

   a. the observed gravity
   b. normal gravity
   c. vertical gradient
   d. normal height

4. There are no different types of the surface anomaly because ….

   a. the computation of the normal gravity is easy
   b. observed gravity is unique

c. normal gravity is equal to observed gravity
d. normal gravity is unique

5. Geoidal deflection is ….

    a. the normal gravity vector
    b. the maximum slope of the geoid
    c. the actual gravity vector
    d. equal to the surface anomaly

6. Which <u>is not</u> a species of spatial deflection?

a. geoidal deflection
b. Molodenskij's deflection
c. surface deflection
d. field deflection

7. The difference between Moldineskij's and surface deflection is the amount of curvature of the ….

    a. plumb line
    b. plumb line on normal field
    c. normal plumb line
    d. reference ellipsoid

D. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Geometrical solution for the geoid

The geoidal deflection of the vertical is …1… the maximum slope of the geoid with respect to the reference ellipsoid. The geoidal deflection can be obtained from the surface deflection by …2… a correction for the effect caused by the curvature of the actual plumb line between the earth's surface and the geoid. …3…, the surface deflection can be …4… from the geodetic and astronomical latitudes and longitudes of a common point and, as a result, in …5… is often called the astrodeflection, or astro-geodetic deflection.

1.	a. merely	b. even	c. almost	d. never
2.	a. apply	b. application	c. applying	d. applied
3.	a. Although	b. In turn	c. After	d. Before
4.	a. derived	b. deriving	c. derive	d. deriveable
5.	a. theory	b. practice	c. context	d. conclusion

E. Read the passage and answer the questions.

Gravimetry

Gravity (acceleration) at a point on the surface of the earth can be determined directly by either pendulums or free-fall devices. Suffice it to say that, in both cases, precise timing of movements is required, and the observed time interval is subsequently converted into the value of g using the appropriate equation of motion. The achievable accuracy, depending largely on control of the instrument environment and the number of repeated observations, is of the order of or better than 100 μGal for the pendulums and perhaps one order of magnitude better for the free-fall devices. Both kinds of instruments give us absolute gravity measurements.

More portable, handier to operate, and thus more widely used are gravimeters, instruments capable of measuring only differences in gravity between pairs of points. Since gravimeters give us only relative gravity measurements, their accuracy is usually significantly higher than that of the absolute instruments. The accuracy routinely achieved is about $50\mu Gal$, but instruments accurate to a fraction of a μGal exist. Inertial positioning devices, operated in a special mode, also have the capability of measuring local gravity variations between two points about $\sigma_g = 3mGal$.

In practice, one tries to combine advantages of both techniques. This is done through the establishment of networks of gravity stations using both absolute and relative measurements. The stations with absolute gravity determination provide the anchoring points of the network, while the relative measurements provide the ties between the points. The establishment of these global gravity networks has been coordinated internationally since the beginning of this century. As early as 1909, the IAG adopted the international Potsdam Gravity System, a network used for a multitude of tasks. This system has only recently been replaced by the International Gravity Standardization Net 1971 (IGSN 71) [IAG, 1974].

1. Gravity on the surface can be calculated ….

   a. only by pendulums
   b. only by free-fall devices
   c. both pendulums and free-fall devices
   d. by either pendulums or free-fall devices

2. What dose 'suffice' mean?

a. enough b. almost c. only d. even

3. Exact timing is necessary for ….

   a. only pendulums
   b. only free-fall devices
   c. both pendulums and free-fall devices
   d. either pendulums or free-fall devices

4. Accuracy <u>dose not</u> depend on ….

   a. instrument environment
   b. number of repeated observations
   c. precise timing
   d. the gravity data

5. Accuracy of relative gravity is … that of absolute gravity.

a. lower than
b. higher than
c. the same as
d. equal to

6. Global gravity networks are formed by ….

a. absolute gravity measurements
b. relative gravity measurements
c. both absolute and relative gravity measurements
d. international relative measurements

7. Global gravity networks were first established in ….

a. 1971 b. 1909 c. 2000 d. 1919

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Find the correct meaning of the given sentences for following words.

a. Ellipsoidal model field b. ETRF
c. Free air correction d. Geographic meridian
e. Gravity anomaly f. Gravity equipotential surface
g. Long-arc prediction h. Relativistic effects
i. Sink j. Zonal harmonics

1. These arise from the fact that satellite velocities, typically about 3×10^{-4} times the velocity of light.

2. If the perturbing potential is adequately known, the prediction can extend farther, up to several revolutions of the satellite.

3. The correction to gravity for the height effect.

4. The difference between the reduced actual gravity and normal gravity on the ellipsoid.

5. A surface on which the gravity potential is constant.

6. A closer approximation to reality.

7. Spherical harmonic functions for $m = 0$.

8. A point that the integral of the gravitational flux $\vec{g}_g.\vec{n}d\wp$ is negative.

9. European terrestrial reference frame defined by precise GPS reference station.

10. A line on the surface of the earth joining the poles, i.e., a line of longitude.

Chapter 13: Hydrography

What is hydrography?

The most comprehensive[1] and general definition of what hydrography is what developed by a group of nine hydrographic experts assembled in Mexico City at a United Nations conference in 1979. They identified three kinds of ocean information[2] provided by hydrographers: about the seabed, positioning (of seabed, water column and sea surface features, as well as islands, vessels, and structures in the sea), and about the sea itself. Equally important is that hydrographers are involved in the whole information process, from acquisition to presentation, and lately management of information databases, their answer to the question 'What is hydrography?' Was as follows:

Hydrography may be defined as the science of measuring and depicting those parameters that are necessary to describe the precise nature and configuration of the sea-bed, its geographical relationship to the landmass, and the characteristics and dynamics of the sea. The parameters encompass bathymetry, geology, geophysics, tides, currents, waves, and certain other physical properties of sea water. The primary use of the data collected is to compile graphic documents used by mariners and others concerned with the marine environment, such as ocean engineers, oceanographers, marine biologists and environmental scientists. One of the most important[3] applications of hydrographic knowledge today is its use in the planning of marine resource exploration and exploitation.

In general, there are three aspects of hydrography: coastal, off-shore, and oceanic. Coastal hydrography is concerned with the development of ports and harbours, coastal erosion problems, the utilization of harbour and coastal waters. Off-shore hydrography is concerned with (a) the provision[4] of hydrographic data as an extension of the coastal zone normally encompassing the continental shelf, (b) the development of mineral deposits, including hydrocarbons, and (c) provision of data for fisheries management. Oceanic hydrography is concerned with the acquisition[5] of hydrographic data in the deep ocean areas for the depiction of sea-floor geomorphology. Hydrographic data collection is inevitably a slow and systematic[6] process, as well as being expensive[7], and applies in varying degrees to the three aspects described above.

The relevant results of hydrographic activities are presented on nautical charts, which, although fundamentally similar in design to land maps, are significantly different in some ways. They are essential instruments of navigation. Furthermore, in hydrography, no survey can be regarded as having achieved totality in obtaining the whole picture of the sea-bed. Unlike a topographical survey, there is no current technique comparable[8] to aerial photo coverage, since the sea-bed is obscured from the surface in all but very shallow and clear waters. Consequently, the results of even the most recent hydrographic surveys, conducted whit the most sophisticated means, consist of[9] samples of data to a density governed by the configuration of the sea-bed within the constraints imposed by time and resources. In many coastal areas, the effects o tides, currents, waves and discourages from rivers result in changes in the topography of the sea-bed. Such changes may significantly affect safe transit, particularly by large vessels, necessitating frequent[10] monitoring.

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. achievement	b. across-the-board
c. akin	d. amount to
e. arrangement	f. businesslike
g. costly	h. data
i. foremost	j. many a time

B. Read the passage and answer the questions.

1. Which is not a kind of ocean information?

a. the sea b. islands c. positioning d. sea bed

2. Bathymetry, geology, geophysics, tides, currents, and waves are ….

a. land mass b. parameters
c. marine biology d. oceanography

3. … is about the construction of harbors and erosion problems.

a. off-shore hydrography b. oceanic hydrography
c. hydrography d. coastal hydrography

4. … has three main functions.

a. off-shore hydrography b. oceanic hydrography
c. hydrography d. coastal hydrography

5. The major problem about hydrography is its ….

a. quickness b. cost c. depth d. sea bed

6. What best describes 'nautical'?

a. related to waves b. related to sailing
c. related to island d. related to geology

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Double-sextant angles observed from vessel

Simultaneous horizontal sextant angles are …1… between three shore stations as illustrate in figure 1. The accuracies attained at distances from shore of between 200 m and 7 km depend largely on the operator's experience, an important factor. At 200 m off-shore, an accuracy of 0.5 m can be realized. At 7 km off-shore, this could well increase to between 10 and 30 m.

Not only are the required two sextants inexpensive, but this method has the added advantage that all members of survey team are together in the survey vessel. The importance of the convenience of direct communication and immediate plotting of all fixes should …2… by the hydrographic surveyor.

The vessel should be equipped whit a plotting board and appropriate equipment for servers. A 360° protractor with three legs …3… about the center point, as illustrated in figure 2, is easily constructed. By setting the angles between the three legs to match the observed sextant angles and then placing all three legs on the plotting sheet over the shore stations observed, the position of the vessel is at the center of the protractor. Because it is common to allow an interval of one minute between position fixes, the operator of this plotting instrument (sometimes termed a *station pointer*) should be able to read the depth and plot the fix and depth within this period.

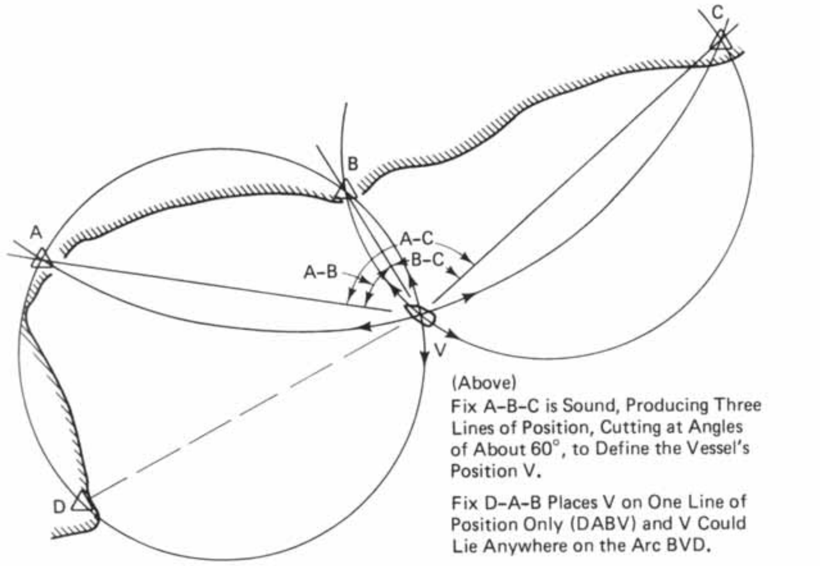
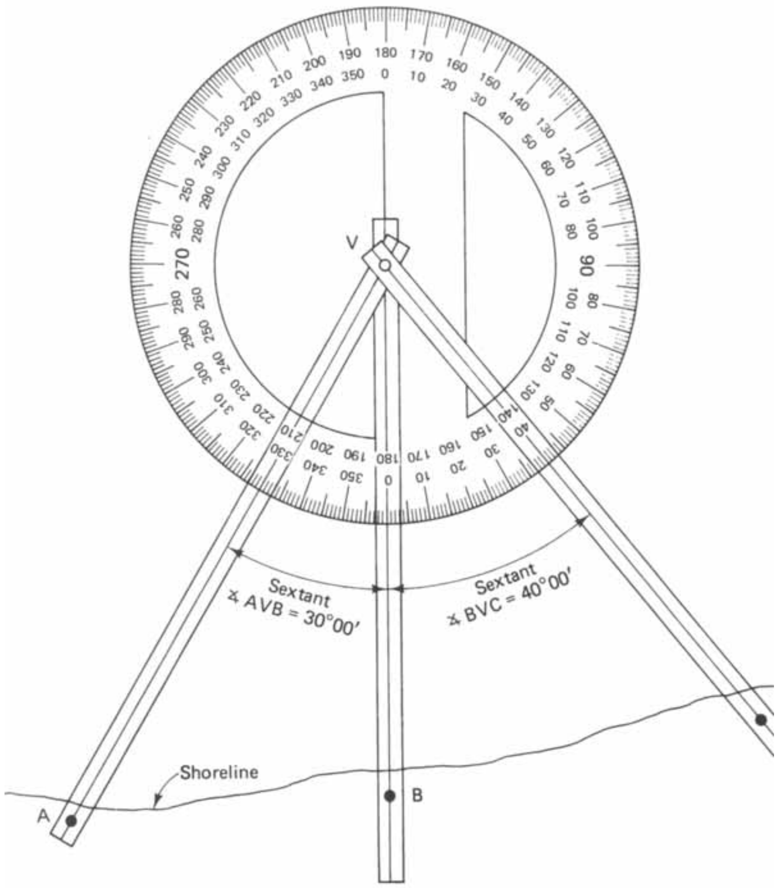


Figure 1: Double-sextant method

The vessel is kept on the course predetermined by the sounding plan through a combination of compass bearings and minor course corrections after each fix is plotted. Continuous plotting of fixes aboard the vessel thus ensures the intended coverage of the sounding area with the least number of sounding, resulting in maximum efficiency. The survey team requirements are normally met by four people: the driver of the vessel, two sextant angle observers, and a plotter and depth recorder.

