



# SURVEYING AND LEVELLING

By  
Rangwala

REVISED  
& ENLARGED

Edition : 7<sup>th</sup> Revised and Enlarged Edition : 2014  
ISBN : 9789380358949  
Binding : Paperback  
Pages : 664 + 16 = 680  
Size (mm) : 240 × 26 × 170  
Weight : 810 g



₹ 300.00 **BUY**

## ABOUT THE BOOK

This text-book provides an up-to-date knowledge of the basic *principles of Surveying and Levelling*. The subject matter is canvassed along with theory, variety of examples, various types of survey techniques; survey instruments used in the field; measurement of distances, both vertical and horizontal; the direction of lines or angles between the lines, where as various levelling instruments, principles, techniques, methods applied in levelling are given in this text book. The subject matter is expressed in a simple language and practical manner. The treatment is clear, methodical as well as interesting and easy to follow.

The entire subject matter is systematically arranged in the chapters like: Introduction, Scales, Linear Measurements of Distances, Chain Surveying and Ranging, Cross Staff Chain Surveying and Instruments, Compass Survey, Levelling, Contouring, Plane Table Survey, Computation of Areas, Computation of Volumes, Minor Instruments, Theodolite, Permanent Adjustments of Levels, Tacheometric Surveying, Circular Curves, Transition Curves, Vertical Curves, Field Astronomy, Theory of Errors, Setting Out Works, Hydrographic Surveying, Photographic Surveying, Modern Techniques of Surveying.

Appendix I contains *Question Bank and Solved Problems*. Total 215 theory as well as numerical questions mostly asked in viva and written examination of G.T.U. and other universities are included. Appendix II contains 181 *Multiple Choice Questions* and Appendix II showing *Abbreviated Terms* used in this book are added at the end of the book.

The book now contains:

- \* 404 Self-explanatory and neatly drawn sketches
- \* 218 Solved problems
- \* 215 Theory as well as numerical questions
- \* 66 Useful tables
- \* 480 Questions at the ends of chapters.

The book should prove to be extremely useful to the Engineering students preparing for the Degree Examinations of all the Indian Universities, Diploma Examinations conducted by various Boards of Technical Education, Certificate Courses as well as for the A.M.I.E., U.P.S.C., G.A.T.E., I.E.S. and other similar competitive and professional examinations. It should also prove of interest to the practising professionals.

## CONTENT

- 1: INTRODUCTION
- 2: SCALES
- 3: LINEAR MEASUREMENTS OF DISTANCES
- 4: CHAIN SURVEYING AND RANGING
- 5: CROSS STAFF CHAIN SURVEYING AND INSTRUMENTS
- 6: COMPASS SURVEY
- 7: LEVELLING
- 8: CONTOURING
- 9: PLANE TABLE SURVEY
- 10: COMPUTATION OF AREAS
- 11: COMPUTATION OF VOLUMES
- 12: MINOR INSTRUMENTS
- 13: THEODOLITE
- 14: PERMANENT ADJUSTMENTS OF LEVELS
- 15: TACHEOMETRIC SURVEYING
- 16: CIRCULAR CURVES
- 17: TRANSITION CURVES
- 18: VERTICAL CURVES
- 19: FIELD ASTRONOMY
- 20: THEORY OF ERRORS
- 21: SETTING OUT WORKS
- 22: HYDROGRAPHIC SURVEYING
- 23: PHOTOGRAPHIC SURVEYING
- 24: MODERN TECHNIQUES OF SURVEYING
- APPENDIX I : QUESTION BANK AND SOLVED PROBLEMS
- APPENDIX II : MULTIPLE CHOICE QUESTIONS
- APPENDIX III : ABBREVIATED TERMS
- INDEX

Catalogue Checklist

**SURVEYING AND LEVELLING**  
**DETAILED CONTENTS**

**Chapter 1 INTRODUCTION**

- 1-1. General
- 1-2. Object of survey
- 1-3. Purposes of survey
- 1-4. Classification of surveys
- 1-4-1. Engineering surveys
- 1-4-2. Geodetic surveys
- 1-4-3. Plane surveys
- 1-4-4. Miscellaneous surveys
- 1-5. Principles of surveying
- 1-6. Uses of survey
- 1-7. Measurements and their units
- 1-8. Roll of Surveyor
- 1-9. Precision and accuracy in surveying
- QUESTIONS 1

