

**UNIT I**

**Chapter 1 : Compass and Levelling 1-1 to 1-50**

- a) Definition and Importance of Surveying ; Principles of Surveying
- b) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Construction and use of prismatic compass, Concept of bearing and types of bearings such as Whole Circle Bearing, Quadrantal Bearing, meridian and their types, local attraction and correction for local attraction, dip, declination and calculation of true bearings, including numericals of all types.
- c) Equipment required for plane table surveying, uses, advantages and disadvantages and errors in plane table surveying. Methods of plane table Survey Radiation, intersection, traversing and resection
- d) Introduction to leveling, Types of leveling, Types of benchmarks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principal axes of dumpy level, testing and permanent adjustments reciprocal leveling, curvature and refraction corrections, distance to the visible horizon. Collimation Plane Method, Rise and Fall Method.

**1.1 Definition and Importance of Surveying, Principles of Surveying ..... 1-1**

1.1.1 Importance of Surveying..... 1-1

1.1.2 Principles of Surveying ..... 1-1

**1.2 Definition, Objective and Fundamental Classification of Surveying (Plane and Geodetic) ..... 1-2**

**1.3 Concept of Scale..... 1-3**

**1.4 Ranging..... 1-5**

1.4.1 Code of Signals used by Surveyor in Ranging..... 1-6

**1.5 Chaining ..... 1-6**

1.5.1 Chain survey Instruments..... 1-6

1.5.2 Chain Survey Station ..... 1-11

1.5.3 Methods of chaining on sloping ground ..... 1-11

**1.6 Offsetting and Traversing ..... 1-12**

1.6.1 Offsetting..... 1-12

1.6.2 Traversing..... 1-13

**1.7 Construction and use of Prismatic Compass... 1-14**

1.7.1 Construction of Prismatic Compass..... 1-14

1.7.2 Use of Prismatic Compass..... 1-15

**1.8 Concept of Bearing..... 1-15**

1.8.1 Types of Bearings ..... 1-15

**1.9 Meridian and their Types..... 1-16**

**1.10 Local Attraction..... 1-17**

**1.11 Dip, Declination ..... 1-17**

1.11.1 Dip..... 1-17

1.11.2 Magnetic Declination ..... 1-17

**1.12 Numericals on Conversion of bearings..... 1-18**

1.12.2 Numericals on Calculations of Included Angles.... 1-19

1.12.3 Numericals on Local Attraction and Magnetic Declination ..... 1-23

**1.13 Plane Table Surveying..... 1-25**

1.13.1 Equipment Required for Plane Table Surveying..... 1-25

1.13.2 Uses of Plane Table Survey ..... 1-27

1.13.3 Advantages and Disadvantages of Plane Table Survey..... 1-27

1.13.4 Errors in Plane Table Surveying of Plane Table Survey..... 1-27

1.13.5 Orientation..... 1-28

1.13.6 Methods of Plane Table Survey of Plane Table Survey..... 1-29

**1.14 Levelling..... 1-32**

1.14.1 Introduction to Levelling ..... 1-32

1.14.2 Types of Levelling.....1-32

1.14.3 Types of Benchmarks.....1-34

1.14.4 Study and use of Different Levels in Construction Industry.....1-34

1.14.5 Principal Axes of Dumpy Level.....1-37

1.14.6 Testing and Permanent Adjustments.....1-38

1.14.7 Reciprocal Levelling .....1-40

1.14.8 Curvature and Refraction Corrections .....1-41

1.14.9 Distance to the Visible Horizon.....1-41

1.14.10 Collimation Plane Method, Rise and Fall Method.....1-42

1.15 Numericals on Levelling..... 1-46

**UNIT II**

**Chapter 2 : Theodolite Surveying 2-1 to 2-46**

a) Study of vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

b) Theodolite traversing – computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch’s rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