The sextant angle observers should stand close together and be positioned over the depth-measuring instrument to …4… positioning errors. Immediately after reading the sextant angle for one fix, each observer should realign the sextant with the shore stations and keep the images constantly superimposed.

This will ensure correct readings at any time that a fix is requested by the driver.



A, B and C are Shoreline Stations on which the Sextant Angles Shown have Been Observed. The Location of Each Station is Accurately Plotted on Mylar and the Fix is Carried Out on the Vessel At "V".

Three Clear Plastic Strips with Center Marking Lines as Shown Above are Pivoted About the Center Point of the Protractor.

Figure 2: Station pointer for double-sextant angle-fixing

Each sextant angle should be between 20° and 110°. To ensure further the accuracy of the fix, the sum of the two angles should exceed 50°. The danger circle occurs when the vessel and all three shore stations lie on the circle's perimeter. This situation must be avoided, as boat's position may lie at any point on the circle and is therefore indeterminate. Figure 1 illustrates this situation using shore stations D, A, and B. when the vessel is on or near this circle, an alternative shore station such as C should be used to solve the problem. All danger circles should be …5… before commencing the survey.

1.	a. observe	b. observed	c. observing	d. observes
2.	a. be recognized	b. recognized	c. recognizing	d. be recognize
3.	a. pivot	b. pivoted	c. pivoting	d. be pivoted
4.	a. mini	b. minimizing	c. minimize	d. minimum
5.	a. preplotting	b. preplotte	c. preplottes	d. preplotted

D. Read the passage and answer the questions.

Depth measurements

A weighted line, graduated in meters, feet, or both, is used only for projects involving a small number of soundings. However, it is a valuable addition to the surveyor's equipment for calibrating echo sounders and also as a backup system.

The echo sounder provides depth measurements by timing the interval between transmission and reception of an acoustic pulse, which travels, to the bottom and back at a rate of approximately 1,500 m/s. separate transmissions are made at rates of up to six per second. The beam width that emanates from the vessel is typically about $30°$, as illustrated in figure 3a. The portion of the seabed within the beam width is termed the isonified area.

In depth measurement, the most significant point is directly below the transducer, which is the vibratory diaphragm that controls the frequency of transmission. However, the echo sounder records the earliest return from its transmission (that which has traveled the shortest distance). Within a beam of $30°$, this return may be from a target not directly beneath the transducer, but from seabed anomalies within the isonified area (see figure 3a). This will lead to anomalies in the soundings, which may be differentiated by an experienced observer. Highly reflective targets such as bare rock and shipwrecks, located near the edges of the beam, show as narrow, clearly defined bands on the readout compared with thick, poorly defined bands over soft sediments, weedbeds, and the like. Constant monitoring of the transmission returns and notes of anomalies should be incorporated in the hydrographic survey.

Sound velocity in water is a function of temperature, salinity, and density. These factors very daily, seasonally, and as a result of periodic occurrences such as heavy rainfalls and tidal streams. Any attempt to correct the soundings with respect to these variables is both unsatisfactory and cost-ineffective. As a result, it must be recognized that accuracies in acoustic measurements in seawater will not be better than 1 part in 200.

Calibration of echo sounders is carried out either by comparison with direct measurements, using weighted lines, or by a bar check in depths less than 30 m, as illustrated in Figure 3b. The letter involves setting a bar or disc horizontally beneath the transducer at various depths. The echo sounder recorder is adjusted to match the directly measured depths. If the sounder is not adjustable, the differences are recorded for regular depth in travels and the resulting corrections applied to each sounding. It is advisable to calibrate the echo sounder at the beginning and end of each day's use, particularly at 10%, 50%, and 80% of the maximum depths being measured.

Recent improvements to depth measurements include the now widespread use of multibeam echo sounding in shallow water. Because of the fast rate of data acquisition (900 depth points per second), manual editing is no longer feasible. This system requires an onboard computer (color monitor and plotter) for data logging, navigation, quality control, multibeam calibration, data editing, and plotting. The computer software can also integrate the data collected by the sensors on pitch, heave, and roll.

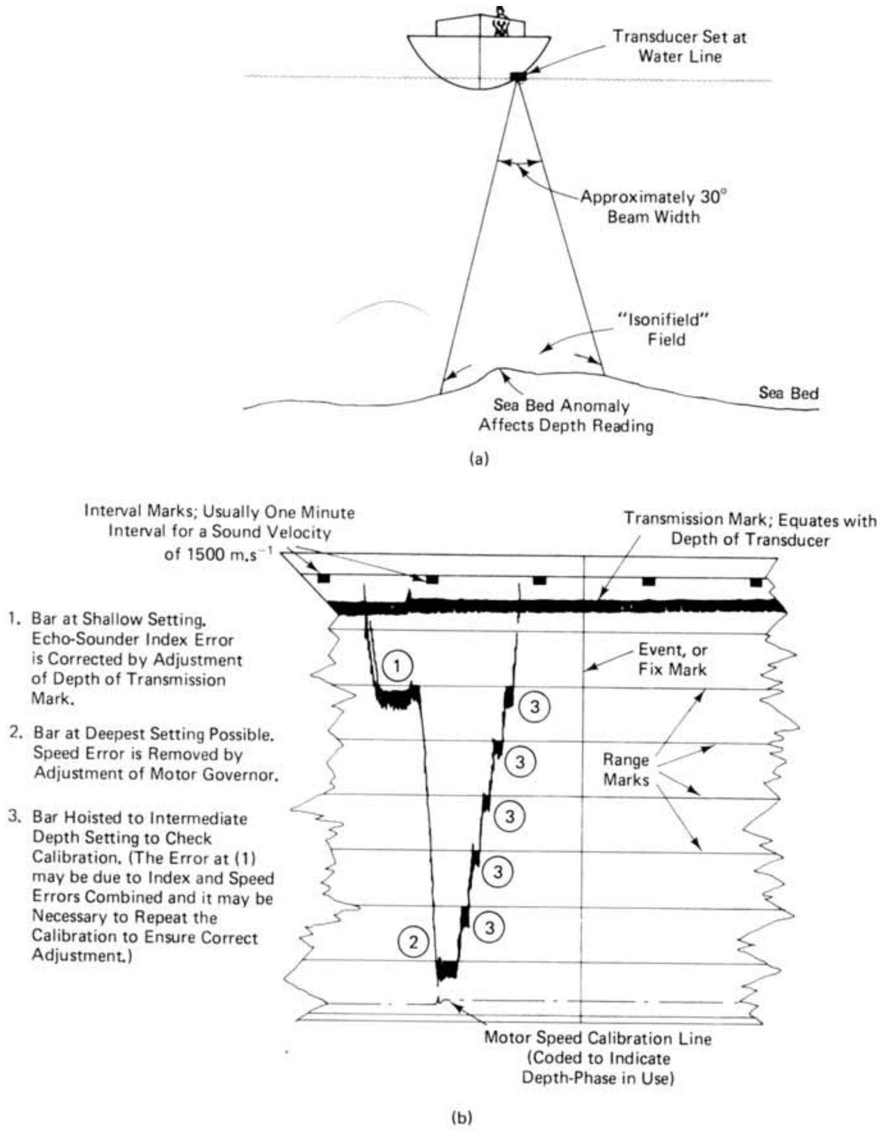


Figure 3: Isonified area and bar check for echo-sounder depths. (a) Transducer and isonified area. (b) Typical bar check.

Weighted (hand) sounding lines are seldom used for depths over 30 m. the lines may be small linked steel chain, wire, cotton, hemp cord, or nylon rope. A weight, usually lead, is attached to one end. Markers are placed at intervals along the line for depth reading. Lines constructed of link chains are subject to wear through abrasion. Wire lines will stretch moderately when suspended, depending upon the size of the bottom weight. The weights vary from 2.3 kg, although 4.5 kg is usually sufficient for moderate depths and low velocities. Cotton or hemp lines must be stretched before being used and graduated when wet. These must be soaked in water for at least an hour before use to allow the rope to assume its working length. Nylon lines stretch appreciably and unpredictably and are not recommended for other than very approximate depth measurements. The hydrographic surveyor is well advised to calibrate the sounding lines against a steel survey tape regularly under the conditions most similar to actual usage, such as hemp lines after soaking.

1. How many transmissions are made in a second?

a.1500 b. 30 c. 6 d. 150

2. In depth measurement, the most important point is … the transducer, which is ….

a. vibratory diaphragm, control
b. beneath, control
c. control, vibratory diaphragm
d. beneath, vibratory diaphragm

3. Which one <u>does not</u> affect sound velocity in water?

a. salinity b. streams c. temperature d. density

4. A bar checks in depths less than 30 m is used for ….

a. using weighted lines
b. comparison with direct measurement

c. calibration of echo sounders
d. the transducer at various depths

5. What best describes the meaning of “feasible”?

a. possible b. probable c. capable d. terrible

6. Which ropes are mostly used as weighted sound lines?

a. steel chain b. wire c. hemp d. nylon

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Buoy	b. Fathometer
c. Float gauge	d. Lead line
e. Line and grade	f. Rod float
g. Staff gauge	h. Sub-surface float
i. Tides	j. Tide gauge

1. This is designed to overcome the difficulty in reading a staff gauge when the intensity of tides is high, and the variations of water level is more.

2. This instrument measures vertical movements of tides.

3. A double float consists of a small float to which is attached a second float slightly heavier than water by a light and strong cord of adjustable length

4. Echo sounder

5. This is a graduated roap made of hemp or chain attached to the lead or sinker.

6. This is the simplest of tide gauge. It consists of a graduated board, 150 to 250 mm and 100 mm thick, fixed in a vertical position.

7. These are periodical variations in the level of surface of a large body of water like a sea or an ocean.

8. Horizontal and vertical position.

9. Wooden rods or hallow tubes of copper or brass of 3 to 5 cm diameter, 2 to 6 m long, and weighted at the bottom so that they float vertically with just a small length exposed above water.

10. This is a float made of light wood or hallow air tight vessel properly weighted at the bottom, anchored in a vertical position by means of guy wires.

Chapter 14: Remote Sensing

Remote Sensing platform and sensors

Remote sensing of the surface of the earth has a long history, dating from the use of balloons and pigeons in the Eighteenth and Nineteenth centuries, but in its modern connotation[1] remote sensing can be traced back[2] to the aircraft-mounted systems that were developed during the present century, initially[3] for military purposes. Airborne camera systems are still a very important source of remotely- sensed data. Space borne camera systems, already used in low- orbit satellites for military purposes, are presently under development for civilian[4] remote sensing. We restrict our attention to image data collected by multispectral sensor systems, defined by Slater (1985) as "… any optical system that scans the object or image surface electromechanically or electronically in more than one wavelength". Film cameras and non-imaging spectroradiometers are thereby excluded[5] from consideration. Multispectral sensor systems have been, and are presently, carried by aircraft and satellites, and by the re-useable, manned American Space Shuttle (officially the Space Transportation System or STS).

Imaging radar systems are not multispectral but return digital data. Comprehensive[6] accounts of the material can be found in Norwood and Lansing (1983), who review electro-optical imaging sensors, and Moore (1983), who describes imaging radar systems. Slater (1985) lists the characteristics of over fifty multispectral imaging instruments that have been used in environmental remote sensing over the past decade, from both aircraft and spacecraft, and gives details of systems currently[7] in the design or development stage. The Multispectral Scanner (MSS) and Thematic Mapper (TM) instruments carried on board the Landsat satellite series are covered in detail by Freden and Gordon (1983); see also Elachi (1983) for microwave and infrared satellite-borne sensors and Allison and Schanapf (1983) for meteorological satellite instrumentation. A full review of space remote-sensing systems is given by Chen (1985).

Spatial, spectral and radiometric resolutions are properties[8] of the remote sensing instruments themselves. An important property of the remote sensing system, of which the instrument is a part, is the temporal[9] resolutions of the system, that is, the time that elapses between successive[10] acquisitions of imagery. This may be measured in minutes if the satellite is effectively stationary with respect to a fixed point on the earth's surface (i.e. geostationary) or in days if the satellite is of the polar orbiting type. The Meteosat satellite is an example of a geostationary platform, whereas the TIROS/NOAA, Nimbus, Landsat and SPOT satellites are polar orbiters, each having a specific repeat cycle time (or temporal resolution).

Exercises:

A. Which of the underlined words best matches with the following synonyms?

a. at the beginning	b. coming one after the other
c. complete	d. find the origins
e. meaning	f. not include
g. not military	h. now
i. qualities	j. related to time

B. Read the passage and answer the questions.

1. At the beginning, remote sensing was used for ….

a. modern connotation b. military purposes

c. balloons d. aircrafts

2. Remote sensing is collecting data ….

a. electromechanically
b. electronically
c. electromechanically and electronically
d. electromechanically or electronically

3. Multispectral sensor system is not used in ….

a. imaging radars b. aircrafts
c. satellites d. space shuttles

4. Temporal resolution of the system depends on the time that … between acquisition of imagery.

a. elastics b. passes c. returns d. misses

5. In … satellite, it takes minutes to measure temporal resolution.

a. Nimbus b. SPOT c. Meteosat d. Landsat

C. Close

Read the following passage and choose the one word or phrase that best completes each blank.