**Chapter 2 SCALES**

- 2-1. General
- 2-2. Requirements of a scale
- 2-3. Classification of scales
- 2-3-1. Plain scale
- 2-3-2. Diagonal scale
- 2-3-3. Vernier scale
- 2-3-4. Miscellaneous scales
- 2-4. Plans and maps
- 2-5. Scale for survey maps and plans
- 2-6. Correction due to use of wrong scale
- QUESTIONS 2

**Chapter 3 LINEAR MEASUREMENTS OF DISTANCES**

- 3-1. General
- 3-2. Direct methods of linear measurements
- 3-2-1. Direct methods without instruments
- 3-2-2. Direct methods with instruments
- 3-3. Types of chains
- 3-4. Testing and adjusting of chain
- 3-5. Instruments for marking stations
- 3-6. Types of tapes
- 3-7. Tape corrections
- QUESTIONS

**Chapter 4 CHAIN SURVEYING AND RANGING**

- 4-1. General
- 4-2. Principle of chain survey
- 4-3. Survey stations
- 4-4. Survey lines
- 4-5. Offsets
- 4-6. Ranging
- 4-7. Types of ranging
- 4-7-1. Direct ranging
- 4-7-2. Indirect ranging
- 4-8. Chaining on plain ground
- 4-9. Points to be observed during chaining
- 4-10. Chaining on sloping ground
- 4-10-1. Direct method of chaining
- 4-10-2. Indirect method of chaining
- 4-11. Errors in ordinary chaining
- 4-11-1. Compensating errors
- 4-11-2. Cumulative errors
- 4-12. Degree of accuracy in chaining work
- 4-13. Field book
- 4-14. Instruments required in chain survey
- 4-15. Procedure for carrying out chain survey
- 4-16. Plotting work with conventional signs
- QUESTIONS 4

**Chapter 5 CROSS STAFF CHAIN SURVEYING AND INSTRUMENTS**

- 5-1. General
- 5-2. Purpose
- 5-3. Basic principle
- 5-4. Instruments for setting out perpendiculars
- 5-4-1. Chain or tape
- 5-4-2. Cross-staff
- 5-4-3. Optical square
- 5-5. Cross-staff survey
- 5-6. Obstacles in chaining
- 5-6-1. Chaining free but vision obstructed
- 5-6-2. Chaining obstructed but vision free
- 5-6-3. Chaining and vision both obstructed
- QUESTIONS 5

**Chapter 6 COMPASS SURVEY**

- 6-1. General
- 6-2. Traversing and triangulation
- 6-3. Methods of measuring direction
- 6-4. Magnetic needle
- 6-5. Pivot
- 6-6. Compass
- 6-7. Tripods
- 6-8. Bearings
- 6-9. Magnetic declination
- 6-10. Classification of declination
- 6-11. Methods of designation
- 6-12. Fore bearing and back bearing
- 6-13. Included angles from bearings
- 6-14. Local attraction
- 6-15. Chain and compass survey
- 6-16. Plotting of compass survey
- 6-17. Closing error
- 6-18. Errors in compass survey
- 6-19. Precautions in using the compass
- 6-20. Accuracy and precision
- 6-21. Limits of precision
- QUESTIONS 6

**Chapter 7 LEVELLING**

- 7-1. General
- 7-2. Definitions of some common terms in levelling
- 7-3. Methods of levelling
- 7-3-1. Direct levelling
- 7-3-2. Indirect levelling
- 7-4. Principles of levelling
- 7-5. Instruments for levelling
- 7-6. Types of levels
- 7-7. Levelling staff
- 7-8. Essential parts of a level
- 7-9. Parallax and focussing
- 7-10. Defects of a single lens
- 7-11. Parts of a telescope
- 7-12. Optical characteristics of telescope
- 7-13. Accessories to a level
- 7-14. Bench marks
- 7-15. Temporary adjustments of levels
- 7-16. Entering the staff readings
- 7-17. Reduction of levels
- 7-18. Difficulties in levelling
- 7-19. Curvature and refraction
- 7-20. Errors in levelling
- 7-21. Precision of levelling
- QUESTIONS 7

**SURVEYING AND LEVELLING**  
**DETAILED CONTENTS**

**Chapter 8 CONTOURING**

- 8-1. General
- 8-2. Contour lines
- 8-3. Contour interval
- 8-4. Horizontal equivalent
- 8-5. Characteristics of contours
- 8-6. Location of contours
- 8-7. Interpolation of contours
- 8-8. Contour drawing
- 8-9. Contour gradient
- 8-10. Uses of contours
- QUESTIONS 8

