Practical Manual

on

Forest Survey & Engineering

FNR 217 - 3 (2+1)

B.Sc. (Hons.) Forestry, III Semester

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2020

College of Horticulture & Forestry,
Rani Lakshmi Bai Central Agricultural University
Jhansi - 284003

Syllabus FNR 217 – 3 (2+1)

Chain surveying, compass traversing; plane table surveying, levelling, calculations of earth work for construction of forest; roads & earth dams; alignment of forest roads; preparation building plans; design of water ways; design of simple wooden beam bridge; design of retaining walls. Design of check dams.

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Experiment No. 1

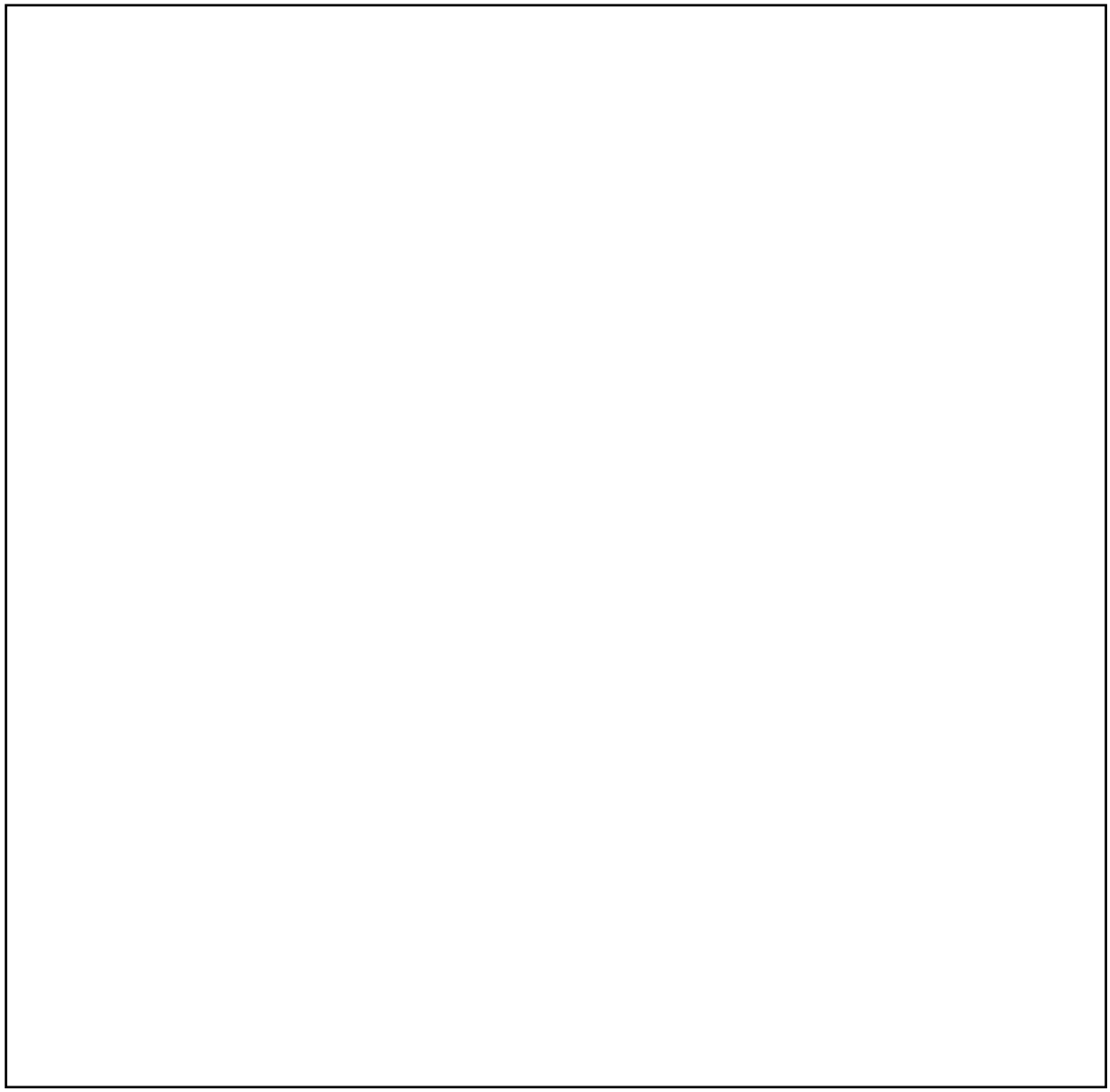
Objective: To study the instruments used in Chain Surveying.

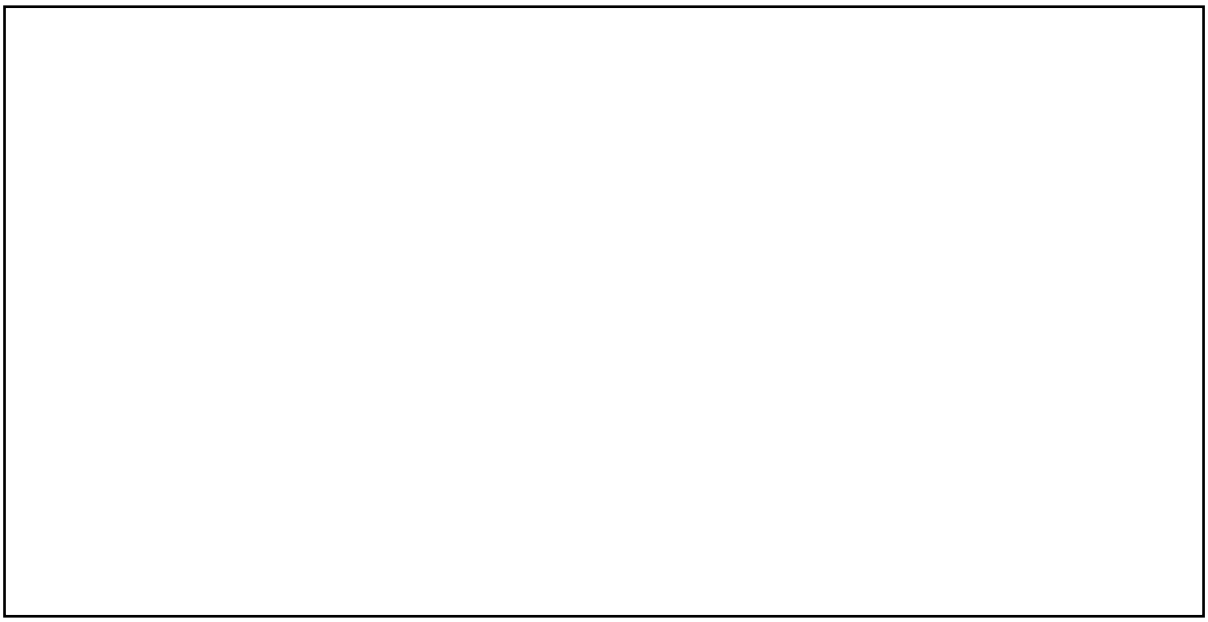
Equipment's required:

Ranging Rods: ----------

Chains: ----------

Metric chain: ----------





Steel band: ---

Engineer's chain: ---

Gunter's chain: ---

Revenue chain: ---

Tapes: ---

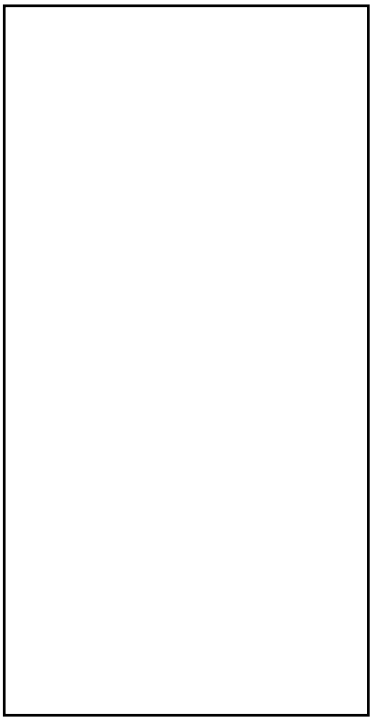
Cloth or linen tape: ---

Metallic tape: ---

Steel tape: ---

Invar tape: ---

Arrows: ---



Experiment No. 2

Objective: To measure the given field with the help of Chain Surveying.

Equipment's required:----------

Procedure:---------- ----------

Results: By Chaining and Ranging the total distance is found to be ----------

---

Experiment No. 3

Objective: To determine the area of a given polygon by chain & cross-staff survey.