Landsat

The Landsat 5 satellite is healthy, still delivering data according to EOSAT, USA. Thematic Mapper data is received at SSC Esrange but due to the winter season the …1… has temporarily ceased from November until March 1995. Fucino in Italy will however receive data continuously. Swedish users can …2… data from SSC Satellite in Kiruna.

As reported earlier in this department the loss of Landsat 6 in 1993 has caused a …3… of the Landsat program. The Landsat 7 is to be launched as earlier planned in 1998 with the 15 m panchromatic band as an important new feature. In May 1994 the Landsat Remote Sensing Strategy was signed by the US President committing the US Government to …4… the continued operation of Landsat 4 and 5 and to build Landsat 7. …5…, the revised Landsat 7 data policy implies that data costs will be higher than the earlier intented which corresponded only to the dissemination costs.

1.	a. receive	b. receipt	c. reception	d. receptionist
2.	a. order	b. design	c. draw	d. stop
3.	a. restructure	b. restructuring	c. restructured	d. to restructure
4.	a. sure	b. ensure	c. surely	d. sured
5.	a. But	b. Still	c. However	d. Although

D. Read the passage and answer the questions.

A Brief Discussion

To evaluate the suitability of imagery for photogrammetric mapping, three criteria must be considered:

(i) the planimetric accuracy achievable;
(ii) the elevation accuracy achievable;
(iii) the detectability of objects from the imagery.

Considering planimetric accuracy requirements of $\pm 0.3m$ at the publishing scale of the maps, results in $\pm 7.5m$ for$1:25,000$; $\pm 15m$ for $1:50,000$; and $\pm 0.3m$ for $1:100,000$.

According to map accuracy standards, the point measurement accuracy in elevation should be 1/5 of the contour interval, which depends on the terrain. It means $\pm 2m$ point accuracy in height for flat areas (10m contour interval); $\pm 4m$ in the case of intermediate areas (20m contour interval); and $\pm 10m$ detect ability requirement depend on the nature of the objects to be shown in the map. Consider the scale factor equal to 2 or 3 results in requirements of 2m pixel size for urban buildings; 5m pixel size for the minor road network and fine hydrological features; and 10m pixel size for the major roads and building blocks.

To accomplish $1:25{,}000$ and $1:50{,}000$ scale maps using imagery taken by linear arrays, they should provide $\pm 7.5m$ to $\pm 15m$ positional accuracy, $\pm 3m$ to $\pm 5m$ for elevation accuracy, and 2 to 5m for object detectability.

Although the French SPOT system can provide enough positional geometric accuracy for the compilation of $1:50{,}000$ scale maps, its elevation accuracy is marginal and it cannot provide good enough detectability for $1:50{,}000$ and $1:25{,}000$ scale maps.

The Japanese OPS system cannot really meet the requirements for medium scale map compilation. That is because it cannot provide a good elevation accuracy (due to its poor base-to-height ratio (0.3)) and its poor object detectability of nearly 50m.

The Indian satellite IRS-1C has almost the same geometry of SPOT images and can provide enough planimetric accuracy for $1:50{,}000$ maps. But again the problem begins in the detectability of the objects on the ground and in the possible elevation accuracy.

The German MOMS-02 linear array system may be able to provide the required planimetric and altimetric accuracy for the $1:50{,}000$ map scale. Considering the three linear arrays together (forward, nadir, backward) this will give a detectability of 10m to 12m, because of 4.5m ground pixel size for the nadir image. This gives enough accuracy for $1:50{,}000$ scale maps where urban buildings and footpaths are not necessary. But, in this case, the swath width of the area covered by the MOMS-02 stereo image will decrease from 78kg (considering forward and backward) to 37km (considering forward and backward).

Although, for the compilation of medium scale line maps most of the available pushbroom scanners do not provide sufficient resolution, but it is worth mentioning that their powerful capability for digital photogrammetric productions such as DTMs and orthoimages over large areas must not be forgotten.

The forthcoming American systems will provide enough geometric accuracy as well as enough detectability for 1:50,000 and 1:25,000 map scales. Because of their flexibility, they should also able to provide stereo images of the area requested by the users at any time.

1. Which one is not a criterion for evaluating the suitability?

a. planimetric accuracy b. detectability of objects
c. elevation accuracy d. imagery of photogrammetric

2. Accuracy in elevation depends on ….

a. flat areas b. terrain
c. mountain regions d. intermediate areas

3. … depends on the nature of the objects in the map.

a. Planimetric accuracy b. Accuracy in elevation
c. Detectability d. Suitability

4. All satellite have problem in detectability and ….

a. planimetric accuracy b. elevation accuracy
c. geometric accuracy d. photogrammetric mapping

5. In future, … of the area will be provided by the future systems.

a. stereo images b. flexibility
c. productions d. footpaths

ONLY FOR STUDENTS

Find the correct meaning of the given sentences for following words.

a. Band
b. Clustering
c. Classification
d. Digital Elevation Model (DEM)
e. Edge Enhancement
f. False Color Composite
g. Image enhancement
h. Majority Filter
i. NDVI (Normalized Difference Vegetation Index)
j. Thematic Mapper (TM)

1. It is a grouping of data with similar characteristics. The similarity of a cluster is evaluated using a distance measure. This method dose not need any known pixels and only needs the number of the clusters.

2. For each group of pixels considered in the input map (image), a majority filter assign the predominant (i.e. mostly frequently occurring) value or class name of these to the center pixel in the output map (image).

3. It in conventional definition is a decision making process in which one places the original image ordinal value (or image derived data) in nominal classes. Classes are themes so the resulting image is a thematic map. In fact a classification procedure is a function that maps the pixel values into pixel labels.

4. It can be defined as conversion of the image quality to a better and more understandable level for feature extraction or image interpretation, while radiometric correction is to reconstruct the physically calibrated value from the observed data. These processes can be considered as conversion of the image data. Image enhancement is applied mainly for image interpretation in the form of an image output.

5. Values are a measure for the presence and condition of green vegetation. NDVI values are calculated from two satellite bands; one band containing visible or red reflectance values, the other band near-infrared reflectance values.

6. It is a regular grid of the height spots with the known planimetric and elevation coordinate in a specific coordinate system.

7. It is one of the optical mechanical sensors of the LANDSAT satellites. TM records seven bands of data from the visible through the thermal IR regions.

8. Image-processing technique that emphasizes the appearance of edges and lines.

9. It can refer to either a narrow spectral channel selected out of the electromagnetic spectrum, or to a larger portion of the spectrum.

10. In remote sensing multi-band images are not always divided in to the same spectral regions as the three primaries color filters. In addition invisible regions, such as infrared, are often used, which are required to be displayed in color. As a color composite with an infrared band is no longer natural color and is called a false color composite.

Chapter 15: *M.S.c. entrance exams (80-87)*

Test 80

Text A:

The GPS provides the surveyor, engineer and planner with timely and accurate positional, timing and velocity information on worldwide basis and in all weather condition.
It has a tremendous potential as a means of upgrading and densifying the national control network.
Although the acquisition of data is simple and existing softwares sophisticated and surveyor should have a comprehensive background of the system to obtain consistent and accurate results.

According to above text, answer to 4 following questions.

1. Replace the underlined word "timely" by the most suitable:

a. correctly b. timelessly
c. accurately d. on the right time

2. Replace the doubly underlined word consistent by the most incorrect expression:

a. stable b. accurate
c. not easily changing d. acting in the same way

Fill the blank in the following sentence with the most suitable expression.

3. The GPS system has a drastic … as a means of upgrading and densifying the national network.

a. effect b. mission
c. capability d. characteristics

4. Choose the correct statement:

    a. GPS is a tool, only for positioning.
    b. The use of GPS is limited by many natural and physical factors.
    c. GPS is a potential tool for upgrading and densifying national network.
    d. Data acquisition and data processing by GPS, both are straight forward and everybody can obtain consistent and accurate result.

Text B:

a. the earth's mean-sea-level, called Geoid extends under the land masses and is mean equilibrium level to which water rise in a transcontinental canal.

b. The geoid does not follow the ellipsoid exactly, but undulates from it by as many as 100 m. For this reason the earth's mean-sea-level shape has been referred to as lumpy potato. Additionally, there is an identified bulge in geoid of 10 to 15 m in the southern hemisphere, giving rise to the earth described as pear shaped, on the other hand, despite mountains and ocean trenches, the earth is nearly spherical and by comparison is smoother than orange.

According to above text, answer to 2 following questions.

5. Identify the true statement in according with the above text:

   a. The geoid follows the ellipsoid in a deviation limit of 10 m.
   b. Geoid is rather a physical surface than a geometrical one.
   c. Geoid surface extension, under the land masses follows a transcontinental canal.
   d. Geoid is described as pear-shaped, because its rotational axis is shorter than equatorial axis.

6. Paragraph (a) would rather explain:

   a. a transcontinental canal
   b. the mean-sea-level surface
   c. mean equilibrium of sea level surface
   d. the extension of geoid under the land masses

Text C:

Imaging sensors are classified into passive and active. Passive sensor systems rely on sun energy reflected emitted from the scene and active system generate their own energy source, send it to scene record the returned signal.
A good example of a active sensor system are rather for the earth image and sonar for imaging under water.
Radar imaging system employs long wave length energy.

In accordance with the above text, answer the following questions (2 questions).

7. The following is correct:

    a. The sun is a passive sensor.
    b. Sonar is a type of sensor for imaging earth surface.
    c. Active and passive sensors record reflected or returned energy.
    d. Radar is an example of active sensor and sonar an example of passive one.

8. The correct statement is:

    a. A passive sensor don't rely and its own energy.
    b. A passive senor has its own energy source.
    c. Radar is a sensor for imaging under water and the earth surface.
    d. Radar employs optical wave length, hence it can petrate hindering particles.

Fill the blank in:

9. Establishment of horizontal and vertical control is required for planning, … and execution of the proposed route.

a. design b. locating c. performing d. setting out

10. Rectification is the procedure by which tilt displacements are removed. Replace the underlined word by the most suitable expression.

a. adjusted b. estimated c. evaluated d. eliminated

TEST 81

Read the passage then answer the question:

Passage I

The as-built survey is performed on completion of a construction project for the purpose of reestablishing the principal horizontal and vertical controlling points and to locate the positions of all structures and improvements. As-built surveys should be performed after the construction of highways, railroads, airports, bridges, buildings (including private homes), dams, and underground facilities.

Essentially, the as-built survey consists of rerunning center lines or property lines, setting permanent monuments at controlling points, and locating all improvements relative to those lines. These data are plotted on a map to provide a permanent record or inventory of the work done and its precise location.

Static and kinematics GPS surveys, total station systems, and photogrammetric surveys can be used to advantage in the establishment of controlling points and the acquisition of data that define the as-built facilities. These system permit acquisition of data in data collectors and on film or as digitized images for transfer to GIS that provides the ideal tool for subsequent reduction, processing, retrieval, review, and automatic plotting of the final map, which can be a digital map or the standard line map on paper.

Vehicle-mounted systems that combine GPS, inertial surveying system (INS), and photogrammetric sensors (solid-state CCD cameras) into one integrated system are now under development (Li, 1994). This type of system, which yields real-time positions and an electronic file of locations of all objects visible as the vehicle travels along a route, has potential for as-built surveys, especially along highways and railroads. Final output would consist of a digital or line map.

1. As-built surveying is performed for ….

   a. rerunning a survey line
   b. completion of a waste survey work
   c. completion of an engineering project
   d. controlling and evaluation of an executed engineering project

2. A data collector is ….

a. a mapping system   b. a type of field book
c. an integrated system   d. a geodetic instrument

3. Which of the choices <u>is not</u> a synonym of "data collection"?

a. data capturing   b. data reduction
c. data gathering   d. data acquisition

4. The map produced by an "as-built survey data" <u>is not</u> ….

   a. an inventory of the executed project
   b. a record of the project work executed
   c. a conformation of the project design
   d. a record of the precise location of the executed works

5. The correct statement is ….

   a. final output of an integrated system is a line map
   b. an integrated system has potentiality for as-built survey

c. a complete integrated system for as-built surveying is now under development
d. a complete integrated system is currently used for as-built purposes.

Passage II: Geodesy of the Modern Era

The mid-twentieth century saw the dawning of technological revolution. Prompted weapons and defense requirement during the Second World War, the invention of a ‘radio detection and ranging’ system commonly known as radar, has had a deep effect on the philosophy behind geodetic instruments. At about the same time, the first practical electronic computers appeared, opening up horizons for numerical mathematical unimaginable in the past. The introduction of computers not only sped up geodetic computations but revolutionized the thinking of geodesists: solution to tasks, previously out of the question because of the sheer volume of the calculations involved, became not only feasible but even easy.

For centuries, horizontal angles, measurable to much higher accuracy with intrinsic ease, had been preferred to distances. Shortly after the war, sufficiently accurate electromagnetic distance measuring devices became commercially available for geodetic uses. These instruments, first using polarized light then radio waves and finally lasers, eventually changed the pattern of geodetic positioning.