2.1 Theodolite Surveying..... 2-1

2.2 Classification of Theodolites ..... 2-1

2.3 Size of Theodolite ..... 2-1

2.4 Use of Theodolite..... 2-1

2.5 Component Parts of Transit Theodolite and Their Function..... 2-2

2.6 Reading the Vernier of Transit Theodolite ..... 2-4

2.7 Technical Terms Used in Manipulating a Transit Theodolite..... 2-4

2.7.1 Fundamental Axis of Transit Theodolite and Their Relationship.....2-5

2.8 Temporary Adjustment of Theodolite ..... 2-6

2.9 Changing the Face and Its Necessity..... 2-7

2.10 Measurement of Horizontal Angle..... 2-7

2.11 Method of Reiteration ..... 2-8

2.12 Measurement of Magnetic Bearing by Transit Theodolite ..... 2-9

2.13 Prolonging a Straight Line ..... 2-9

2.14 Measurement of Deflection Angle.....2-10

2.15 Measurement of Vertical Angles.....2-10

2.16 The Permanent Adjustments in case of a Transit Theodolites.....2-11

2.17 Theodolite Traversing .....2-14

2.17.1 Traversing by Included Angle Method.....2-14

2.17.2 Traversing by Deflection Angles .....2-15

2.18 Checks for Closed Traverse .....2-15

2.19 Check in Open Traverse.....2-15

2.20 Calculation of Bearings from Angles.....2-16

2.20.1 Problems on Calculation of Bearing .....2-16

2.21 Traverse Computation .....2-19

2.21.1 Latitudes and Departure of Lines .....2-19

2.22 Consecutive Coordinates.....2-20

2.23 Independent Coordinates (Total Latitude and Total Departure) ..... 2-20

2.24 Error of Closure .....2-20

2.25 Balancing a Traverse .....2-21

2.26 Gale’s Traverse Table .....2-22

2.27 Problems of Traverse Survey .....2-24

2.28 Differentiates .....2-45

➤ Model Question Paper (In sem.) ..... M-1 to M-3

**UNIT III**

**Chapter 3 : Tacheometry and Contouring 3-1 to 3-48**

- a) Tacheometry - applications and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring. Numericals.
- b) Contouring - Definition of Contours, Characteristics of Contours, Contour Patterns for various natural features, direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications.

**3.1 Tacheometry ..... 3-1**

3.1.1 Advantages of Tacheometry ..... 3-1

**3.2 Principle of Stadia Tacheometry ..... 3-1**

**3.3 Tacheometry and its Component Parts..... 3-2**

**3.4 Anallatic Lens ..... 3-2**

**3.5 Tacheometric Methods..... 3-3**

**3.6 Fixed Hair System..... 3-3**

**3.7 Determination of Tachometric Constant..... 3-4**

**3.8 Errors in Tacheometry ..... 3-5**

**3.9 Examples of Line of Sight Horizontal and Staff is Vertical ..... 3-5**

**3.10 Definitions..... 3-36**

**3.11 Characteristics of Contours ..... 3-36**

**3.12 Contour Patterns for Various Natural Features ..... 3-38**

**3.13 Direct and Indirect Methods of Contouring... 3-42**

**3.14 Relative Merits and Demerits of Direct and Indirect Methods of Contouring ..... 3-44**

**3.15 Interpolation of Contours..... 3-45**

**3.16 Study and Use of Topo-Sheets..... 3-46**

**3.17 Use of Topo-sheets ..... 3-46**

**3.18 Profile Leveling and Cross-Sectioning and their Applications..... 3-46**

**UNIT IV**

**Chapter 4 : Curves 4-1 to 4-26**

Introduction to horizontal and vertical curves (including numericals but derivation not expected), different types of curves and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods : Rankine’s method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), Transition curves : necessity

**4.1 Curves ..... 4-1**

**4.2 Necessity of Curves ..... 4-1**

**4.3 Types of Curves Used in Roads and Railway Alignments..... 4-2**

4.3.1 Horizontal Curve .....4-2

4.3.2 Vertical Curves .....4-3

**4.4 Designation of Curve..... 4-4**

4.4.1 Relation between Degree of Curve and its Radius .....4-4

**4.5 Notation of Simple Curve..... 4-4**

**4.6 Elements of a Simple Circular Curve..... 4-5**

**4.7 Elements of Compound Curve ..... 4-5**

**4.8 Methods of Setting Out Simple Circular Curve. 4-6**

4.8.1 Linear Method .....4-6

4.8.4 Angular Methods .....4-8

4.8.5 Rankine’s Method of Deflection Angle .....4-9

4.8.6 Two - theodolite Method .....4-10

**4.9 Solved Examples on Simple Curve .....4-10**

**UNIT V**

**Chapter 5 : Construction Survey and Modern Techniques 5-1 to 5-10**

- a. Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals),. Setting out of a bridge, Determination of the length of the central line and the location of piers. Setting out of a tunnel – Surface setting out and transferring the alignment underground.
- b. Introduction to SBPS, SBPS systems - GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