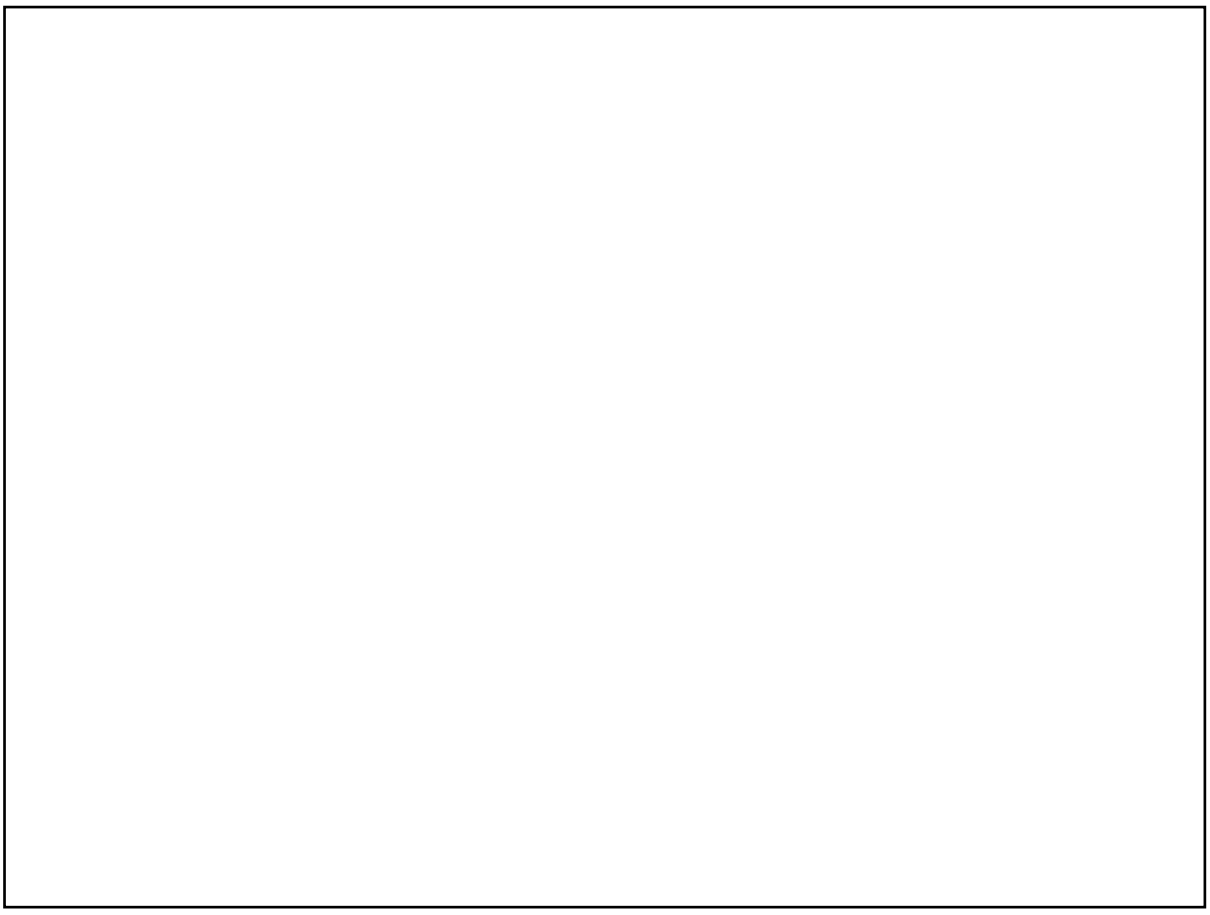
Equipment's required: ----------

Theory: ---------- ----------

Procedure: ---

Problem 1: Plot the following cross-staff survey of a field ABCDEFG and calculate its area.

	750	D
	650	210 E
C 180	490	
	300	250 F
B 160	180	
	100	50 G
	0	A



Observations:

S No.	Figure	Chainage(m)	Base (m)	Offsets (m)	Mean (m)	Area (m^2)
					Total	

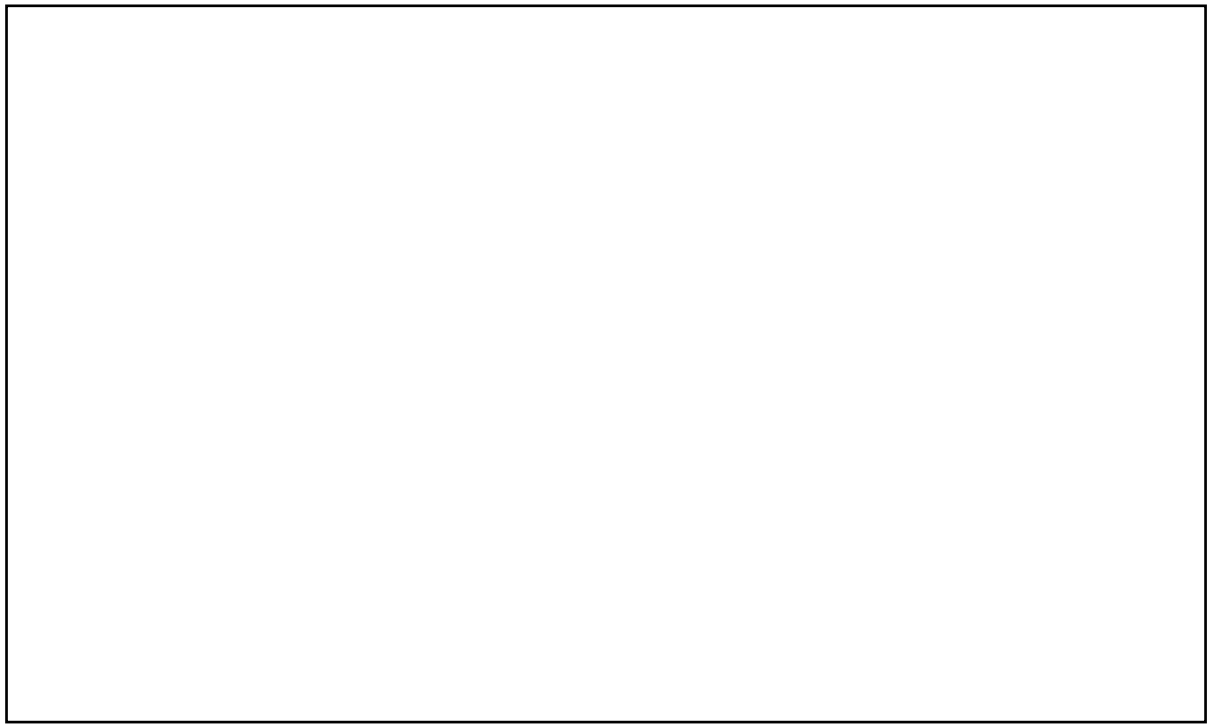
Results: ----------

Experiment No. 4

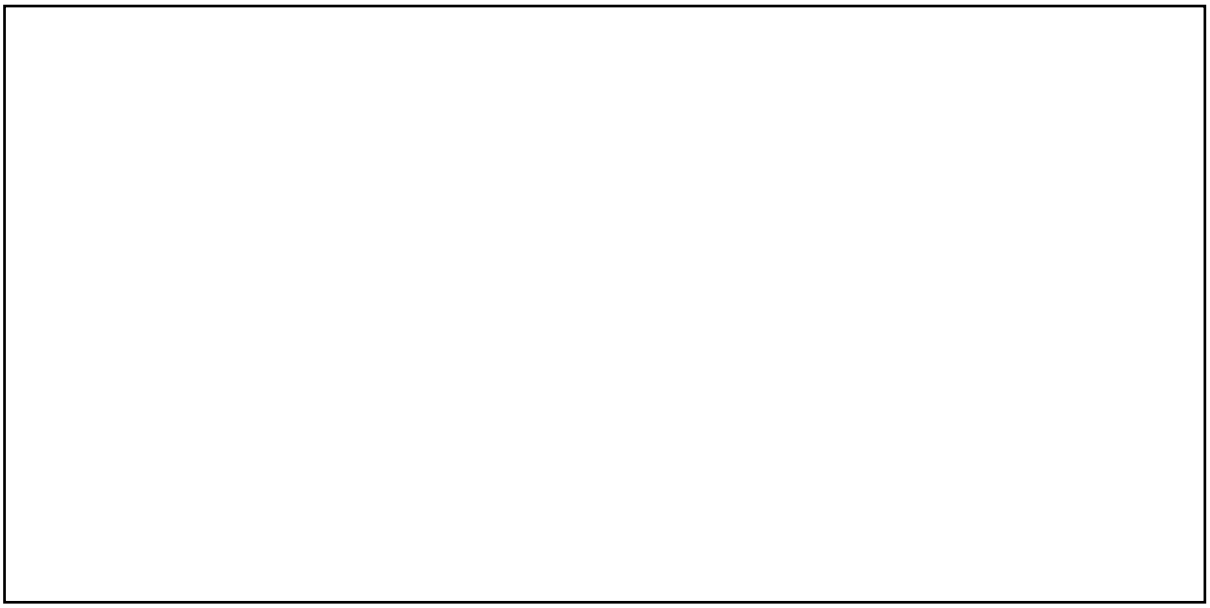
Objective: To identify the accessories needed in plane table surveying and also discuss the procedure of setting up a plane table over a station.