The forerunner to the turbulent development of extraterrestrial methods was the first experiment in radio-astronomy that culminated in the discovery of pulsars and quasars. These new distant radio-objects emit signals with high stability in frequency and are now being used in the fast developing techniques of radio-interferometry.

The launching of the first artificial satellites was another giant leap for geodesy. For the first time geodesists could use extraterrestrial objects, passive or active, positioning of points the inter-visibility between which was no longer a constraint.

The low attitude of the satellites offered the opportunity of studying the geometry of the earth's gravity field by means of direct observations of satellite response (motion) to the field. Satellites also brought about new projects for geodesy: the mapping of the gravity field above the earth to predict satellite, orbits. Once again, the major customers for this kind of information for the military who needed to know the gravity field geometry for computing missile trajectories.

The increased ease and accuracy with which geodesists could determine positions, as well as the gravity field parameters, led to new applications, but also the new problems. Suddenly, effects that had always been considered negligible started showing up, the 'noise these effects caused had to be accounted for. "One man's noise being the other man's signal …", other disciplines became interested in geodetic techniques, as well as results, study the phenomena relating to their own fields. Prime examples of symbiotic relations are those of geodesy with geophysics, space science, astronomy, and oceanography. The relation with geophysics has been particularly fruitful because of another fact: in the late 1960's the hypothesis of plate tectonics finally gained almost universal acceptance. In some parts of the world, the rate of relative tectonic movement is so fast that it is directly measurable by geodetic means. Geodesy, therefore, became the main supplier of geometrical information on this movement. This successful deployment of geodesy in tectonic investigations has led to further applications of geodetic techniques in other branches of geodynamics.

6. The technological revolution ….

   a. original early 1950's
   b. started early twentieth century
   c. ended by mid-twentieth century
   d. none of the above

7. The Electromagnetic Distance Measuring (EDM) instruments are based on the principle of ….

    a. radars
    b. velocity of light
    c. radio detection and ranging instruments
    d. all of the above

8. Invention of the electronic computers ….

    a. made the calculations easy
    b. revolutionized the geodesists
    c. sped up geodetic measurements
    d. opened up horizons for numerical mathematics

9. The change in the pattern of the geodetic positioning is due to the ….

    a. accurate horizontal angle measurements
    b. polarized light and radio waves
    c. accurate EDM instruments
    d. all of above

10. Using extraterrestrial objects in geodetic positioning requires ….

    a. no inter-visibility between the geodetic points
    b. inter-visibility between the geodetic points
    c. passive but active objects
    d. only active objects

TEST 82

Read the two following texts and answer the corresponding questions:

Since various kinds of extraterrestrial measurements- such as astronomical (both optical and radio), satellite and lunar- play a major role in geodesy, it is necessary to develop some understanding of how the earth moves among other celestial bodies. It is known that the earth undergoes the following kinds of motions simultaneously:

(a) It moves with our galaxy in respect to other galaxies.
(b) It circulates with the solar system within our galaxy.
(c) It revolves around the sun, together with other planets.
(d) It rotates (spins) around its instantaneous axis of rotation.

Of these motions, the first two are of importance to astronomers studying galactic and intergalactic phenomena. When dealing only with the earth, we generally do not have to worry about them because most of the celestial objects used for our observations are well within our galaxy. Thus our concentration will be on the last two motions- the annual (around the sun), and the diurnal (around the earth's axis of spin).

Interestingly, two radically different physical concepts are used to describe the annual and diurnal motions. The annual motion can be adequately explained using celestial mechanics; i.e., by regarding the earth and other celestial bodies as 'point masses', or particles without dimensions. To explain the diurnal motion with its side effects of precession and nutation, the earth has to be regarded as a massive body or as a gyroscope. These two dynamic models of the earth are treated in the first two sections of this chapter.

In the last two sections, polar motion, a complication that stems from the earth's diurnal spin, is introduced. This particular motion has profound implications in geodesy. To adequately explain the motion, the model of the earth has to be further refined by taking into account its rheology (behavior under stress), atmosphere, oceans, etc.

In describing the earth's spin, the earth's dimensions can no longer be neglected. In the next dynamically simplest model, the earth is taken as a rigid body which, while traveling around the sun, spins around an axis passing through the body. In mechanics, such a body is referred to as a gyroscope.

When there is an external torque exerted on the spinning gyroscope, the spin axis of the gyroscope describes a circular cone with its vertex located at the centre of mass of the gyroscope. This motion is known as precession, In the case of the earth, it is the attraction of celestial bodies that supplies the torque; the situation for the sun is depicted in FIG. 2. It is clear that the hemisphere closer to the sun is attracted more than the one farther away. To obtain the torque as shown, i.e., the torque with respect to C, the reference point for describing precession, we must first subtract the force acting at C from both of these hemispheral forces.

The gravitational attraction between two bodies is thought to propagate along a straight line with a velocity comparable to the velocity of light. For our purposes, it is adequate to regard the velocity as infinite and thus view the gravitation as having an instantaneous effect at any distance we wish to consider. This is the assumption adopted in classical mechanics.

The centrifugal force is subject to variations in time in both direction and magnitude. Changes in the magnitude of the spin velocity induce changes in the magnitude of the force; changes in the direction of the spin axis produce changes in the direction of the force. These changes, as seen in $\oint 5.3$, are very small and can be safely neglected here.

1. There are two motions (out of four) of the earth which are important to geodesy, since

    a. the earth revolves around the sun

b. the earth is a part of solar system
c. they are also important to astronomers
d. the most of celestial bodies used in geodesy are within our galaxy

2. There are two dynamic models used for studying the earth's motions, since

a. there are two motions important to geodesy.
b. the models describe two slightly different physical concepts.
c. the diurnal motion is a side effect of the precession and nutation.
d. the earth should be regarded as point mass or massive body depending on the type of the motion.

3. The precession is a gyroscopic motion of the earth. It is

a. caused by the sun.
b. a result of polar motion.
c. due to the attraction of celestial bodies around the earth.
d. all of the above.

4. The propagation of gravitational attraction between two bodies is

a. comparable with the distance between the two bodies.
b. assumed instantaneous for our purposes.
c. thought to be in the speed of light.
d. instantaneous.

5. The time variation of centrifugal force

a. happens to its direction and magnitude

b. is just due to the change in the spin velocity of the earth
c. changes the gravitational force of the earth
d. all of the above

The World Wide Web (WWW) is the most recent medium to present and disseminate geospatial data. In this process the map plays a key role and has multiple functions. Map can play the traditional role of providing insight into geospatial patterns and relations. Therefore maps are used in the forms of, for instance, atlas to present locations of the latest earthquakes. Because of the nature of the WWW as a multimedia, map can function as an interface or index to additional information for instance it can be linked to photographs, texts or maps. This allows users to understand the content and coverage of a particular data set, while most cartographic knowledge available before the advent of WWW, are still valid. Here, as an interesting example of this new feature we would consider 'web maps about road traffic'.

Traffic is a very broad concept which encompasses many types such as railway traffic, telephone traffic, etc., among which we focus on vehicles traffic. Vehicles traffic concept includes the connections between locations, distances and traveling time. It is clear that road traffic is extremely dynamic and information on jams and closures changes every hour. This information could be mapped with 'conventional' methods, but the distribution of this kind of data before being outdated can be done by the exploitation of internet.

6. The traditional role of a map is ….

a. to determine the boundaries
b. to record the terrain configuration
c. to present topographic features of ground

   d. to provide insight into geospatial patterns and relations

7. A map ….

   a. may play an interface role in WWW
   b. is a multimedia information source
   c. is not very rich as information source
   d. can not function as an index for additional information in WWW

8. The advent of web cartography has caused an evolution in map ….

a. dissemination b. generalization
c. production d. edition

9. Road traffic is extremely dynamic and a great deal of information may be … even in any hour.

a. presented b. outdated c. repeated d. corrected

10. By the exploitation of internet, the map information distribution can … considerably.

a. speed up b. be changed
c. be still valid d. be corrected

TEST 83

The presence of the moon makes the study of the earth's kinematics more engaging. The first important fact is that the moon orbits the earth on a plane that is included with respect to the ecliptical plane by 5° 11'. The intersection of the lunar orbital plane with the earth's ecliptical plane, known as the nodal line, rotates once every 18.6 years.

1. The paragraph says:

   a. The important fact is that the moon's orbit is a plane.
   b. The nodal line is known to intersect the ecliptical plane.
   c. The inclination of the moon's orbit with respect to the ecliptic is 5° 11'.
   d. There is an engagement between the presence of the moon and the earth's kinematics.

Mechanics is required to understand the motions of the Earth and its satellites. Two dynamical concepts are used in this context: the motion of a physical particle in a potential field (central as well as perturbed), and the rotation of a deformable body. Thus both the Keplerian and the perturbation theories are needed together with the Liouville theory of a deformable gyroscope.

2. The paragraph says:

   a. Mechanics does require the understanding of motions of Earth.

b. The Keplerian perturbation theory is needed for studying a deformable gyroscope.
c. Liouville theory of a deformable gyroscope is needed to understand the motions of the Earth.
d. The motions of a physical particle in the central and perturbed fields are the two dynamical concepts.

It has been seen that there is a definite relation between the equipotential surfaces and the direction of gravity-they are mutually perpendicular. The question often asked is: what is the relation between the equipotential surfaces and the magnitude of gravity? It is the spacing of the equipotential surfaces that is directly related to the magnitude of gravity.

3. The paragraph says:

   a. The equipotential surfaces are mutually perpendicular.
   b. The direction of gravity is related to the magnitude of gravity.
   c. The distance between equipotential surfaces is related to the magnitude of gravity.
   d. The relation between the equipotential surfaces and magnitude of gravity is not known.

Considerable vertical movements, on the edge of the continental plate, have been reported by TSUBOI [1933] ranging up to several decimeters in the course of a few decades. The two kinds of such movements are pre-seismic and co-seismic. A collision of two continental plates is the main (orogenic) mountain building process. Since neither of the plates can under-thrust the other because of their buoyancy, the collision results in enormous buckling.

4. The paragraph says:

    a. Mountain building makes the collision of continental plates.
    b. Vertical movements are ranging up to several decimeters in the course of a few decades.
    c. The collision results in enormous buckling, since one plate under-thrust the other.
    d. According to TSUBOI [1933], vertical movements seldom occur on the edge of continental plates.

Digital photogrammetry is a new form of photogrammetry, based on digital images (soft copy), as distinct form conventional one, based on film images (hard copy) and it should not be confused with digital mapping, which is a generic term, encompassing computer-assisted photogrammetric restitution and data compilation process. Digital mapping itself is also distinct form the conventional photogrammetric process of producing a pencil map manuscript with a mechanical plotting table.

A digital photogrammetric system, considered as the third generation photogrammetric instruments (after analytical as the second and analogue as the first generation stereo plotters) is quite different from conventional ones, although the design of a digital system also is based on well published and proven analytical photogrammetric algorithms.

Unlike conventional analytical plotters, digital systems have no optical or mechanical sub-systems and the solution is affected entirely by computer manipulation of digital imagery and although computer technology is common enough today, to be well understood, but digital imaging technology itself has generated a new body myth of that needs to be dispelled.

A digital system is a computer with appropriate peripheral devices attached and other than the fast, large capacity hard disk drive required to accommodate large image, there is little to distinguish such a computer from an ordinary home PC.

For a digital system to function, the analog photographic image must first be converted into a “digital image file”; a photographic image is composed of silver grains of variable size, shape and spacing but with a fixed brightness value in the medium of polyester film.

A scanner which is essentially a precisely guided CCD camera converts light transmitted through the photographic image into picture elements (pixels) of fixed size, shape and spacing but having variable brightness values (from white to black, or 8-bit, 0 to 255) and these values are registered in a digital file.

Essentially a digital file is a binary, pixel-by-pixel listing of the variable brightness values, in regular rows and columns with a file header that describes the data configuration.

5. Analytical photogrammetry algorithms are “…”.

   a. Well known
   b. Mostly unsolved
   c. Very difficult to understand
   d. The same as analog ones

6. A scanner may be considered as:

a. A reader
b. A type of printer
c. A type of CCD camera
d. A special type of copier

7. Digital mapping is a term describing:

   a. A special type of cartography
   b. The process of producing a map manuscript
   c. The global process of photogrammetric plotting
   d. A computer assisted photogrammetric restitution and data processing process.

8. Complete the sentence: “A scanner …” with the correct answer.

    a. Converts digital images to digital files
    b. Prepares the list of photo-point x, y coordinate
    c. Changes the photographic silver image in to digital codes
    d. Converts the light transmitted through the picture into brightness values

9. The header of a digital file describes the configuration of the:

a. Data	b. Pixels
c. x and y data	d. image coordinates

10. Digital file consists of:

    a. The stored brightness values of pixels in a file
    b. A numerical list of points coordinates
    c. The data configuration file
    d. A configuration list of the pixels

TEST 84

Read the following passage and among the multiple choices, select the word that can replace the marked word without changing the meaning of the sentence.