**Chapter 9 PLANE TABLE SURVEY**

- 9-1. General
- 9-2. Instruments required for plane table survey
- 9-3. Accessories required for plane table survey
- 9-4. Temporary adjustments of plane table
- 9-5. Methods of plane table survey
- 9-6. Two-point and three-point problems
- 9-6-1. Two-point problem
- 9-6-2. Three-point problem
- 9-7. Errors in plane table survey
- 9-8. Advantages of plane table survey
- 9-9. Disadvantages of plane table survey
- QUESTIONS 9

**Chapter 10 COMPUTATION OF AREAS**

- 10-1. General
- 10-2. Methods for the computation of areas
- 10-3. Geometrical figures
- 10-4. Measuring grids
- 10-5. Ordinates
- 10-6. Co-ordinates
- 10-7. Planimeter
- 10-8. Method of using a planimeter
- 10-9. Zero circle
- QUESTIONS 10

**Chapter 11 COMPUTATION OF VOLUMES**

- 11-1. General
- 11-2. Methods for computation of volumes
- 11-2-1. Cross-sections
- 11-2-2. Spot levels
- 11-2-3. Study of contour plan
- 11-3. Prismoidal correction
- 11-4. Curvature correction for volumes
- QUESTIONS 11

**Chapter 12 MINOR INSTRUMENTS**

- 12-1. General
- 12-2. Abney level
- 12-2-1. Essential parts of abney level
- 12-2-2. Working of abney level
- 12-2-3. Testing of abney level
- 12-3. Box sextant
- 12-3-1. Essential parts of box sextant
- 12-3-2. Principle of box sextant
- 12-3-3. Working of box sextant
- 12-3-4. Optical requirements and adjustments of box sextant
- 12-4. Ceylon ghat tracer
- 12-4-1. Essential parts of ghat tracer
- 12-4-2. Working of ghat tracer
- 12-5. De Lisle's clinometer
- 12-5-1. Essential parts of De Lisle's clinometer

- 12-5-2. Working of De Lisle's clinometer
- 12-6. Eidograph
- 12-7. Foot-rule clinometer
- 12-7-1. Working of foot-rule clinometer
- 12-8. Hand level
- 12-8-1. Working of hand level
- 12-8-2. Adjustment of the hand level
- 12-9. Indian pattern clinometer
- 12-9-1. Essential parts of Indian pattern clinometer
- 12-9-2. Working of Indian pattern clinometer
- 12-9-3. Adjustment of Indian pattern clinometer
- 12-10. Pantagraph
- 12-11. Proportional compass
- 12-12. Watkin's mirror clinometer
- QUESTIONS 12

**Chapter 13 THEODOLITE**

- 13-1. General
- 13-2. Essential parts of a transit theodolite
- 13-3. Definitions and terms used for theodolite work
- 13-4. Micrometer theodolites
- 13-5. Temporary adjustments of theodolite
- 13-6. Measurement of horizontal angles
- 13-7. Measurement of vertical angles
- 13-8. Miscellaneous operations with theodolite
- 13-9. Theodolite traverse
- 13-10. Locating details in theodolite traverse
- 13-11. Degree of accuracy in theodolite traversing
- 13-12. Plotting of theodolite traverse
- 13-13. Closing error
- 13-14. Angular error
- 13-15. Adjustment of bearings
- 13-16. Balancing the traverse
- 13-17. Traverse table
- 13-18. Errors in theodolite work
- 13-19. Fundamental lines and desired relations
- 13-20. Permanent adjustments of theodolite
- 13-21. Uses of theodolite
- 13-22. Typical problems on theodolite
- 13-23. Modern theodolites
- QUESTIONS 13

**Chapter 14 PERMANENT ADJUSTMENTS OF LEVELS**

- 14-1. General
- 14-2. Fundamental axes of the levelling instruments
- 14-3. Principle of reversibility
- 14-4. Precautions to be taken during the permanent adjustments
- 14-5. Adjustments of dumpy level
- 14-6. Adjustments of Y-level
- 14-7. Adjustments of Cooke's reversible level
- 14-8. Adjustments of Cushing's level
- 14-9. Adjustments of tilting level
- QUESTIONS 14

**Chapter 15 TACHEOMETRIC SURVEYING**

- 15-1. General
- 15-2. Instruments
- 15-3. Uses of tacheometry
- 15-4. Systems of tacheometric measurements
- 15-5. Stadia method
- 15-6. Subtense method
- 15-7. Tangential method
- QUESTIONS 15