Accessories of a Plane Table:

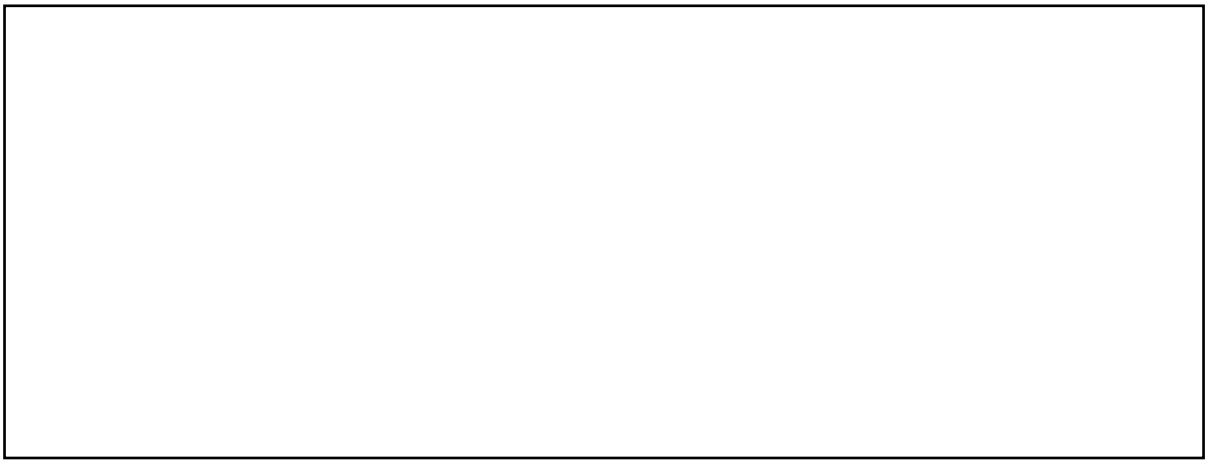
Plane Table: ----------



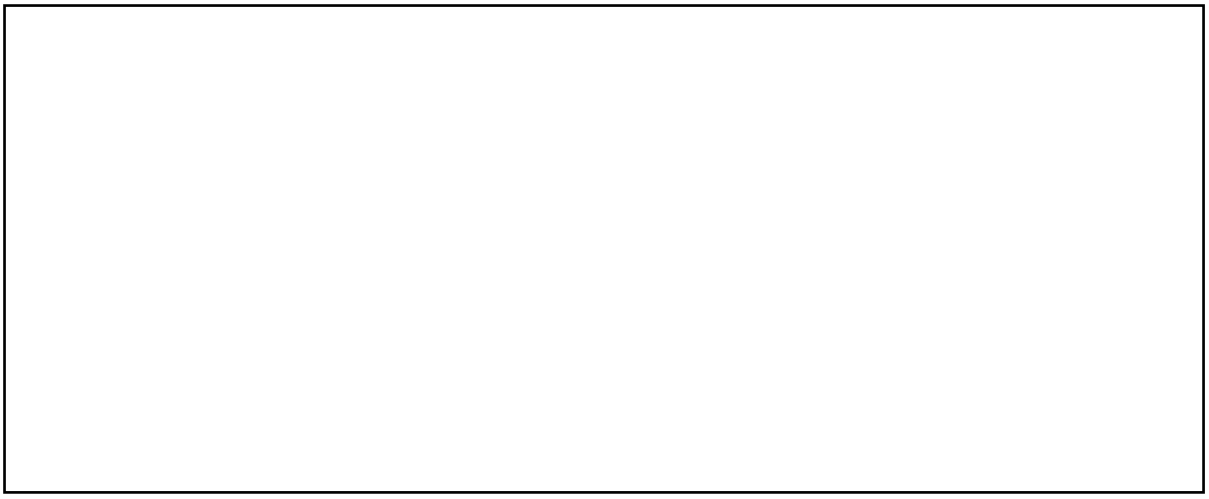
The Alidade: ----------



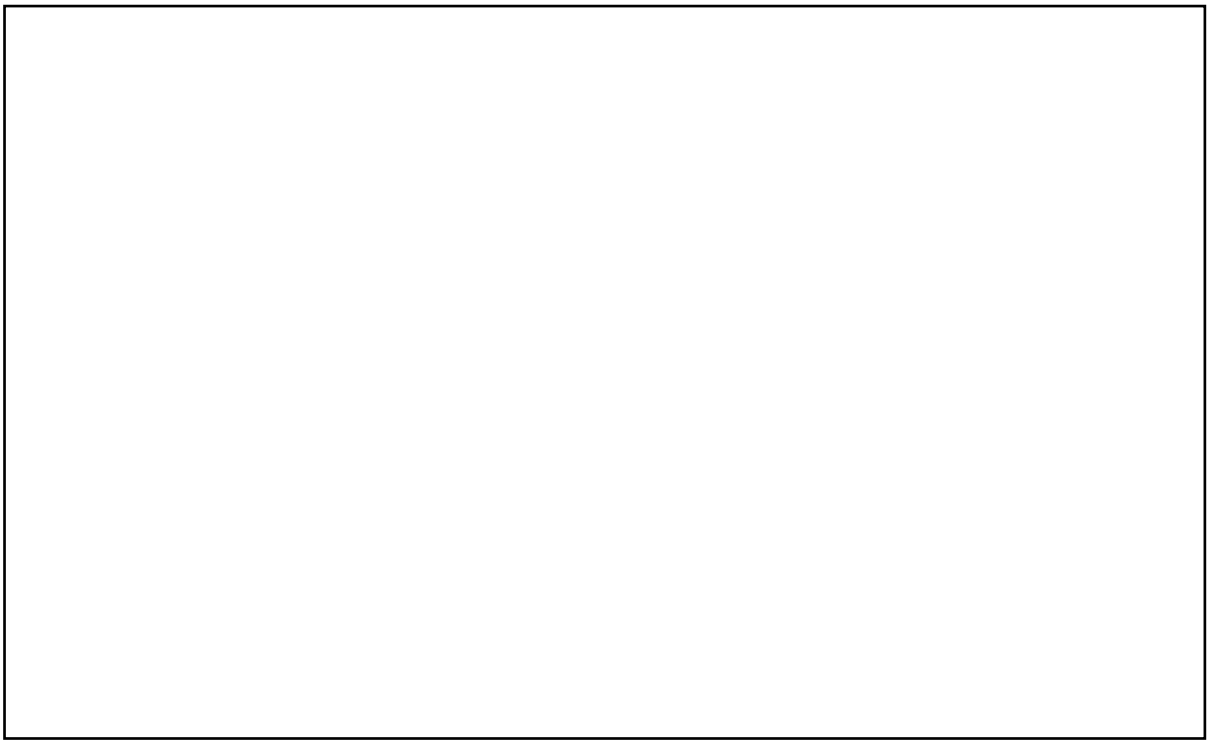
The Spirit Level: ---



The Compass: ---



U-fork or Plumbing fork with plumb bob: ----------



Procedure of setting up a plane table over a station

Steps:

Experiment No. 5

Objective: To study construction and working of prismatic and surveyor's compass.