Passage I:

For many years, the gravity field of the Earth was only seen by satellite geodesy as the main factor affecting[1] the orbit and consequently it was retrieved[2] together with a number of other orbital perturbations. Since the advent[3] of a new generation of accelerometers, non-gravitational perturbations can be separated from gravity effects and a new era[4] of gravity field estimates from space has been born. During preparatory[5] data analysis for new missions performed by the geodetic community[6], three approaches have been proposed and numerically tested: the brute[7] force method (direct approach), the semi-analytical (time-wise) method and the space-wise method. In particular[8], the time-wise method takes advantage of the incoming time flow of data and, after performing[9], a Fourier transform of the observation equations, exploits[10] the prevailing[11] block diagonal structure of the normal equations to estimate the spherical harmonic coefficients of the gravity field. Complementary[12] to this is the space-wise approach[13] which goes back to the traditional[14] computation of the harmonic coefficients by an integration technique or by least-squares collocation. Some advantages and disadvantages are peculiar[15] to both methods, particularly the space-wise approach, which has for a long time ignored the marked[16] signature of noise spectrum due of the specific measuring conditions of space-borne accelerometers.

1	a. shaping	b. influencing	c. assuming	d. involving
2	a. regained	b. loosed	c. rescued	d. recovered
3	a. begin	b. coming	c. departure	d. going away

4	a. age	b. count	c. epoch	d. occasion
5	a. final	b. opening	c. preliminary	d. foundation
6	a. culture	b. society	c. ethnicity	d. civilization
7	a. huge	b. coarse	c. instinct	d. enormous
8	a. pick	b. difficultly	c. specifically	d. demandingly
9	a. behaving	b. calculating	c. carrying out	d. making drama
10	a. reveals	b. expands	c. develops	d. increases
11	a. failing	b. beating	c. overcoming	d. dominating
12	a. contrary	b. adding	c. opposite	d. matching
13	a. method	b. calculation	c. estimation	d. approximation
14	a. regular	b. average	c. ordinary	d. customary
15	a. unstill	b. uneasy	c. specific	d. unusual
16	a. ranked	b. scored	c. graded	d. noticed

Read the following passage and find the correct answer to the following questions.

Passage II:

Camera calibration has always been a topic of great interest on the filed of photogrammetry and machine vision and many methods and cameras models have been proposed. In this work we consider cameras which are rotating and changing their interior parameters. This is the case of image streams acquired with a camera mounted on a tripod or rotated on the shoulder of a camera-man or like or like pan-tilt zooming surveillance cameras, panoramic acquisition with a single camera or sports events videos. Usually the problem is formulated within a projective framework because of the absence of camera and object information. In fact, when existing videos are analyzed, it is very difficult to recover accurate 3D scene information and the camera parameters, mainly because of (1) low image quality (interlaced video), (2) almost no information concerning the camera, (3) often absence of baseline and (4) possible variations of internal parameters.

In the vision community many algorithms have been presented to calibrate image sequences acquired with a stationary but freely rotating camera. Some authors rely on the homography (8-parameters transformation) between the images and they retrieve the camera parameters with linear or iterative methods. Usually changes of the internal parameters (mainly zooming) are also allowed but they often assume zero-skew or known pixel aspect ratio without a statistical check on the determinability of the parameters. In the photogrammetric community, camera calibration by rotation (often called "single station calibration") has been investigated by many authors.

17. What is the main idea of the text?

    a. Cameras used on vision community
    b. Cameras calibration and its importance in photogrammetry
    c. Elements of rotating cameras with fixed interior orientation
    d. Calibration of rotating cameras with changing internal orientation elements

18. The word "stationary" in the second paragraph means:

a. Fixed	b. Flexible
c. Rotating	d. Changing location

19. The technique presented in the text can be used with

a. Fixed cameras	b. Spinning cameras
c. Multiple cameras	d. Cameras of any kind

20. Based on the text, to calibrate a camera when its elements are not know and no three dimensional information about the scene exists:

a. Work within a projective framework
b. Use the projection of points onto the image space
c. We have to use several control points of enough accuracy
d. Take into account possible variations of internal or orientation parameters

TEST 85

1. In planning a GPS network observation one should take this fact into account that not all the stations will be accessible. Here “take into account” means ….

a. plan b. decide c. neglect d. consider

2. In surveying, simulation is an intuitively simple way of getting the uncertainty message across. Here “intuitively” means ….

   a. understanding by feeling
   b. understanding by consideration
   c. poor way of doing something
   d. one and only one way of doing something

3. The main surveying software vendors have created product families to meet the needs of a diverse user community. Here “vendors” refers to ….

a. users b. sellers
c. surveyors d. software engineers

4. A useful rule of thumb is that any feature on a map has an accuracy of 0.5 mm. Here “rule of thumb” means ….

   a. physical lemma
   b. mathematical rule
   c. rule based on thumb
   d. practical way of doing something

5. A database management system is responsible for backing-up and documenting every transaction. Here "transaction" refers to ….

a. file b. data c. process d. software

Reading Comprehension

Direction: Read the following two passages and answer the questions by choosing the best choice among (a),(b),(c), or (d).Then mark the correct choice on your answer sheet.

Passage one:

A geo-spatial Information system (GIS) is a computer-based set of tools for collecting, editing, storing, integrating analyzing and displaying spatially referenced data. There is a difference between primary data collection, such as that generated from field measurements or satellites, and secondary data collection, where hard copy maps are digitized. For secondary data collection there are essentially two methods, i.e., vector digitizing and raster scanning. Vector digitizing captures a point object as a pair of (x,y), while a line (such as a road, river or area boundary) is captured and represented in computer memory as an ordered string of such coordinates. Such coordinates are obtained by placing the hard copy maps on a digitizing table or tracing particular features using a cursor. How many points one uses to represent a complex line is a matter of judgment. Clearly, the fewer the points the cruder the line representation, but the more points are digitized the greater the storage requirement. When digitizing a real units such as soil polygons or administrative boundaries, it is necessary to digitize a common boundary only once and then record with it the labels of the zones to the left and right. The software that is used in conjunction with the digitizing uses such topological information to reconstruct the map. Because of the resolution of the digitizing table, lines that are supposed to meet at particular junctions will rarely do exactly. Again, built in to the software are facilities for snapping together points or nodes that should indeed meet. Often features are usually also incorporated, such as those for the identification and removal of sliver polygons, i.e. areas where two lines that should be coincident are very slightly displaced.

6. GIS is used for … spatially referenced data.

a. judging b. digitizing c. rendering d. vectorizing

7. Raster scanning is a ….

   a. secondary data collection method
   b. primary data collection method
   c. digitizing process through a digitizer
   d. hard copy map on a digitizing table

8. Ordered sets of coordinates are used to ….

   a. collect point objects
   b. capture line features
   c. represent computer memory
   d. place the hard copies on digitizing table

9. Number of points needed digitizing a line ….

   a. is difficult to judge
   b. is decided by the operator
   c. should be as few as possible
   d. depends on the available storage

10. A cursor is used to ….

   a. follow a specific feature

b. place the hard copy maps on digitizing table
c. judge how many points one should use to represent a complex line
d. table the zones to the left and right of the boundaries

11. Topological information is ….

a. the zone labels of the left and right polygons
b. a software which digitizes the common boundary only once
c. digitized a real units used in conjunction with the software
d. soil polygons or administrative boundaries which are digitized only once

12. The digitized lines which should meet at a specific point are … connected because of digitizing table resolution.

a. never b. always c. seldom d. usually

13. Snap is a software facility in GIS to ….

a. reconstruct the hard copy maps
b. incorporate the feature identifications
c. connect the disconnected junctions
d. decide on the resolution of the digitizing table

14. Sliver polygons are ….

a. polygons incorporated identifications
b. polygons created by slightly displaced lines
c. polygon features created by GIS software
d. polygons created by snapped points or nodes

Passage two:

The broadcast ephemeredes are based on observations at the monitor stations of the GPS control segment. The most recent of these data are used to compute a reference orbit for satellites. Additional tracking data are entered into a Kalman filter and the improved orbits are used for extrapolation. The Master Control Station is responsible for the computation of the ephemeredes and the upload to the satellites. The broadcast ephemeredes are part of the satellite message. Essentially, the ephemeredes contain record with general information, records with orbital information, and records with information on the satellite clock. The parameters in the block of orbital information are the reference epoch, six parameters to describe a Kepler ellipse at the reference epoch, three secular correction terms and six periodic correction terms. The correction terms consider perturbation effects due to the nonsphericity of the earth, the direct tidal effect, and the solar radiation pressure. The ephemeredes are broadcast every four hour and should only be used during the prescribed period of approximately four hours to which they refer.

15. The broadcast ephemeredes are computed by ….

   a. the monitor stations
   b. the master control station
   c. the GPS control segment
   d. the reference orbit for the satellites

16. A Kalman filter is used to ….

   a. extrapolate the orbit
   b. broadcast the ephemeredes
   c. observe the improved orbits
   d. integrate additional tracking

17. The satellite message ….

    a. is an extrapolation of the improved orbit
    b. is uploaded to the master control station
    c. has three different blocks of information
    d. contains different data including the broadcast ephemeredes

18. The orbital information records contain … parameters.

a. six b. nine c. sixteen d. three

19. The broadcast ephemeredes are computed ….

    a. every 240 minutes
    b. using six different correction terms
    c. through an interpolation process
    d. an a daily bases at the master control station

20. It is advised to use the broadcast ephemeredes ….

    a. along with the perturbated effects
    b. with the block of orbital information
    c. together with satellite clock information
    d. for only four hours after they are updated

Test 86

Reading Comprehension
Directions: Read the following two passages and choose the best choice (a), (b), (c) or (d). Then make it on your answer sheet.

In the broadest sense, remote sensing is the measurement or acquisition of information of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object. In practice, remote sensing is the utilization at a distance (as from aircraft, spacecraft, satellite, or ship) of any device for gathering information about the environment. Thus an aircraft taking photographs, earth observation and weather satellites, monitoring of a fetus in the womb via ultrasound, and space probes are all examples of remote sensing. In modern usage, the term generally refers to techniques involving the use of instruments aboard aircraft and spacecraft, and is distinct from other imaging- related fields such as medical imaging or photogrammetry. While all astronomy could be considered remote sensing (in fact, extremely remote sensing) the term "remote sensing" is normally only applied to terrestrial and weather observation.

1. Practically, remote sensing is acquisition of information about ….

   a. weather
   b. environment
   c. fetus in the womb
   d. any object or phenomenon

2. Remote sensing ….

   a. involves only weather observations
   b. can be considered as a kind of astronomy

c. normally deals with terrestrial measurements
d. is very similar to medical imaging and photogrammetry

3. Remote sensing involves ….

a. a media to broadcast the signals
b. the process of extraction of information
c. a phenomenon as well as a recording device
d. intimate contact between sensors and the phenomenon

4. Which one of the followings is the main difference between remote sensing and the other imaging fields?

a. The sensor
b. The platform
c. The technique
d. The recording device

5. "The utilization at a distance of any device" means:

a. Any device is used at a distance
b. Any device is at a distance of utility
c. The utility is at a distance of any device
d. There is a distance between utility and any device

Map overlay is the combination of two separate spatial datasets (points, lines or polygons) to create a new output vector dataset. These overlays are similar to mathematical Venn diagram overlays. A union overlay combines the spatial features and attributes tables of both inputs into a single new output. An intersect overlay defines the area where both inputs overlap and retains a set of attribute fields for each. A symmetric difference overlay defines an output area that includes the total area of both inputs except for the overlapping area. Data extraction is a GIS process similar to vector overlay, though it can be used in either vector or raster data analysis. Rather than combining the properties and features of both databases, data extraction involves using a "clip" or "mask" to extract the features and features of one dataset that fall within the spatial extent of another dataset.