**5.1 Introduction to Construction Survey ..... 5-1**

**5.2 Establishing of Horizontal and Vertical Control ..... 5-1**

**5.3 Setting Out Building..... 5-2**

**5.4 Survey of Open Traverse ..... 5-3**

**5.5 Setting Out Bridge ..... 5-5**

5.5.1 Locating the Centre Line..... 5-5

5.5.2 Locating Bridge Piers..... 5-5

**5.6 Setting out Tunnels..... 5-7**

5.6.1 Transferring Alignment ..... 5-7

**5.7 Satellite Based Positioning System ..... 5-8**

5.7.1 Introduction..... 5-8

5.7.2 SBPS Systems ..... 5-8

5.7.3 Basic Principles of GPS..... 5-8

5.7.4 GLONASS..... 5-9

5.7.5 GALILEO ..... 5-9

5.7.6 GAGAN..... 5-10

5.7.7 BeiDou..... 5-10

**5.8 Applications of SBPS..... 5-10**

**UNIT VI**

**Chapter 6 : Geodetic Survey, Hydrograph Survey, and Aerial Photogrammetry 6-1 to 6-23**

- Introduction to Geodetic Survey, Objects, Methods of Geodetic Surveying, Introduction to triangulation and trilateration, Objective of triangulations surveys, Classification of triangulation systems, Triangulation figures, Strength of figure, Study and use of one second theodolite and Electronic Total Station,
- Introduction to Hydrographic Survey Objects, Applications, Shore line survey, Sounding, Sounding equipment, Methods of Sounding and Sounding Equipment, Stream gauging, Three point problem
- Aerial Photogrammetry Objects, Classification-qualitative and quantitative photogrammetry, Applications, comparison of Map and aerial photographs, Flight Planning, Calculation of no of Photographs.

**6.1 Introduction to Geodetic Survey ..... 6-1**

6.1.1 Object of Geodetic Survey.....6-1

6.1.2 Methods of Geodetic Survey .....6-1

**6.2 Micro - Optic Theodolites..... 6-3**

6.2.1 Construction Details of 1" Micro Optic Theodolite .....6-4

6.2.2 Component Parts of Micro – Optic Theodolite .....6-4

6.2.3 Use of Micro – optic Theodolite .....6-4

**6.3 Electronic Digital Theodolite..... 6-5**

6.3.1 Advantages of Digital Theodolite.....6-5

6.3.2 Features in a Digital Theodolite .....6-5

**6.4 Total Station ..... 6-5**

6.4.1 Saight Features of Total Stations.....6-6

6.4.2 Soft Keys and their Function.....6-7

6.4.3 Instrument Set - Up (Temporary Adjustments) of Total Station.....6-8

6.4.4 Reflector Prisms .....6-8

6.4.5	Construction of total Station.....	6-8	6.10.1	Objects of Aerial Photogrammetry.....	6-18
6.4.6	Use of Total Station.....	6-9	6.10.2	Application of Photogrammetry.....	6-18
6.4.7	Advantages of Total Station.....	6-9	<b>6.11</b>	<b>Qualitative and Quantitative</b>	
6.4.8	Measurements with Total Stations.....	6-10		<b>Photogrammetry .....</b>	<b>6-18</b>
<b>6.5</b>	<b>Profile Survey and Contouring</b>		6.11.1	Computation of Length of Line between	
	<b>with Total Station .....</b>	<b>6-11</b>		Points of Different Elevations from	
<b>6.6</b>	<b>Hydrographic Surveying.....</b>	<b>6-12</b>		Measurements on a Vertical Photograph.....	6-19
6.6.1	Introduction.....	6-12	6.11.2	Determination of Height (H) and Lens	
6.6.2	Objects of Hydrographic Survey.....	6-12		for a Vertical Photograph.....	6-19
6.6.3	Application of Hydrographic Survey .....	6-12	6.11.3	Relief Displacement on a Vertical Photograph.....	6-20
6.6.4	Shore Line Survey.....	6-12	6.11.4	Height of Object from Relief Displacement.....	6-21
<b>6.7</b>	<b>Sounding .....</b>	<b>6-13</b>	<b>6.12</b>	<b>Application of Aerial Photogrammetry .....</b>	<b>6-21</b>
6.7.1	Sounding Equipment.....	6-13	<b>6.13</b>	<b>Comparison of Map and Aerial Photographs..</b>	<b>6-21</b>
<b>6.8</b>	<b>Stream Gauging .....</b>	<b>6-14</b>	<b>6.14</b>	<b>Flight Planning .....</b>	<b>6-22</b>
6.8.1	Methods of Stream Gauging.....	6-14	<b>6.15</b>	<b>Calculations of Number of Photographs.....</b>	<b>6-23</b>
6.8.2	Why Take Stream Gauging Measurement.....	6-15	➤	<b>Model Question Paper (End sem.) .....</b>	<b>M-1 to M-2</b>
<b>6.9</b>	<b>Three Point Problem.....</b>	<b>6-15</b>			
<b>6.10</b>	<b>Aerial Photogrammetry .....</b>	<b>6-18</b>			