Bearings and Angles:

Bearing: ----------

True Meridian: ----------

True Bearing: ----------

Magnetic Meridian: ----------

-

Magnetic Bearing: ----------

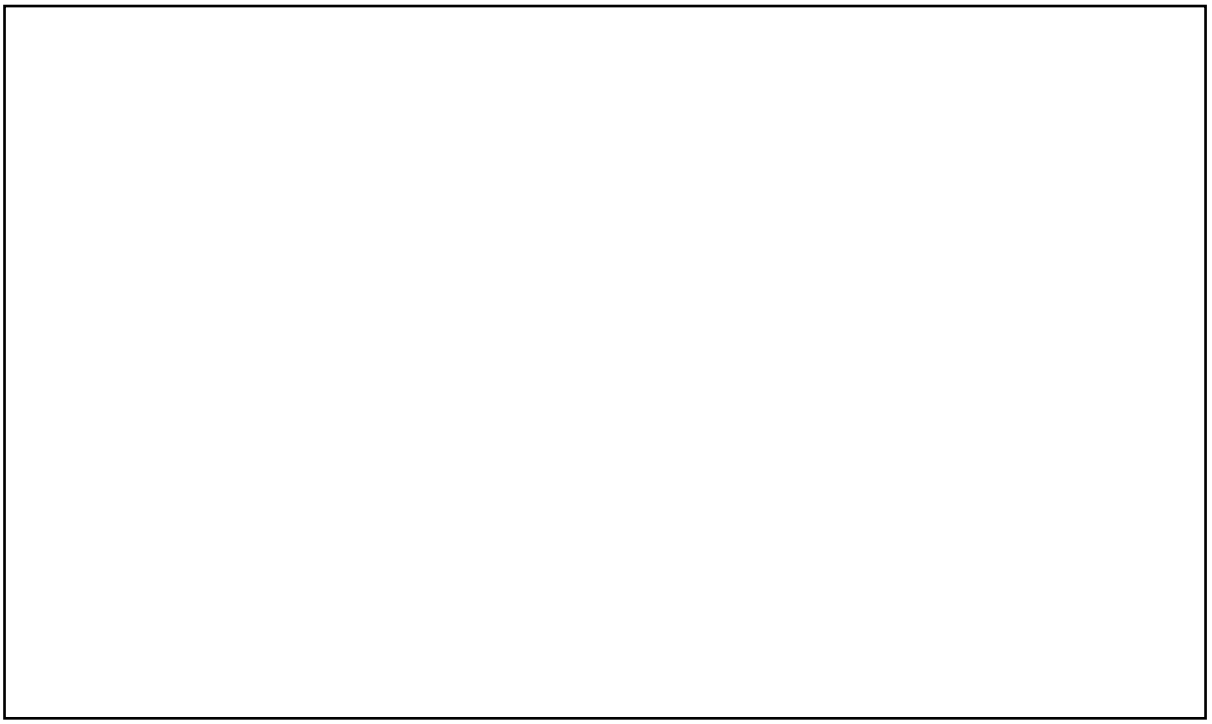
-

Arbitrary Meridian: ----------

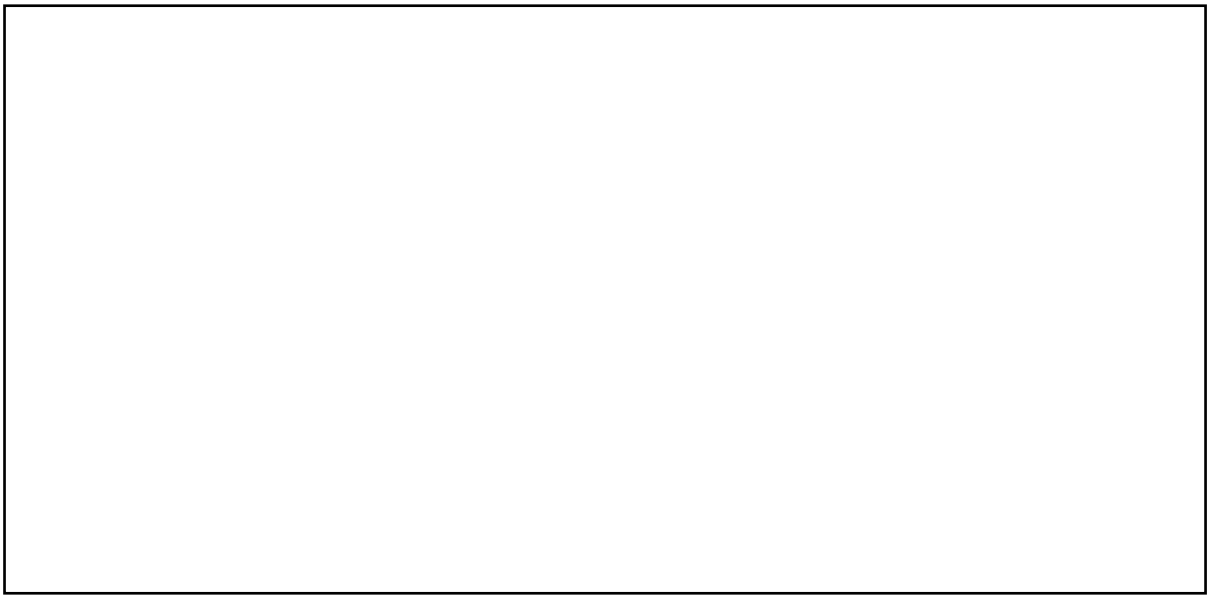
Arbitrary Bearing: ----------

Designation of bearings:

The Whole circle bearing system: ----------



The Quadrantal bearing system: ----------



Conversion of W.C.B. into R.B.

Line	W.C.B. between	Rule for R.B.	Quadrant

Conversion of R.B. into W.C.B.

Line	R.B.	Rule for W.C.B.	W.C.B. between

Types of Compasses:

The Prismatic compass: ----------

Components:
Compass box: ----------

Magnetic needle and graduated ring: ----------

Sight vane and prism: ----------

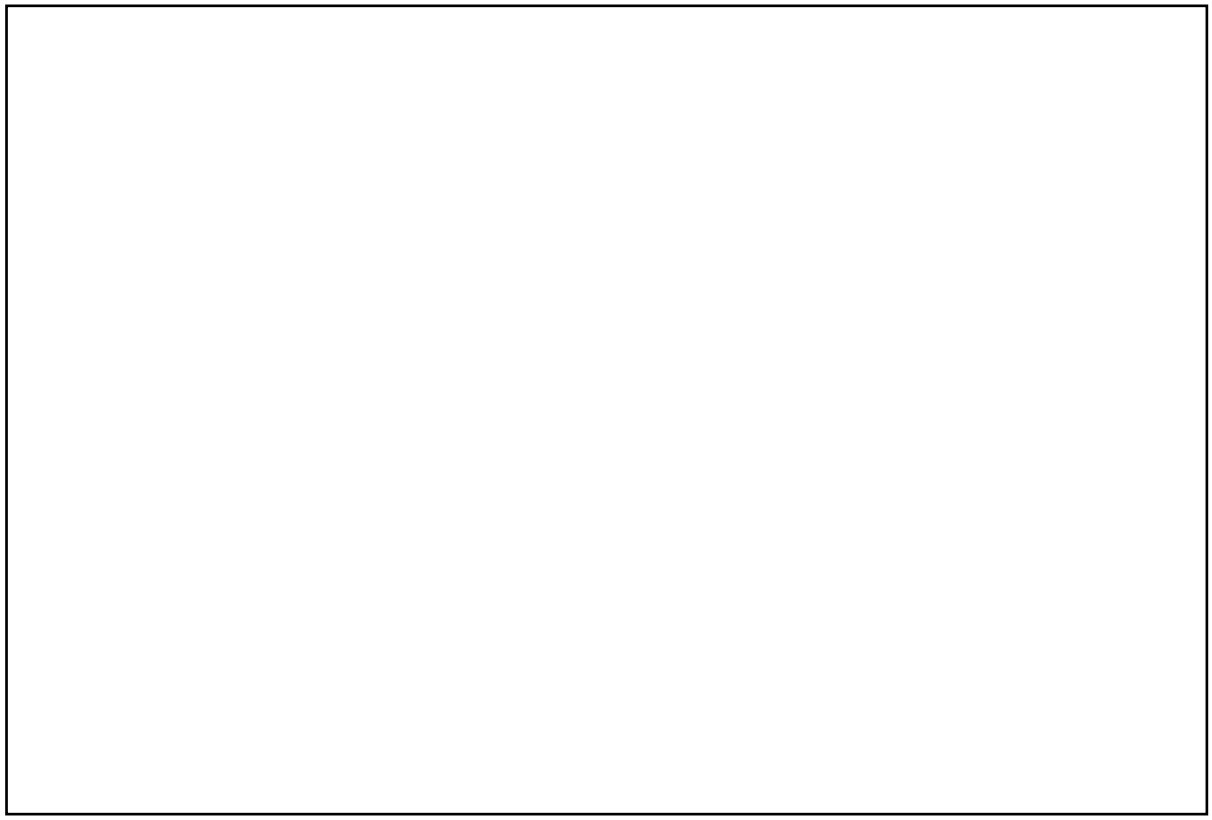
Dark glasses: ----------

Adjustable mirror: ----------

Brake pin: ----------

Lifting pin: ----------

Glass cover: ----------



Temporary adjustment of prismatic compass:

Fixing the compass with tripod stand: ----------

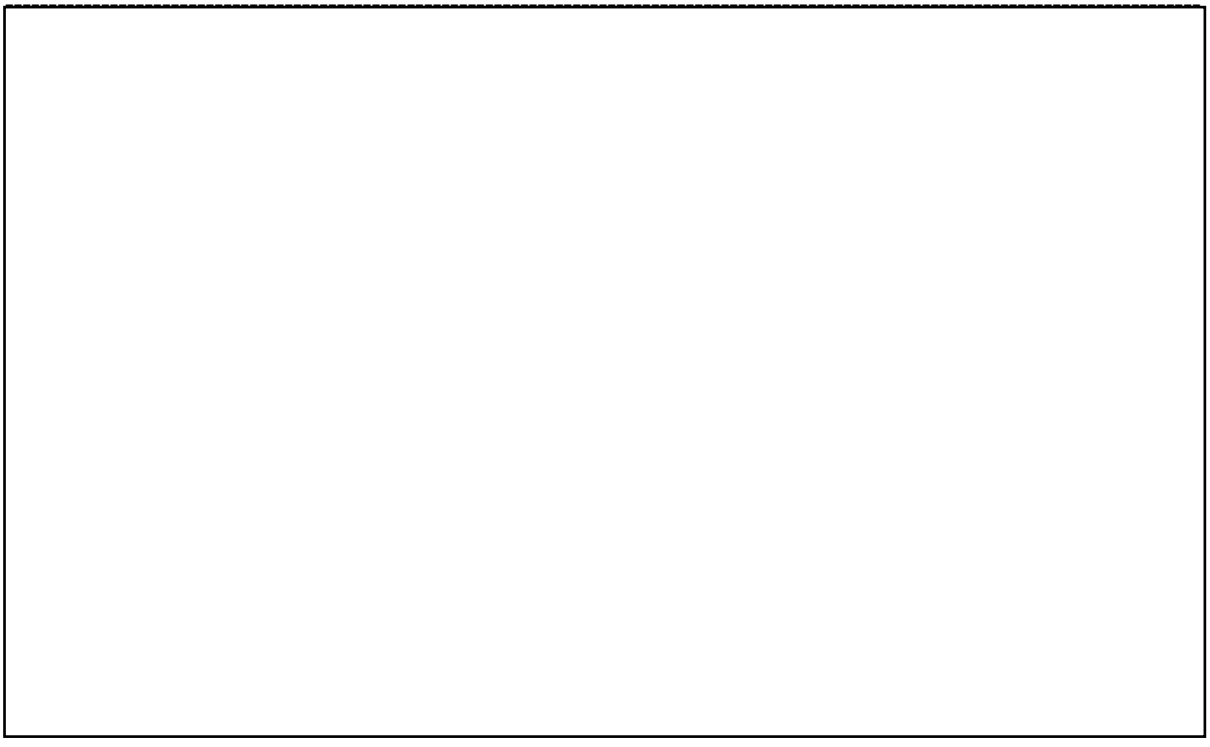
Centring: ---

Levelling: ---

Focusing the prism: ---

Observation of bearing: ---

The Surveyor's Compass: ---



Permanent adjustments of surveyor's compass: ----------

Errors in compass survey:

Instrumental errors: ----------

Personal errors: ----------

Natural errors: ----------

Experiment No. 6

Objective: To solve the numerical problem on computation of interior angles and correct included angle.

Problem 1: The following bearings were observed with a compass. Calculate the interior angles.

Line	Fore bearing
AB	60^{o} 30’
BC	122^{o} 0’
CD	46^{o} 0’
DE	205^{o} 30’
EA	300^{o} 0’

Solution:

Problem 2: The following are the bearings observed in traversing, with a compass, an area where local attraction was suspected. Find the amount of local attraction at different stations, the correct bearings of the lines and the included angles.

Line	Fore bearing	Back bearing
AB	59^o 0’	239^o 0’
BC	139^o 30’	317^o 0’
CD	215^o 15’	36^o 30’
DE	208^o 0’	29^o 0’
EA	318^o 30’	138^o 45’

Solution:

Calculation of included angles: ----------

Calculation of corrected bearings: ----------

Result: The result is tabulated as follows:

Line	Observed		Correction	Corrected		Remarks
	FB	BB		FB	BB	
AB						
BC						

CD						
DE						
EA						

Experiment No. 7

Objective: To study various instruments of levelling and describe working and construction of dumpy level.

Levelling: ----------

Levelling instruments:

Level: ----------

Levelling staff: ----------

Self-reading staff: ----------

Target staff: ---

Dumpy level: ---

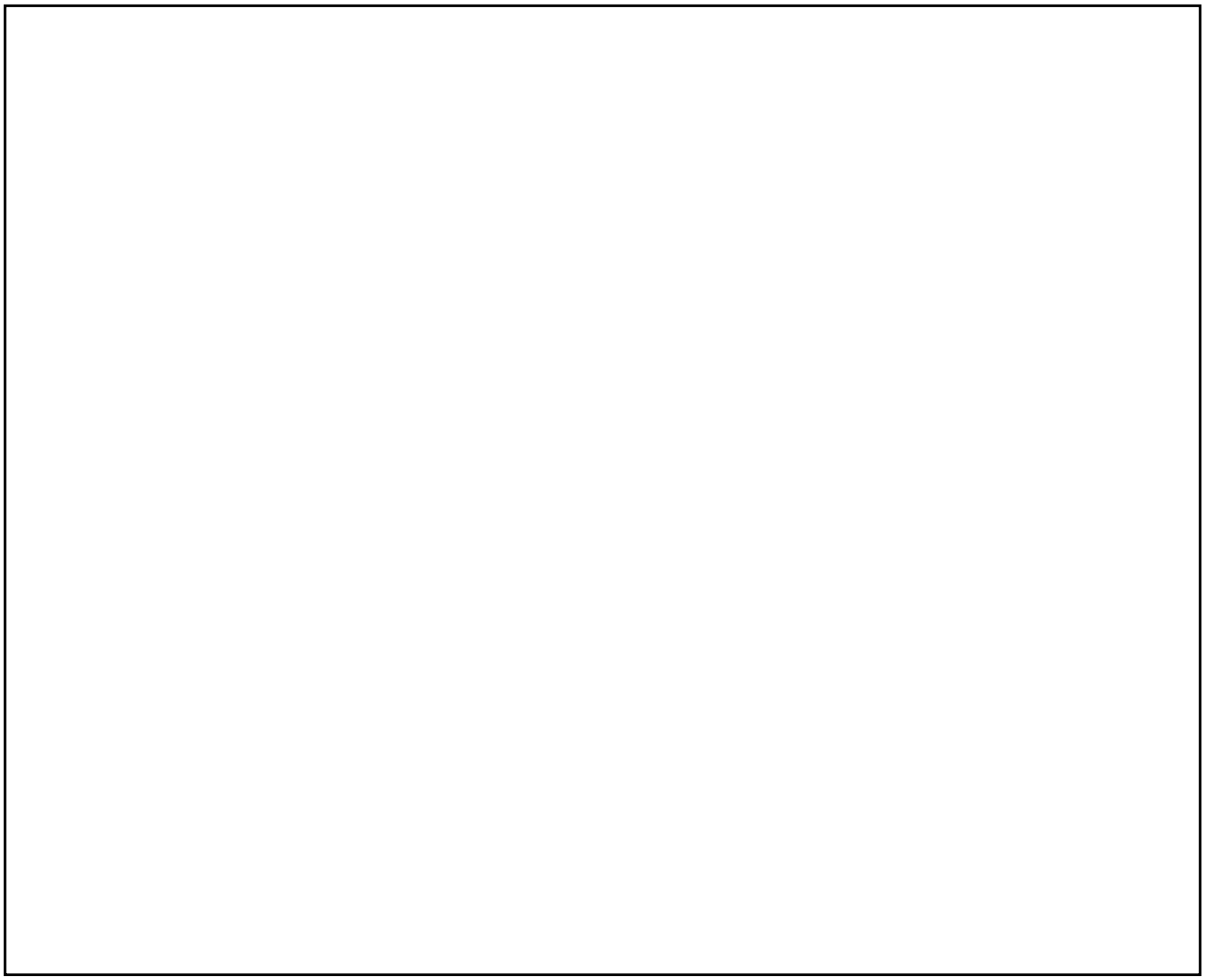
Description of dumpy level:

Tripod stand: ---

Levelling head: ---

Foot screws: ---

Telescope: ---



Bubble tubes: ----------

Compass: ----------

Diaphragm: ----------

Points to be remembered by staffmen: ---------- -------

Points to be remembered by Level men: ---------- ----------

Procedure for use of compass: ----------

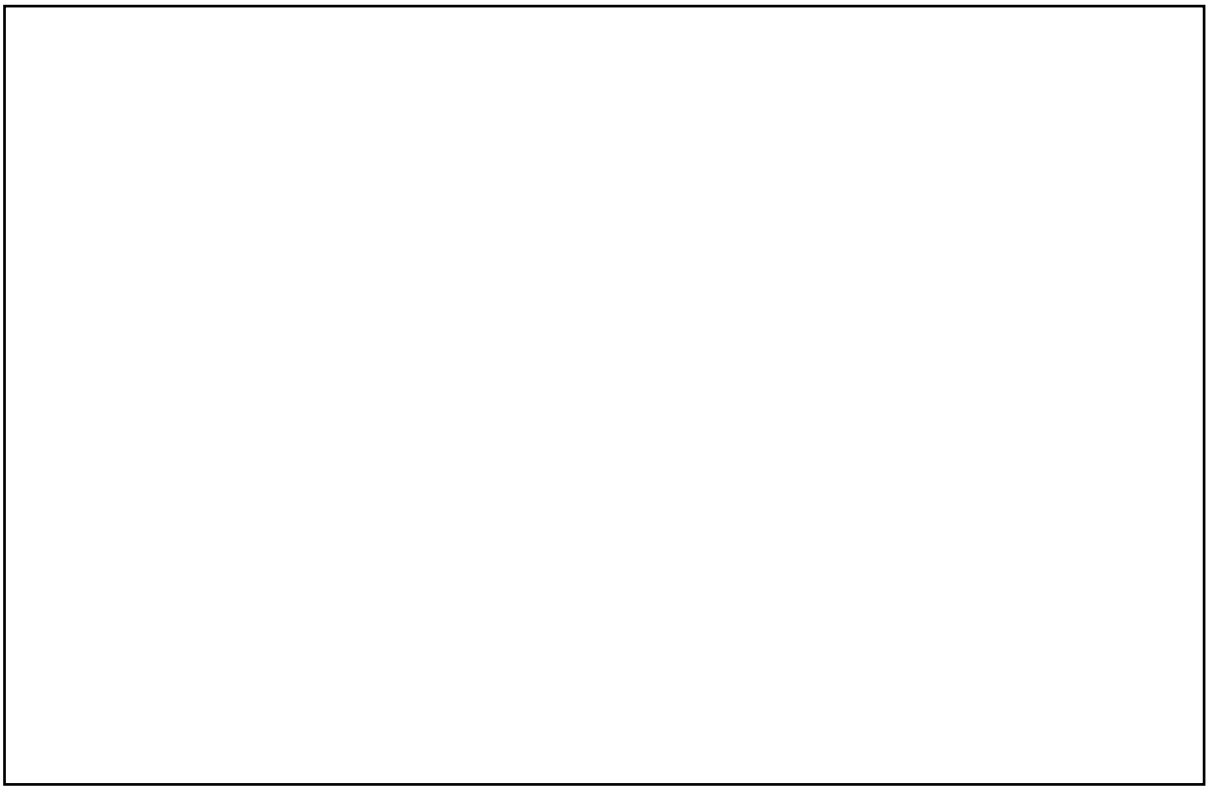
Temporary adjustment of level: ----------

Selection of suitable position: ----------

Fixing level with tripod stand: ----------

Approximate levelling by legs of tripod stand: ----------

Perfect levelling by foot screws: ----------



Focussing the eyepiece: ---

Focussing the object glass: ---

Taking the staff readings: ---

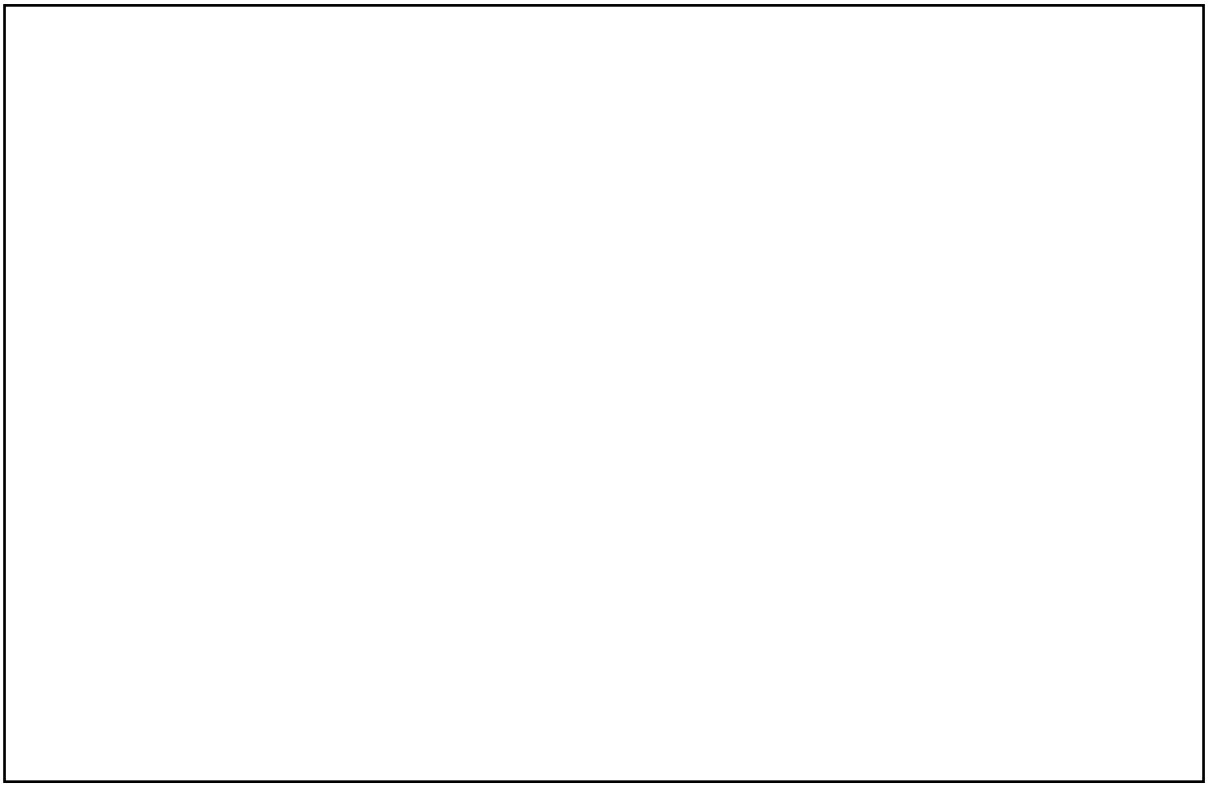
Experiment No. 8

Objective: To study various types of levelling operations.