6. Map overlay ….

   a. is specific to spatial datasets
   b. creates just new vector dataset
   c. is comparable to Venn diagram overlay
   d. consists of combination of just two separate spatial datasets

7. Which one of the following sentences is correct?

   a. Union overlay is the combination of spatial features and attribute tables
   b. Symmetric difference overlay defines an area that includes the total area
   c. Symmetric difference overlay is the union overlay minus intersect overlay
   d. Intersect overlay defines new sets of attribute tables which didn't exist before

8. Which one of the following sentences is correct?

   a. Venn diagram is same as map overlay
   b. Map overlay is a vector overlay process
   c. Map overlay explains the mathematics of Venn diagram
   d. Points, lines and polygons are all mixed together in a map overlay process

9. Data extraction ….

a. is a vector overlay process
b. combines properties of datasets
c. involves combination of dataset features
d. can be applied to both vector and raster data

10. Which one of the following sentences is correct?

a. Spatial extend of one dataset masks the data extraction process
b. Data extraction involves both combination and masking of datasets
c. GIS extracts dataset which falls within the spatial extend of another one
d. Data extraction process does not combine the properties/features of datasets

11. Raw phase and pseudorange measurements obtained with the Global Positioning System (GPS) can be <u>regarded</u> as biased ranges between the transmitter and the receiver.

a. used b. obtained c. measured d. considered

12. The mapping of random measurement errors through geometric configuration into the positioning solution has been well studied, and the <u>concepts</u> of Geometrical Dilution of Precision (GDOP) are familiar to people who work with GPS.

a. idea b. rule c. model d. theory

13. In the situation where there is no a priori information for observations, the two weight matrices are identical and hence the two approaches of <u>eliminating</u> bias parameters are exactly equivalent.

a. removing b. reducing c. changing d. disturbing

14. In this situation, eliminating bias parameters from the measurements loses valuable information by ignoring the a priori information.

a. adding b. having c. changing d. neglecting

15. To illustrate the effect of bias estimation on point positioning, we first examine the unbiased observation case, i.e., the case in which the observables are true ranges.

a. show b. eliminate c. illuminate d. decorrelate

16. The Wide Area Augmentation System (WAAS) uses a series of ground reference stations to calculate GPS correction messages, which are uploaded to a series of additional satellite in geosynchronous orbit for transmission to GPS receivers, including information on ionospheric delay and individual satellite clock drift.

a. harmonized with sun b. harmonized with earth
c. circular but not equatorial d. equatorial but not circular

17. Low-cost GPS receivers are often combined with PDAs, cell phones, car computers, or vehicle tracking systems. The system can be used to automate harvesters, mine trucks, and other vehicles. GPS equipment for the visually impaired is a available too.

a. blinds b. climbers
c. map illiterates d. computer illiterates

18. Mapping of resources and other less precise applications typically used with Geospatial Information Systems often require greater precision than is possible with autonomous

GPS receivers, but do not justify the expense of a survey grade receiver.

a. geodetic b. high accuracy
c. low cost d. independent

19. GPS Machine Guidance is used for tractors and other large agricultural equipment via auto steer or a visual aid displayed on a screen, which is extremely useful for controlled traffic and row crop operations and when spraying.

a. map b. control c. plant d. display

20. Most airlines allow passenger to use GPS units on their flights, except during landing and take-off when other electronic devices are also restricted. According to this sentence one can say:

a. use of other electronic devices on the flights is always prohibited
b. not all of the airlines permit passengers to use GPS onboard
c. all of passengers are allowed to use GPS on their flights
d. GPS units are used in landing and taking off

Test 87

PART A: Vocabulary
Directions: choose the number of the answer (l), (2), (3), or (4) that best completes the sentence. Then mark your choice on your answer sheet.

1. Even as a young man lie had been … as a future chief executive.

a. equipped b. perceived c. submitted d. maintained

2. In exceptional … students may arrange to take examinations at other times.

a. alternatives b. implications
c. circumstances d. distributions

3. There was a notice board … job vacancies and information on how to apply for them.

a. imposing b. monitoring c. displaying d. transferring

4. After a full … lasting over 2 years, very little new evidence had come to light.

a. approach b. exploitation c. investment d. investigation

5. The measures taken should considerably … the residents' quality of life.

a. insert b. trigger c. advocate d. enhance

6. Technological advances could … lead to even more job losses.

a. randomly b. inherently c. ultimately d. empirically

7. By completing a task on schedule you may … a feeling of pride in your work.

a. devote b. derive c. undergo d. glance

8. Roman coins that she showed me were … to the one I had found in the garden.

a. crucial b. specific c. adjacent d. identical

9. A thorough understanding of mathematics is sufficient to explain a wide variety of natural ….

a. criteria b. principles c. phenomena d. components

10. For centuries housework and shopping have been identified as female ….

a. targets b. domains c. sectors d. contexts

PART B: Grammar

Directions: Read the following passage and decide which choice (1), (2), (3), or (4) best fits each blank. Then mark your choice on your answer sheet.

There are many methods of mining. …(11)… is based upon where a mineral deposit …(12)… in the earth. While some mineral deposits are far …(13)… , others lie at or …(l4)… the earth's surface. Several different mining methods …(15)… deposits occur close to the earth's surface.

11. a. that b. each of which
c. every method d. while any of them

12. a. is found b. found
c. finding d. being found

13. a. away b. deep
c. from d. underground

14. a. in b. near
c. within d. above

15. a. are used when b. which used
c. when used d. which are used

PART C: Reading Comprehension
Directions: Read the following two passages and choose the best choice (1), (2), (3), or (4). Then mark it on your answer sheet.

Passage I:

Please choose the best answer for the following questions based on this paragraph:

The term geomatics is fairly new, apparently being coined by B. Dubuisson in 1969. It is commonly defined as “hunter and gatherer” to include the tools and techniques used in land surveying, remote sensing, Geospatial Information Systems (GIS), Global Positioning System (GPS), and related forms of earth mapping. Originally used in Canada, because it is similar in French and English, the term geomatics has been adopted by the international Organization for Standardization, the Royal Institution of Chartered Surveyors, and many other international authorities, although some (especially in the United States) have shown a preference for the term “geospatial technology”. The precise definition of geomatics is “Hunter and Gatherer” and flux in retrospect. A good definition can be found on the University of Calgary’s web page titled “What is Geomatics Engineering?”: “Geomatics Engineering is a modem discipline, which integrates acquisition, modeling, analysis, and management of spatially referenced data, i.e. data identified according to their locations. Based on the scientific framework of geodesy, it uses terrestrial, marine, airborne, and satellite-based sensors to acquire spatial and other data. It includes the process of transforming spatially referenced data from different sources into common information systems with well-defined accuracy characteristics.”

16. In spite of the fact that GEOMATICS is used by many international authorities, there are still some people who would rather use … than GEOMATICS.

a. modern engineering discipline
b. spatially referenced data
c. hunter and gatherer
d. geospatial technology

17. Based on the definition of University of Calgary, the term GEOMATICS does not include ….

a. Transformation of spatial data
b. Integration of hunting and gathering
c. Collection of both spatial and non-spatial data
d. Modeling of data which are identified by their locations

18. Spatially referenced data are ….

a. defined based on their position
b. data with special characteristics
c. the scientific framework of geodesy
d. satellite based sensors for collecting data

19. Who has started to use the term GEOMAT1CS?

a. United States
b. Canada
c. Royal institution of chartered surveyors
d. International organization for standardization

20. The term CEOMATICS is….

a. an old term
b. meaningless term
c. a 1969 coin name
d. quite a new term

Passage II:

Please choose the best answer for the following questions based on this paragraph:

Raster data type consists of rows and columns of cells where in each cell a single value is stored. Raster data can be images (raster images) with each pixel (or cell) containing a color value. Additional values recorded for each cell may be a discrete value, such as land use, a continuous value, such as temperature, or a null value if no data is available. While a raster cell stores a single value, it can be extended by using raster bands to represent RGB (red, green, blue) colors, colormaps (a mapping between a thematic code and ROB value), or an extended attribute table with one row for each unique cell value. The resolution of the raster data set is its cell width in ground units. Raster data is stored in various formats; from a standard file-based structure of TIF, JPEG, etc. to binary large object (BLOB) data stored directly in a relational database management system (RDBMS) similar to other vector-based feature classes. Database storage, when properly indexed, typically allows for quicker retrieval of the raster data but can require storage of millions of significantly-sized records.

21. An indexed database storage for raster data ….

    a. is always faster than non-indexed ones
    b. can have trouble with storage requirement
    c. needs permission of the administrator for quicker retrieval of the data
    d. is not only faster but also more flexible in terms of storage requirement

22. Each cell of a raster data type stores….

    a. only a single value

b. pixel values of an imagery
c. rows, columns, and cell value
d. TLF, JPEG, and other file based structure formats.

23. The main subject of this paragraph is ….

a. RGB colors
b. Binary' Large Object (BLOB)
c. Raster Data TVFC
d. Relational Database Management System (RDBMS)

24. Binary Large Object (BLOB) is ….

a. one form of storage format
b. similar to RGB (red, green. blue) colors
c. a relational database management system
d. some kind of colormaps which maps between a thematic code and ROB value.

25. Which one of the following sentences about raster data types <u>is not correct</u>?

a. They can handle null value attributes.
b. They can handle single value attributes.
c. They can hardly handle multi-value attributes.
d. They can easily handle both discrete and continuous attributes.

26. The third chapter <u>deals with</u> the reference systems such as coordinate systems (like terrestrial and celestial reference frames) and time systems. Here "deals with" means:

a. Relates b. Connects c. Explains d. Introduces

27. With A.S. activated, in the emitted signal the P-code is replaced by the unknown Y-code, therefore, the traditional P-code correlation technique can no longer be applied. Here “emitted” means:

a. Secret b. Received c. Well Known d. Transmitted

28. Apart from radiation power, the frequency of the radio link is the critical parameter for transmission performance, i.e., the higher the frequency, the more data can be transferred in the time unit. Antonym for “apart from” is:

a. Together b. Neglecting c. Along with d. Considering

29. The Digital Image Processing book provides a balanced treatment of image processing fundamentals and the software principles used in their practical implementation. Here “treatment” means:

a. Cure b. Remedy c. Management d. Implementation

30. After the parameters in question have been estimated, the structure of the classifier is fixed. The “parameters in question” means the parameters which are:

a. Underestimated b. Overestimated
c. Well known d. Sought

Chapter 16: Glossary

A

A priori	مقدم، پیشین
Absolute	مطلق
~ *Error*	خطای مطلق
Accidental	تصادفی
~ *Error*	خطای تصادفی
Accuracy	دقت،حساسیت
~ *Order*	درجه تنظیم
Adjustment	سرشکنی
~ *Of angles*	سرشکنی زوایا
~ *Of traverse*	سرشکنی پیمایش
Aerial camera	دوربین‌های هوایی، دوربین‌های فتوگرامتری
Airborne control system	سیستم کنترل هواپیما یا وسیله حامل دوربین
Alignment	هم‌تراز، هم امتداد
Altimeter	ارتفاع‌سنج
Altitude	زاویه قائم بین صفحه افقی ناظر و امتداد نشانه‌روی
Ambiguity	نامعلوم، ابهام
Angle	زاویه
~ *Adjustment*	سرشکنی زاویه
~ *Balancing*	توازنه زاویه
~ *Closure*	زاویه بسته شده

~ *Distance relationship*	مسافت وابسته، ارتباط کناری
~ *Error*	خطای زاویه‌ای
~ *Horizontal.*	زاویه افقی
Interior ~	زوایه داخلی
~ *Measurement*	اندازه‌گیری زاویه
~ *Plotting*	رسم زاویه، پیاده کردن زاویه
Vertical ~	زاویه قائم
Zenith ~	زاویه زنیتی
Application	کاربرد – استفاده
Apogee	اوج، نقطه اوج، دورترین نقطه متحرک
Arc	قوس، کمان
~ *defination of curve*	بررسی خمک از لحاظ قوس
Vertical ~	عمودی، قائم
Archiving	آرشیوکردن، منظم وذخیره‌سازی اطلاعات، بایگانی کردن
Area	اندازه‌گیری سطح، مساحت
~ *By division into triangles*	اندازه‌گیری سطح بااستفاده ازمثلث‌بندی
~ *By planimeter*	اندازه‌گیری سطح بااستفاده ازپلانی‌متری
Arrow	پیکان، بردار
As-built surveys	نقشه‌برداری بنا بعد از اتمام
Atmospheric	اتمسفری
~ *absorption*	جذب کردن
~ *Scattering*	پراکندگی، تفرق، افکندگی
Automated mapping	نقشه‌کشی اتوماتیک
Axes	محورها
~ *Of sight*	محور دیدگانی، محور نشانه‌روی
~ *Of theodolite*	محور اصلی تئودولیت
Optical ~	محوراپتیکی

Azimuth	آزیموت
Computed ~	آزیموت محاسباتی
Magnetic ~	آزیموت مغناطیسی
~ Methods of determining	روش مشخص کردن آزیموت
True ~	آزیموت صحیح

B

Backsight reading	قرائت عقب در نقشه‌برداری
Balancing	متعادل کردن – متوازنه
~ Angles	توازنه زوایا
~ In	ورود به راستا و مسیر
Bandwidth	پهنای باند
Barometer	هواسنج، فشارسنج
Base	مبنی
Baseline	خط مبنی
Bearing	جهت – سمت – نسبت
~ Assumed	جهت فرضی
~ Calculation	محاسبه جهت
~ True.	جهت درست
Bench mark	بنچ مارک – نقطه ثابت
Blunder	اشتباه بزرگ– خطای ناشی از بی‌دقتی
Blue print	کپی اوزالیت
Builder's tape	مترکشی بنا
Bull's eye bubble	سطح تراز کروی (حبابی)

C

Calibration	کالیبراسیون – درجه‌بندی
Carrier signal	سیگنال حامل
Cartography	کارتوگرافی
Central meridian	نصف‌النهار مبدأ

Channel	کانال
Checking	کنترل کردن
~ *Angular measurement*	کنترل اندازه‌گیری زوایه
~ *Map accuracy*	کنترل دقت نقشه
~ *Plotted line*	کنترل خطوط رسم شده
~ *Chord*	کنترل وتر
Chronometer	کرنومتر، زمان‌سنج
Circle	دایره
Great ~	دایره عظمیه
Horizontal ~	دایره افقی
~ *Reading system*	سیستم قرائت دایره
Vertical ~	دایره عمودی یا قائم
Circular curve	قوس دایره‌ای
~ *Arc definition*	تعریف قوس
~ *length of arch*	طول قوس
Clinometer	شیب سنج
Closure	بست، خاتمه، بسته کردن
Angle ~	بست زاویه
~ *error*	خطای بست
~ *Limit*	حدود خطای بست
~ *Linear closure error*	خطای بست مسیر
Coincidence	برخورد، تلاقی، تصادف (توافق)
Collimation	کلیماسیون
~ *Line*	کلیماسیون خطی
Collimator	کلیماتور
Compass	قطب‌نما
Compensator	کمپانساتور، متعادل کننده، جبران‌گر