**SURVEYING AND LEVELLING**  
**DETAILED CONTENTS**

**Chapter 16 CIRCULAR CURVES**

- 16-1. General
- 16-2. Classification of circular curves
- 16-3. Simple curves
- 16-4. Elements of simple curve
- 16-5. Location of tangents
- 16-6. Location of tangent points
- 16-7. Peg Interval
- 16-8. Normal chords and sub-chords
- 16-9. Setting out simple curves
- 16-9-1. Linear methods
- 16-9-2. Angular methods
- 16-10. Special problems in simple curves
- 16-11. Compound curves
- 16-12. Setting out compound curves
- 16-13. Reverse or serpentine curves
- QUESTIONS 16

**Chapter 17 TRANSITION CURVES**

- 17-1. General
- 17-2. Requirements of transition curve
- 17-3. Composite curve
- 17-4. Super-elevation
- 17-5. Centrifugal ratio
- 17-6. Length of transition curve
- 17-7. Ideal transition curve
- 17-8. Cartesian co-ordinates of the points
- 17-9. Calculation of deflection angles
- 17-10. Modifications of ideal transition curve
- 17-11. Characteristics of a transition curve
- 17-12. Lemniscate transition curve
- 17-13. Comparison of transition curves
- QUESTIONS 17

**Chapter 18 VERTICAL CURVES**

- 18-1. General
- 18-2. Grade or gradient
- 18-3. Rate of change of gradient
- 18-4. Types of vertical curves
- 18-5. Equation of vertical curve
- 18-6. Length of vertical curve
- 18-7. Sight distance of vertical curve at summit
- 18-8. Sight distance of vertical curve at sag
- 18-9. Vertical curve passing through a fixed point
- 18-10. Setting out vertical curves
- 18-11. Typical problems on vertical curves
- QUESTIONS 18

**Chapter 19 FIELD ASTRONOMY**

- 19-1. General
- 19-2. Some astronomical terms
- 19-3. Terrestrial latitude and longitude
- 19-4. Parallel of latitude
- 19-5. Nautical mile
- 19-6. Spherical trigonometry
- 19-7. Spherical triangle
- 19-8. Some useful data
- 19-9. Astronomical triangle
- 19-10. Star at elongation
- 19-11. Star at prime vertical

- 19-12. Star at culmination or transit
- 19-13. Circumpolar stars
- 19-14. Star at horizon
- 19-15. Relationships between co-ordinates
- 19-16. Time
- QUESTIONS 19

**Chapter 20 THEORY OF ERRORS**

- 20-1. General
- 20-2. Accuracy and precision
- 20-3. Types of errors
- 20-4. Some definitions
- 20-5. Laws of accidental errors
- 20-6. Probability curve
- 20-7. Most probable value
- 20-8. Average error and maximum error
- 20-9. Mean square error
- 20-10. Method of least squares
- 20-11. Laws of weights
- 20-12. Rules for giving weights to the field observations
- 20-13. Distribution of error to the field observations
- QUESTIONS 20

**Chapter 21 SETTING OUT WORKS**

- 21-1. General
- 21-2. General considerations
- 21-3. Control stations
- 21-4. Horizontal control
- 21-5. Vertical control
- 21-6. Setting out of structure
- 21-7. Setting out of important structures
- QUESTIONS 21

**Chapter 22 HYDROGRAPHIC SURVEYING**

- 22-1. General
- 22-2. Requirements of hydrographic survey
- 22-3. Shore line survey
- 22-4. Soundings
- 22-5. Location of soundings
- 22-6. Reduction of soundings
- 22-7. Tides
- 22-8. Tide gauges
- QUESTIONS 22

**Chapter 23 PHOTOGRAPHIC SURVEYING**

- 23-1. General
- 23-2. Classification of photogrammetry
- 23-3. Application of photogrammetry
- 23-4. Mosaics
- QUESTIONS 23

**Chapter 24 MODERN TECHNIQUES OF SURVEYING**

- 24-1. General
- 24-2. Electronic distance measurement instruments
- 24-3. Global positioning system
- 24-4. Geographic information system
- 24-5. Remote sensing
- QUESTIONS 24

**Appendix I QUESTION BANK AND SOLVED PROBLEMS**

**Appendix II MULTIPLE CHOICE QUESTIONS**

**Appendix III ABBREVIATED TERMS**

**Index**