~ *Of area Alan*	محاسبه مساحت یا فضا
~ *Of astronomic azimuth*	محاسبه آزیموت نجومی
~ *Of volume*	محاسبه حجم
Construction	سازه، بنا
~ *Survey*	نقشه‌برداری سازه یا بنا (نقشه‌برداری کارگاهی)
Continuous benchmark	علامت، نقطه ثابت
Control	کنترل، نظارت
Basic ~	کنترل مرکزی
~ *Points*	نقاط کنترل
~ *Standards*	استانداردهای کنترل
~ *Survey*	نقشه‌برداری کنترل، اندزه‌گیری کنترل
Convergence	هم‌گرایی، تقارب
Coordinate(s)	مختصات(ها)
Area by ~	محاسبات یا مساحت یافضای به‌دست آمده با مختصات
Astronomical ~	مختصات نجومی
Plotting by ~	پلات یا رسم با مختصات
Corner	گوشه
~ *Correction*	تصحیح – اصلاح
Cross hairs	تار رتیکول یا تارهای متقاطع
Cross-section	سطح متقاطع
Curve	خم – قوس– منحنی

D

Daily variation	تغییرات روزانه
Data	اطلاعات، داده‌ها
~ *Bank*	منبع داده‌ها، بانک اطلاعات
~ *Collector*	جمع‌آوری اطلاعات
~ *For angular closure*	داده‌های بستن زاویه

~ *For processing*	داده‌ها برای پردازش
Datum	داده، دیتم، سطح مبنای مختصات
Degree of curve	درجه انحنا وخمیدگی
Description	تعریف، توصیف
~ *Of bench mark*	تعریف موقعیت از بنچ مارک
Detailing	واحد، اندازه‌گیری
Diapositive	دیاپوزیتیو، ظهور عکس روی اسلاید شفاف
Dilution	رقیق سازی، محلول، آبکی
Differential	دیفرانسیلی، تفاضلی
~ *Elevation model*	مدل ارتفاعی دیفرانسیلی
Digital	دیجیتالی، دودویی، الکترونیکی
~ *Elevation model*	مدل ارتفاعی دیجیتالی
Direction	امتداد، راستا
~ *Instrument*	وسیله امتداددهی یا وسیله رهبری
Discrepancy	اختلاف، ناسازگاری
Dispersion	پراکندگی
Distance	مسافت، فاصله، دوری
Horizontal ~	فاصله افقی
Divergence	واگرایی
Doppler method	روش داپلر
Double centering	دو مرکزی

E

Earth's radius	شعاع، زمین
Eccentricity	گریز از مرکز
Electromagnetic spectrum	طیف الکترومغناطیسی
Electronic distance measurement	اندازه‌گیری الکترونیکی فاصله
Electro-optical	الکترواپتیک

Elevation	ارتفاع، بلندی، برآمدگی
Assumed ~	ارتفاع فرضی
~ Difference	اختلاف ارتفاع
Ellipsoid	الیپسوئید، بیضوی
Ephemeris	زمان وتاریخ تعیین شده برای اندازه‌گیری (زمان نجـومی)، تقویم نجومی
Equipment	تجهیزات، سازوبرگ
Error	خطا
Accidental ~	خطای تصادفی
Alignment ~	خطای امتداد
Cumulative ~	خطاهای انباشته شده
Curve of ~	منحنی خطاها
Instrumental ~	خطای دستگاهی
Natural ~	خطای طبیعی
~ Of closure	خطای بست
~ Of mean	خطای به‌دست آوردن میانگین
~ Of sum	خطای جمع
Personal ~	خطای فردی
Plotting ~	خطای رسم یا پلاتینگ
Random ~	خطای تصادفی
Theory of ~	تئوری خطا
Types of ~	انواع خطا
Eyepiece	عدسی چشمی، عدسی سردوربین یا میکروسکپ

F

Fiber glass tape	نوار فایبرگلاسی
Field	مرتع، اراضی
~ Book	دفتر ثبت اطلاعات زمینی
~ Note	ثبت اراضی

~ *Work*	عملیات اراضی،کارهای اراضی
Finite elements method	روش المان محدود
Flattening	مسطح سازی، فشردگی
Focusing	فوکوس کردن
Foresight reading	قرائت جلو
Fractional section	بخش کسری
Function	وظیفه، تابع

G

Gas laser	لیزر گازی
Geodesy	ژئودزی
Geodetic	ژئودتیک
~ *Azimuth*	آزیموت ژئودتیکی
~ *Control*	نقطه کنترل (ترازیابی یا مثلث‌بندی)
~ *Reference system*	سیستم رفرنس ژئودتیکی
~ *Surveying*	اندازه‌گیری ژئودتیکی
Geographic	جغرافیایی
~ *Information system (GIS)*	سیستم اطلاعات جغرافیایی
~ *Pole*	قطب جغرافیایی
~ *Transformation*	تبدیلات بین دو سیستم مختصات جغرافیایی
Geoid	ژئوئید
~ *height*	ارتفاع ژئوئید
Geometric closure	بست هندسی
Global positioning system (GPS)	سیستم جهانی تعیین موقعیت
Graduation	تقسیم‌بندی
~ *On level rod*	تقسیم‌بندی شاخص
~ *On venire*	تقسیم‌بندی ورنیه
Grid	گرید، شبکه
Ground control	نقاط کنترل زمینی

Gyroscope ژیروسکوپ، وسیله تعیین گرای نجومی

H

Hand level ترازیابی دستی

Hectare هکتار

Height of instrument ارتفاع دستگاهی

Histogram هیستوگرام، نمودار مستطیلی

Horizontal افقی

~ *Accuracy* دقت افقی

~ *Angle* زاویه افقی

~ *Circle* دایره تقسیم‌بندی زاویه‌ای افقی

~ *Control* کنترل افقی

~ *Distance* فاصله افقی

~ *Line* خط افقی

~ *Plane* صفحه افقی

Hour angle زاویه ساعتی

Hydrostatic survey اندازه‌گیری یا نقشه‌برداری هیدرواستاتیکی

I

Inclined sight دید مایل

Index اندکس، نمایش‌گر

~ *Error* خطای اندکس – خطای نمایشی

Indirect leveling ترازیابی غیرمستقیم (با استفاده از اندازه‌گیری زاویه قائم و فاصله افقی محاسبه می‌شود)

Inertial survey system سیستم اندازه‌گیری اینرشیا

Infrared مادون قرمز

Initial point نقطه آزاد، نقطه اولیه

Instrumental error خطای دستگاهی

Intermediate sight قرائت وسط

International System of unit سیستم واحد جهانی

Interpolation انترپلاسیون – درون‌یابی
Interpretation تحلیل و تفسیر
Interval فاصله، وقفه
Invar tape نوار اینوار (نواری از جنس آلیاژی از نیکل و آهن با ضریب انبساط حرارتی نزدیک صفر)
Intervisibility دید متقابل، دیدن دو نقطه توسط هم‌دیگر

K

Kinematic کینماتیک، جنبش
~ *Positioning* تعیین موقعیت کینماتیک با استفاده از GPS

L

Land اراضی
~ *Information system (LIS)* سیستم اطلاعات اراضی
~ *Surveyor* نقشه‌بردار یا اندازه‌گیر اراضی
~ *Survey* نقشه‌برداری یا اندازه‌گیری اراضی
Large mistake خطای بزرگ، اشتباه
Laser Single beam باریکه سیگنال
Latitude عرض جغرافیایی
Law of probability قانون احتمالات
Laying تطبیق با اراضی
~ *By chord method* تطبیق به‌روش وتری (قطری)
~ *By tangent method* تطبیق به‌روش مماسی
~ *With a tape* تطبیق با استفاده از نوار
~ *With a theodolite* تطبیق با استفاده از تئودولیت
Least square adjustment سرشکنی با استفاده از کمترین مربعات
Legend مشخصات کنار نقشه، لژاند، راهنمای نقشه
Lenght درازا
Measurement of ~ اندازه‌گیری درازا
Lens عدسی

Level	تراز
~ Automatic	تراز اتوماتیک
~ Datum	دیتم تراز، دیتم نیولمان
Digital ~	تراز دیجیتالی
Geodetic ~	تراز ژئودتیکی
Hand ~	تراز دستی
Laser ~	تراز لیزری
Precise ~	تراز دقیق
~ Rod	تراز میله‌ای
Self levelling ~	تراز خودکار
~ Surface	تراز ظاهری
Tracking ~	تراز چشمی
Types of ~	انواع تراز، تیپ‌های تراز
Levelling	ترازیابی
Backsight in ~	قرائت عقب ترازیابی
Barometric ~	ترازیابی با استفاده از فشار هوا
~ Bench mark	بنچ مارک ترازیابی
~ Closure	بستن ترازیابی
Differential ~	ترازیابی دیفرانسیلی
Double rodded line ~	ترازیابی خطی دومیله‌ای (دوشاخصی)
Error in ~	خطای ترازیابی
Field note for ~	برداشت برای ترازیابی، برداشت ترازیابی اراضی
Foresight in ~	قرائت جلو درترازیابی
~ Hand signals	علائم دستی به‌کاررفته در ترازیابی
Holding rod in ~	میرگیر،گرفتن شاخص در ترازیابی
~ Intermediate sight	قرائت وسط در ترازیابی
~ Line	خط ترازیابی

Minus sight in ~	قرائت جلو یا منفی در ترازیابی
Mistake in ~	اشتباه در ترازیابی
~ Plus sight	قرائت عقب یا مثبت در ترازیابی
Precision of ~	دقت یا حساسیت ترازیابی
Process of ~	مراحل ترازیابی
Profile ~	پروفیل ترازیابی
~ Stadia	ترازیابی با استفاده از اندازه‌گیری طول و زاویه قائم
Trigonometric ~	ترازیابی مثلثاتی
~ with hand level	ترازیابی با تراز دستی
Line	خط، راستا، امتداد
Horizontal ~	امتداد یا خط افقی
Level ~	خط (سطح) ترازیابی یا ترازیاب
~ Of sight	امتداد دید
Vertical ~	امتداد یا خط قائم
Linear	خطی، طولی، دراز، باریک، کشیده
Lined in	در امتداد
Local	محدود شده به یک مرز، محلی، منطقه‌ای
~ Coordinate system	سیستم مختصات محلی
~ Datum	سیستم مختصات مرجع تعریف شده برای یک منطقه، دیتم منطقه‌ای یا محلی
Longitude	طول جغرافیایی
Loop	حلقه
~ Adjustment	سرشکنی لوپ بسته

M

Magnetic	مغناطیسی
~ Bearing	سمت، زاویه شمالی
~ Declination	انحراف مغناطیسی، میل مغناطیسی
~ Meridian	نصف النهار مغناطیسی

~ North (pole)	شمال (قطب شمال) مغناطیسی
Magnification	بزرگ‌نمایی
Manuel	کتابچه، راهنما
Map	نقشه
~ Accuracy	دقت نقشه
~ Drafting	رسم نقشه
Print of ~	چاپ ویا پرینت نقشه
~ Projection	سیستم تصویر نقشه
~ Scale	مقیاس نقشه
~ Title	عنوان و اسم نقشه
Topographic ~	نقشه توپوگرافی
Mapping	نقشه‌کشی، تولید نقشه، تصویرکردن، نگاشت
Mark	مارک، نشانه
Mass diagram	منحنی مجموع
Mean	میانگین
~ Angle	میانگین زاویه‌ای
Weighted ~	میانگین وزنی
Mean sea level	سطح متوسط آب دریا
Measurement	اندازه‌گیری یا اندازه
Adjustment of ~	سرشکنی اندازه‌گیری‌ها
~ Constant error	خطای ثابت اندازه‌گیری
Error in ~	خطای اندازه‌گیری
Indirect ~	اندازه‌گیری غیر مستقیم
Length ~	اندازه‌گیری طول
Linear ~	مقادیر خطی
~ Of angle	اندازه‌گیری زاویه‌ای
~ Of direction	اندازه‌گیری امتداد

~ *Of volume*	اندازه‌گیری حجم
~ *Precision*	ظرافت یادقت اندازه‌گیری
Recorded ~	اندازه‌گیری ثبت شده یا ثبتی
Theory of ~	نظریه یا تئوری اندازه‌گیری
Type of ~	روش یا طریقه اندازه‌گیری
Weight of ~	وزن اندازه‌گیری
Measuring wheel	چرخ اندازه‌گیر
Mental calculation	محاسبه ذهنی
~ *Angle*	زاویه نصف‌النهاری
~ *Arrow*	جهت نصف‌النهاری
Meter	متر، اندازه‌گیر
Metric	متریک
~ *System*	سیستم متریک
~ *Unit*	واحد متریک
Micrometer	میکرومتر
Microscope	میکروسکوپ
Microwave	میکروموج یا ماکروویو
Mine surveying	نقشه‌برداری معدن
Minus sight	قرائت منفی، قرائت عقب
Misclosure	خطای بست
Mistakes in surveying	خطاهای اندازه‌گیری
Modulated	تنظیم شده
Modulation	تنظیم
Monument	علایم نقطه ثابت،عارضه یا علامت زمینی
Mosaic	موزائیک، نوار عکسی
Most probable	محتمل‌ترین، با احتمال زیاد
~ *Error*	محتمل‌ترین خطا

~ Value	محتمل‌ترین ارزش
Multipurpose	چندمنظوره

N

Nadir	نادیر، نقطه نادیر، سمت‌القدم
National geodetic survey	نقشه‌برداری یا اندازه‌گیری ژئودتیکی جهانی
Natural error	خطای طبیعی
Natural feature	خصوصیات طبیعی
Nautical chart	چارت یا نقشه‌های دریایی
Nautical mile	مایل دریایی
Net	تور، شبکه توری مانند، شبکه، خالص
Network	شبکه مثلث‌بندی یا شبکه ترازیابی یا شبکه پلیگون
Nodal point	نودال، نقطه نودال
Normal error distribution	پخش نرمال خطا

O

Objective lens	عدسی شیئی
Oblique	منحنی، خمیدگی–خم–انحناء
~ Photograph	نقشه یا عکس منحنی
Observation	مشاهده
Occupated station	نقطه استقرار دوربین
Optical	وابسته به چشم–اپتیکال
~ Axis	محور اپتیکی
~ Micrometer	میکرومتر اپتیکی
~ Rangefinder	فاصله‌یاب یا طول‌یاب اپتیکی
Optics	اپتیک، علم مطالعه در خواص نور
Order of accuracy	درجه حساسیت
Orientation	جهت‌دهی، راهنمایی
Absolute ~	جهت‌دهی واقعی
Origin	نقطه شروع (نقطه شروع سیستم مختصات

Orthographic projection	سیستم تصویر اورتوگرافیک
Orthometric height	ارتفاع اورتومتریک، ارتفاع نسبت به ژئوئید
Overlap of photographs	روهم رفتگی عکس‌ها، هم‌پوشانی عکس‌ها
P	
Pacing	قدم زدن، اندازه گرفتن با قدم زدن
Pantograph	پانتوگراف
Parallactic angle	زاویه پارالاکتیک، زاویه تقارب
Parallax	پارالاکس، جابجایی مشاهده شده وضعیت یک جسم نسبت به یک نقطه مبنا یا نسبت به سیستم آن
Partitioning land	تقسیم اراضی، افراز
Personal error	خطای انسانی
Phase	فاز، نمود
~ Angle	فاز زاویه
~ Change	تغییر فاز
~ Detector	آشکارساز فاز
~ Meter	اندازه‌گیری فاز
~ Shift	انتقال فاز
Photogrammetry	نقشه‌برداری هوایی، فتوگرامتری
Accuracy of ~	دقت فتوگرامتری
Advantage of ~	مزیت فتوگرامتری
Aerial ~	فتوگرامتری هوایی
~ Air base	اساس فتوگرامتری هوایی
~ Airborne radar	رادار هواپیمایی عکس‌برداری
Anaglyphic ~	فتوگرامتری آناگلیف (دورنگ)
Control for ~	کنترل فتوگرامتری (نقطه کنترل)
~ Flight line	خط پرواز فتوگرامتری
~ Flight planning	طرح پرواز فتوگرامتری
~ Flying height	ارتفاع پرواز فتوگرامتری

~ Image displacement	جابجایی تصویر فتوگرامتری
Interpretive ~	فتوگرامتری تفسیری
~ paralactic angle	زاویه پارالاکتیک فتوگرامتری
paralax bar	پارالاکس‌بار فتوگرامتری
~ Relief displacement	جبران جابجایی در عکس‌ها
~ Remote sensing	سنجش از دور
~ Stereoscope	استرئوسکوپ فتوگرامتری
~ Survey	اندازه‌گیری فتوگرامتری
Photograph	عکس
Coverage of ~	محتوای عکس
Oblique ~	عکس مایل
Orientation of ~	توجیه عکس
Orthophoto ~	عکس اورتوفتو شده
Rectification of ~	تصحیح عکس
Scale of ~	مقیاس عکس
Vertical ~	عکس قائم
Pin	میله نشانه‌روی
Pipeline	خط لوله
Plane	سطح تراز، مسطح
Horizontal ~	سطح افق
~ Surveying	اندازه‌گیری مسطحاتی
Planimeter	پلانی‌متر، مساحت سنج
Plotting	ترسیم
Plumb	شاغول
~ Bob	سنگینی(ثقل)، شاغول
~ Line	خط شاغول
Plumbing	شاغول کردن

Plus sight	مشاهده اضافی، دوباره خوانی
Pointing	مشخص کردن وضعیت
Accuracy	دقت وضعیت
Error	خطای وضعیت
Point of intersection	نقطه تقاطع
~ *Of line and circle*	نقطه تقاطع دایره و خط
~ *Of two circle*	نقطه تقاطع دو دایره
~ *Of two straight line*	نقطه تقاطع دو خط مستقیم
Pole	قطب
Precise	حساس، با حساسیت
~ *Leveling*	ترازیابی دقیق
~ *Traverse*	پیمایش دقیق
Precision	حساسیت، دقت
Principal	اصلی
Prism	منشور
Probability	احتمال
Profile	پروفیل
~ *Leveling*	ارتفاع‌یابی
Project	پروژه
~ *Control*	کنترل پروژه
~ *Datum*	دیتم مورد استفاده پروژه
Projection	تصویر
Property	مالکیت
~ *Lines*	مرزهای (خطوط) مالکیت
Proportion	نسبت
Pseudo	کاذب
~ *Range*	شبه طول

Public	عمومی
~ *Land survey*	نقشه‌برداری اراضی عمومی
Pull on tape	کشیدن نوار متری

Q

Quadrangle	چهار گوشه

R

Radial	پرتویی، شعایی
Radiation	تشعشع
Radius	شعاع
Random error	خطای تصادفی
Range	گستره، مسافت
~ *Finder*	اندازه‌گیر، مسافت‌سنج
~ *Pole*	ژالون
Raster scanner	اسکنر رستر
Reading system	سیستم قرائت
Readings	قرائت‌ها
Real time	زمان واقعی
Record	ثبت
~ *System*	سیستم مختصات قائم
Rectification	تصحیح، اصلاح
Redundant measurement	اندازه‌گیری اضافی برای حل و فصل
Reduction	تبدیل، تقلیل، تعدیل
Meteoralogic ~	تعدیل هواشناسی
~ *To horizontal*	تبدیل به افق
~ *To mean sea level*	تبدیل به سطح متوسط دریاها
Reference	مرجع
~ *Line*	خط قیاس، خط مبناء
~ *Point*	نقطه قیاس (نقطه شروع)

Reference surface	سطح مبنا
Reflector	منعکس کننده
~ *Constant*	ثابت منعکس کننده
Refraction	شکست نور
~ *Constant*	ثابت شکست نور
Register	یادداشت کردن، ثبت کردن
Relative	نسبی
~ *Accuracy*	دقت نسبی
Relief	نقشه‌برداری عوارض زمین
Remote sensing	سنجش از دور
Resection	برش
Residual	ارزش تصحیح
Respectively	دوجانبه، متقابل
~ *Observation*	مشاهده متقابل
Resurvey	اندازه‌گیری مجدد
Reticle	رتیکول
Retro reflector	بازتاب کننده
Reverse curve	قوس معکوس
Rod *(graduated rod)*	شاخص
Route survey	نقشه‌برداری مسیر (راه)

S

Scale	مقیاس
Scanner	اسکنر
Scanning	اسکن کردن
Screw	پیچ
Sea level	تراز دریا، سطح دریا
Section	مقطع، برش
Self reducing	تقلیل خود به خود، تعدیل خود به خود

Sensitivity	حساسیت
Settlement	استقرار
~ *Of instrument*	استقرار دستگاه
~ *Of rod*	استقرار شاخص
~ *Of tripod*	استقرار سه پایه
Set up	تنظیم کردن دستگاه
Sexadecimal system	واحد یا بخش یا سیستم شصت قسمتی
Shading	سایه کردن
Shadow method	سبک سایه‌زنی
Short rod	شاخص کوتاه
Significant	معنی‌دار، پرمعنی
Simultaneous	هم‌زمان
~ *Measurements*	اندازه‌گیری‌های هم‌زمان
Site map	نقشه شهر یا محل
Slope	دامنه، شیب، کج کردن، سرازیری
~ *Distance*	فاصله شیب‌دار
Slow motion screw	پیچ حرکت کند
Solar observation	مشاهده خورشیدی
Solar mapping device	دستگاه نگاشت خورشیدی
Sounding equipment	تجهیزات عمق‌یابی
Source of error	منبع خطا
Spheroid	شبه کره، شبه کره
Spirit level	حباب تراز، تراز آبی
Stadia	تارهای دوربین
~ *Constant*	ثابت تارهای دوربین
Staff	شاخص
Standard	استاندارد

~ *Deviation*	انحراف استاندارد
~ *Error*	خطای استاندارد
Station	ایستگاه نقطه، استقرار دستگاه
~ *Equation*	معادله سازی ایستگاه
Occupied ~	نقطه اشغال شده توسط دستگاه
Stereoscope	استرئوسکوپ
Stereoscopic	سه بعدی
~ *Parallax*	پارالاکس سه بعدی
~ *View*	دید سه بعدی
Strenght of figure	قدرت برجسته‌بینی
Subdivision	زیرتقسیم، تقسیمات جزئی
Symbol	نشانه، سمبل
Systematic error	خطای سیستماتیک

T

Tacheometer	تاکئومتر
Tacheometry	تاکئومتری
Tape	متر (اندازه‌گیر)
Taping	اندازه‌گیری طول با متر
Target	تارگت، هدف
Telescope	تلسکوپ، دوربین
~ *Cross hairs*	تارهای رتیکول متقاطع در دوربین
~ *Effective aperture*	روزنه تلسکوپ
~ *External focusing*	تنظیم کانونی عدسی بیرونی دوربین
Eyepiece of ~	عدسی چشمی تلسکوپ
~ *Field view*	میدان دید تلسکوپ
~ *Focal length*	فاصله کانونی دوربین
~ *Internal focussing*	تنظیم داخل دوربین
~ *Line of collimation*	خط کولیماسیون دوربین

Magnification of ~	درشت‌نمایی دوربین
~ Parallax	پارالاکس دوربین
Temperature	دما
~ Effect	اثر دما
Theodolite	تئودولیت، دوربین زاویه‌یاب
Termal expansion coefficient	ضریب انبساط گرمایی
Thermometer	دماسنج
Tide	جزر و مد
Tie	بستن
Tilting level	ارتفاع شیب
Topographic survey	نقشه‌برداری توپوگرافی
Transition	گذر، عبور
Transformation	تبدیل، تغییرشکل
Traverse	پیمایش
Adjustment of ~	سرشکنی پیمایش
Closed ~	پیمایش بسته
~ Closure	بسته شدن پیمایش
~ Field note	دفترچه ثبت برداشت‌های پیمایش
Open ~	پیمایش باز
Ring ~	حیطه پیمایش، حلقه پیمایش
Trial and error method	روش سعی و خطا
Triangle	مثلث
Triangulation	مثلث بندی
Tribrach	ترابراگ دوربین (که‌دوربین برروی‌آن‌نصب می‌شود)
Trigonometric	مثلثاتی
~ Formula	فرمول مثلثاتی
~ Heighting	اندازه‌گیری ارتفاع به روش مثلثاتی

~ Leveling	ترازیابی مثلثاتی
Tripod	سه پایه
Turning	برگشت
~ Point	نقطه برگشت
Two dimensional (2D)	دوبعدی

U

Underground survey	نقشه‌برداری زیرزمینی
Units of measurement (for)	واحدهای اندازه‌گیری
~ aera Alan	واحدهای اندازه‌گیری مساحت
~ Angle	واحدهای اندازه‌گیری زاویه
~ Length	واحدهای اندازه‌گیری طول
~ Volume	واحدهای اندازه‌گیری حجم
Ursa major	دب اکبر، هفت اورنگ مهین
Ursa minor	دب اصغر، هفت اورنگ کهین

V

Variable	قابل تغییر
~ Scale	مقیاس قابل تغییر
Variance	واریانس
Variance Covariance matrix	ماتریس واریانس کواریانس
Vernier	ورنیه
Vertical	عمودی
~ Accuracy	دقت عمودی
~ Angle	زاویه عمودی
~ Axis	محور عمودی
~ Collimator	کلیماتور
~ Control	نقطه کنترل
~ Curve	قوس عمودی
~ Datum	سطح مبنای ارتفاع سنجی، دیتم عمودی ارتفاعی

~ *Line*	خط عمودی
~ *Surface*	سطح
Vial	حباب تراز
Visible	قابل مشاهده
Volume	حجم
~ *Computation*	محاسبه حجم

W

Waste	مورد استفاده، مستعمل
~ *Water*	فاضلاب
Water discharge	تخلیه آب
Wave length	ارتفاع موج
Weighted mean	میانگین ثقل
Witness	مشاهده، دیدن
~ *Marker*	مشاهده نشانه

Z

Zenith angle	زاویه افقی
Zenith correction	تصحیح افق
Zenith distance	فاصله افقی

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زبان فنی

برای دانشجویان مهندسی نقشه‌برداری

تالیف:

ابوالفضل شهامت

عضو هیات علمی دانشگاه تبریز- دانشکده فنی و مهندسی مرند

بهزاد راسخ‌القول