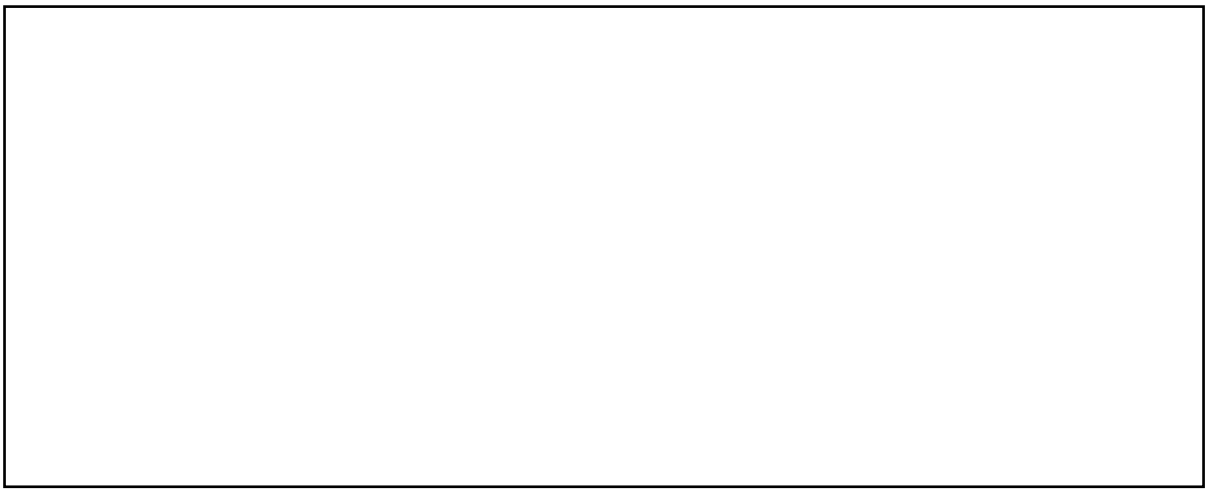
Simple levelling: ----------

Differential levelling: ----------

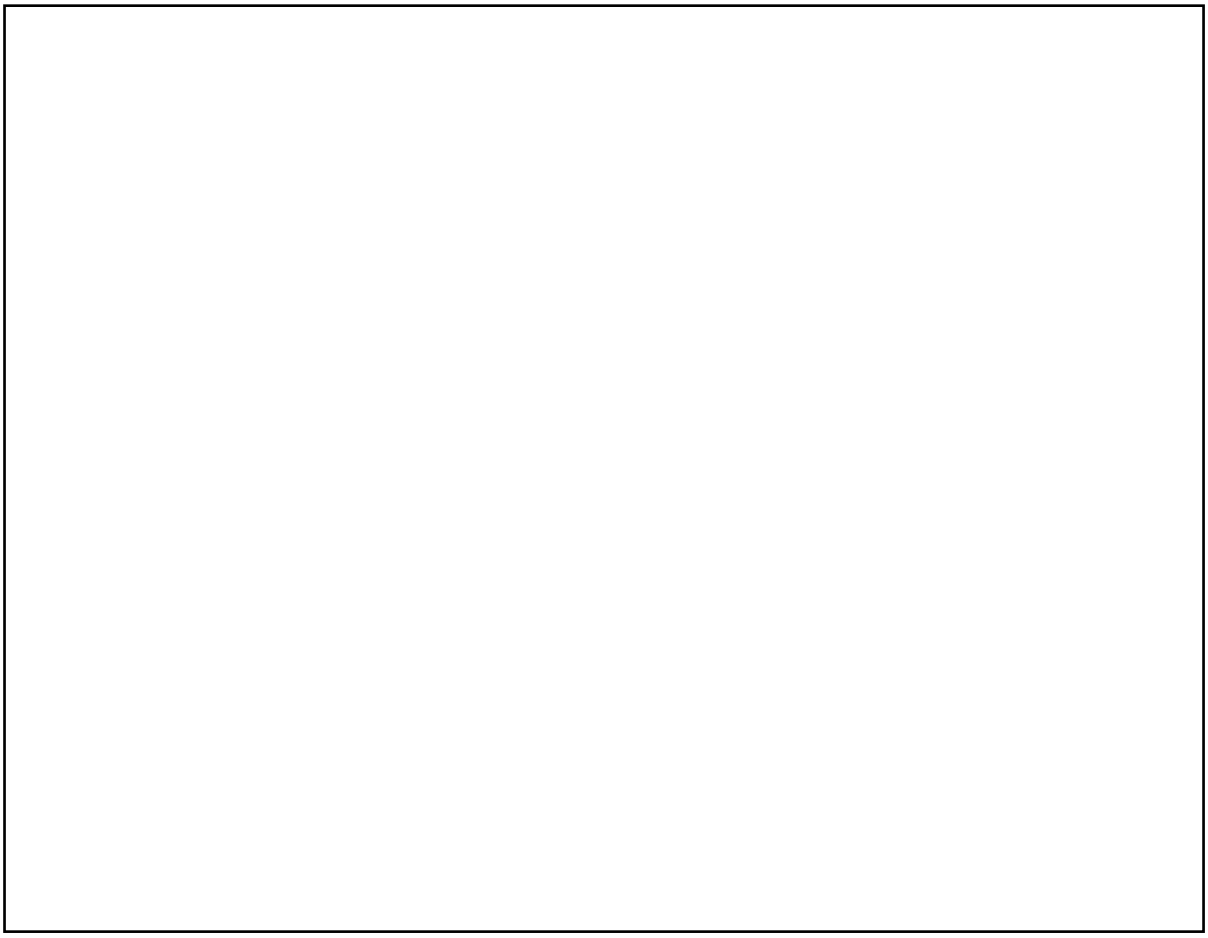
Fly levelling: ----------



Longitudinal or Profile levelling: ----------



Check levelling: ----------



Experiment No. 9

Objective: To determine the elevation of various points with dumpy level by collimation plane method and rise and fall method.

Methods of calculation of reduced levels: ----------

The plane of collimation system (H.I. system): ----------

-

Observation table:

Station	B.S.	I.S.	F.S.	H.I.	R.L.	Remarks

Arithmetic check: ----------

Rise and fall system: ----------

Observation table:

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks

Arithmetic check: ----------

Problem 1: The following staff readings were observed successively with level, the instrument having been moved forward after the second, fourth and eighth readings;

0.875, 1.235, 2.310, 1.385, 2.930, 3.125, 4.125, 0.120, 1.875, 2.030, 3.765 metres.

The first reading was taken with the staff held upon a benchmark of elevation 132.135 m. Calculate the reduced levels of the points by collimation and rise and fall system and enter the readings in level book-form. Apply the usual checks.

Solution: By Collimation system

Observation table:

Station	B.S.	I.S.	F.S.	H.I.	R.L.	Remarks

Arithmetic check: ----------

By Rise and fall system:

Observation table:

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks

Arithmetic check: ----------

Experiment No. 10

Objective: To study working and construction of transit theodolite.

Essentials of transit theodolite:

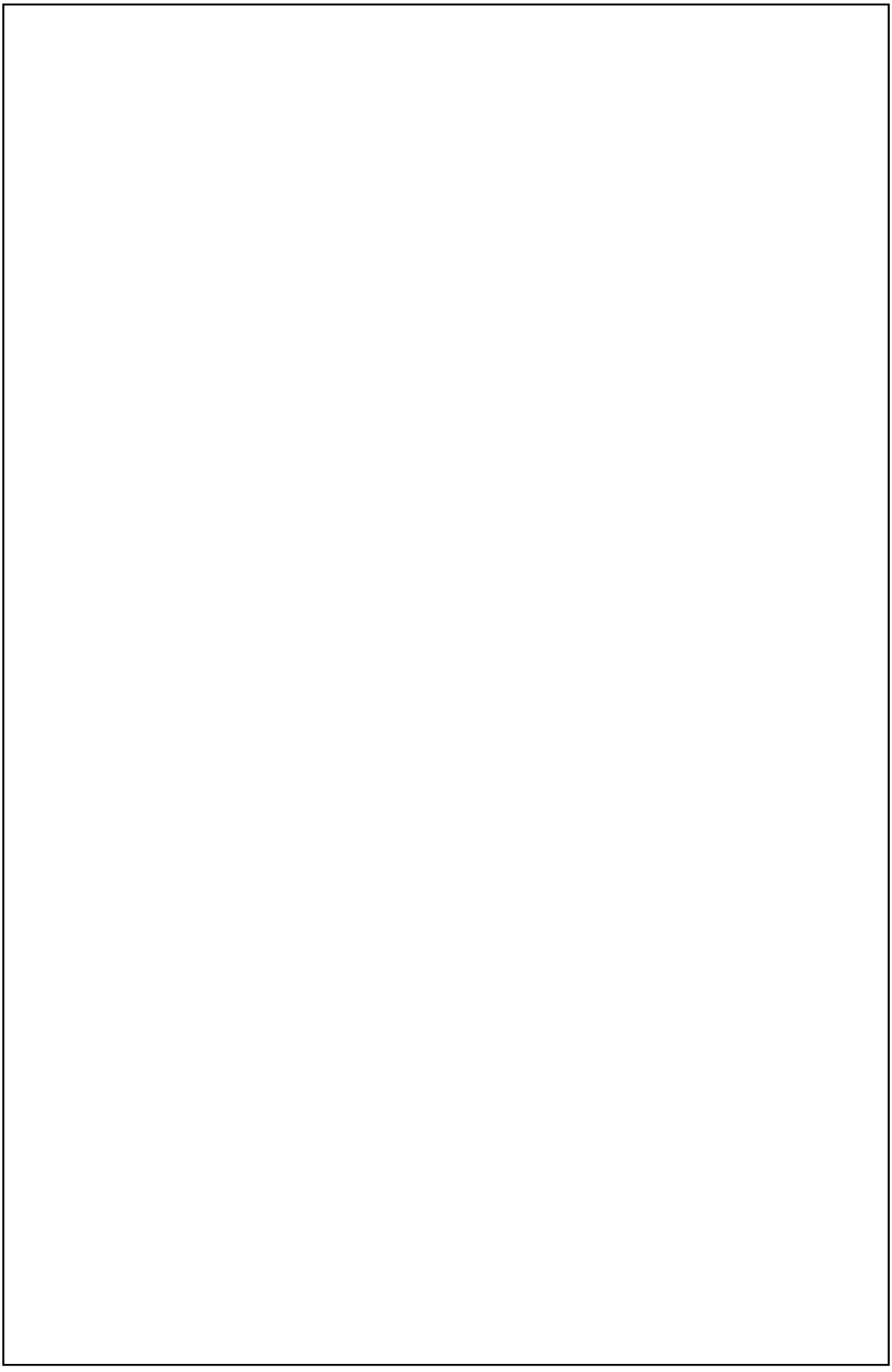
The telescope: ----------

The vertical circle: ----------

The index frame or T-frame or vernier frame: ----------

The standards (or A-frame): ----------

The levelling head: ----------



The two spindles: ----------

The lower plate (or scale plate): ----------

The upper plate (or vernier plate): ----------

Tripod: ----------

The plumb bob: ----------

The compass: ----------

Definitions and Terms:

The vertical axis: ----------

The horizontal axis: ----------

Face left observation: ----------

Face right observation: ----------

Telescope normal: ----------

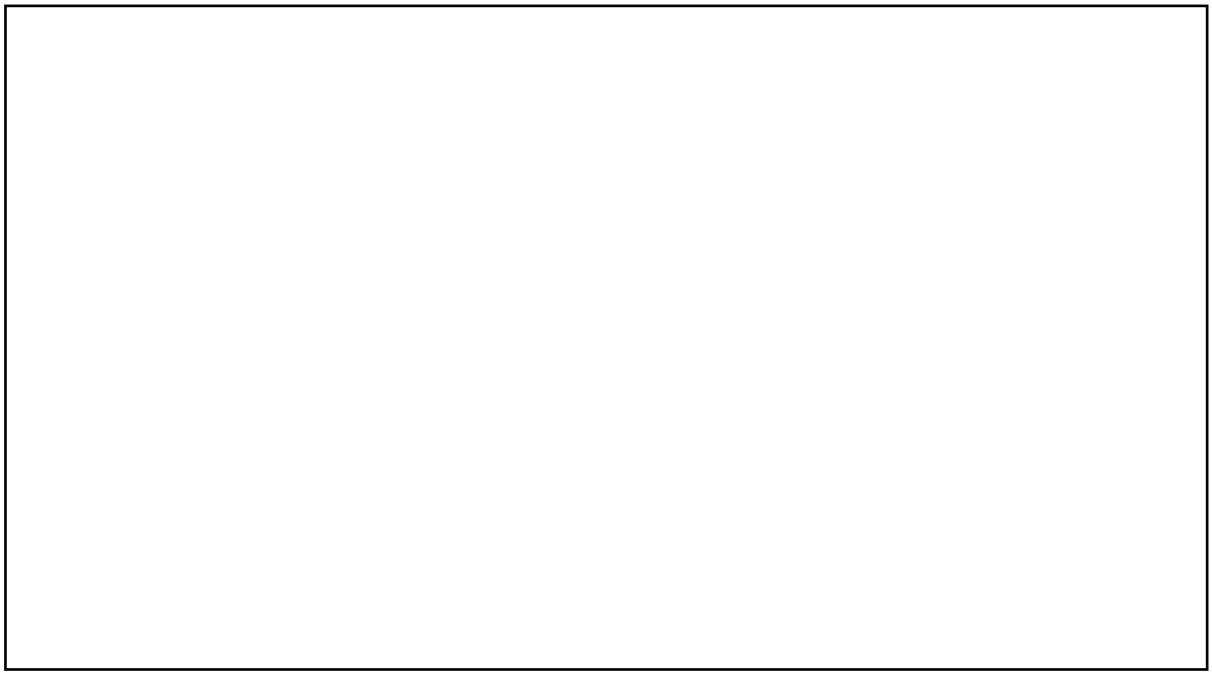
Telescope inverted: ----------

Temporary adjustments: ----------

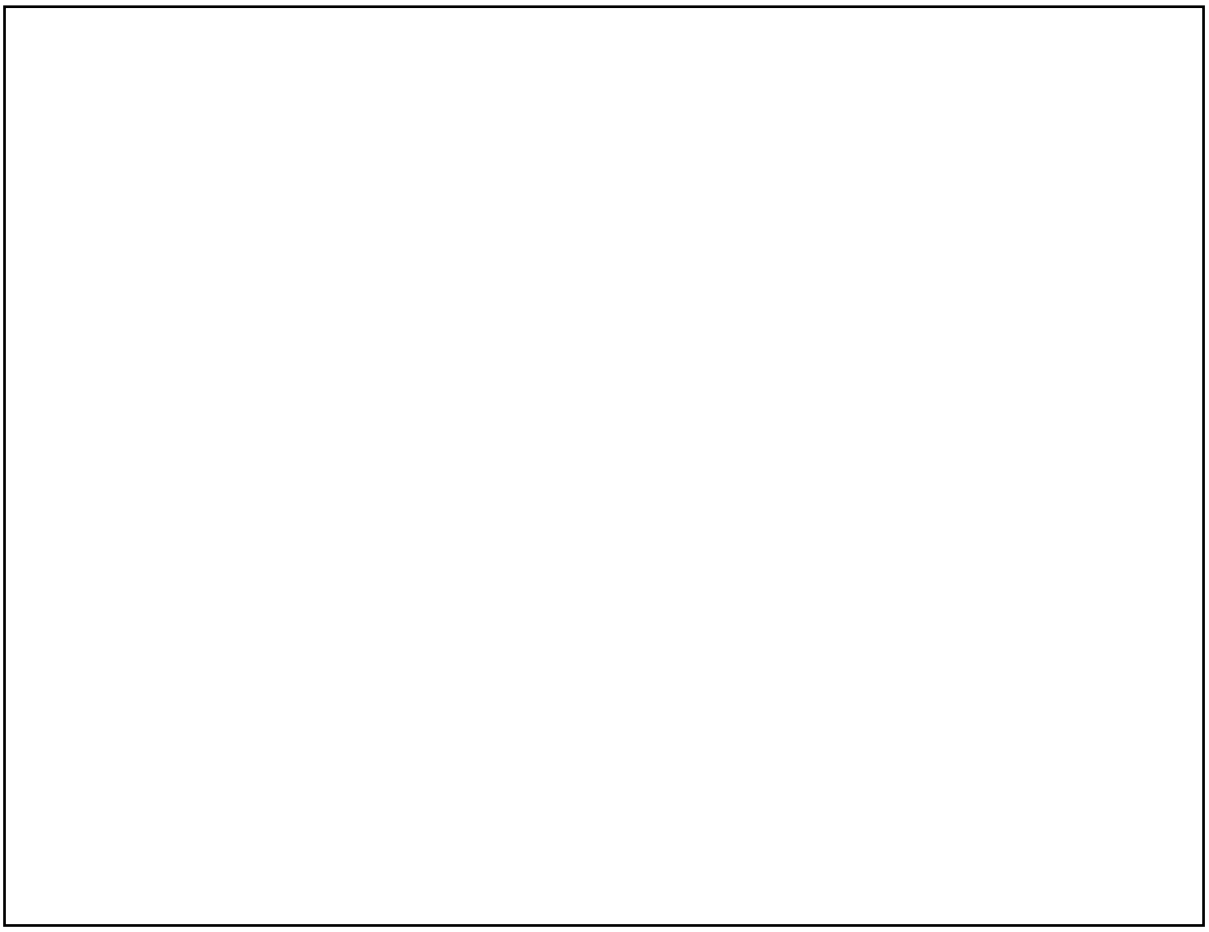
Setting over the station: ----------

Levelling up: ----------

Three screw head: ----------



Four screw head: ----------



Elimination of parallax: ----------

Focussing the eyepiece: ----------

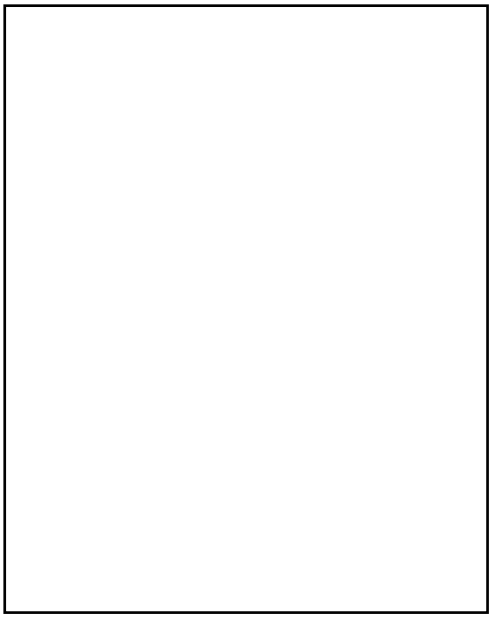
Focussing the objective: ----------

Experiment No. 11

Objective: To measure horizontal angle with the help of theodolite by repetition method.

Repetition method: ----------

Procedure: ----------



Observation table: Measurement of horizontal angle

Station	Object	Angle	Observation	Reading on Vernier		Angle on Vernier		Mean Angle of Vernier	Mean Angle of Observation	Remark

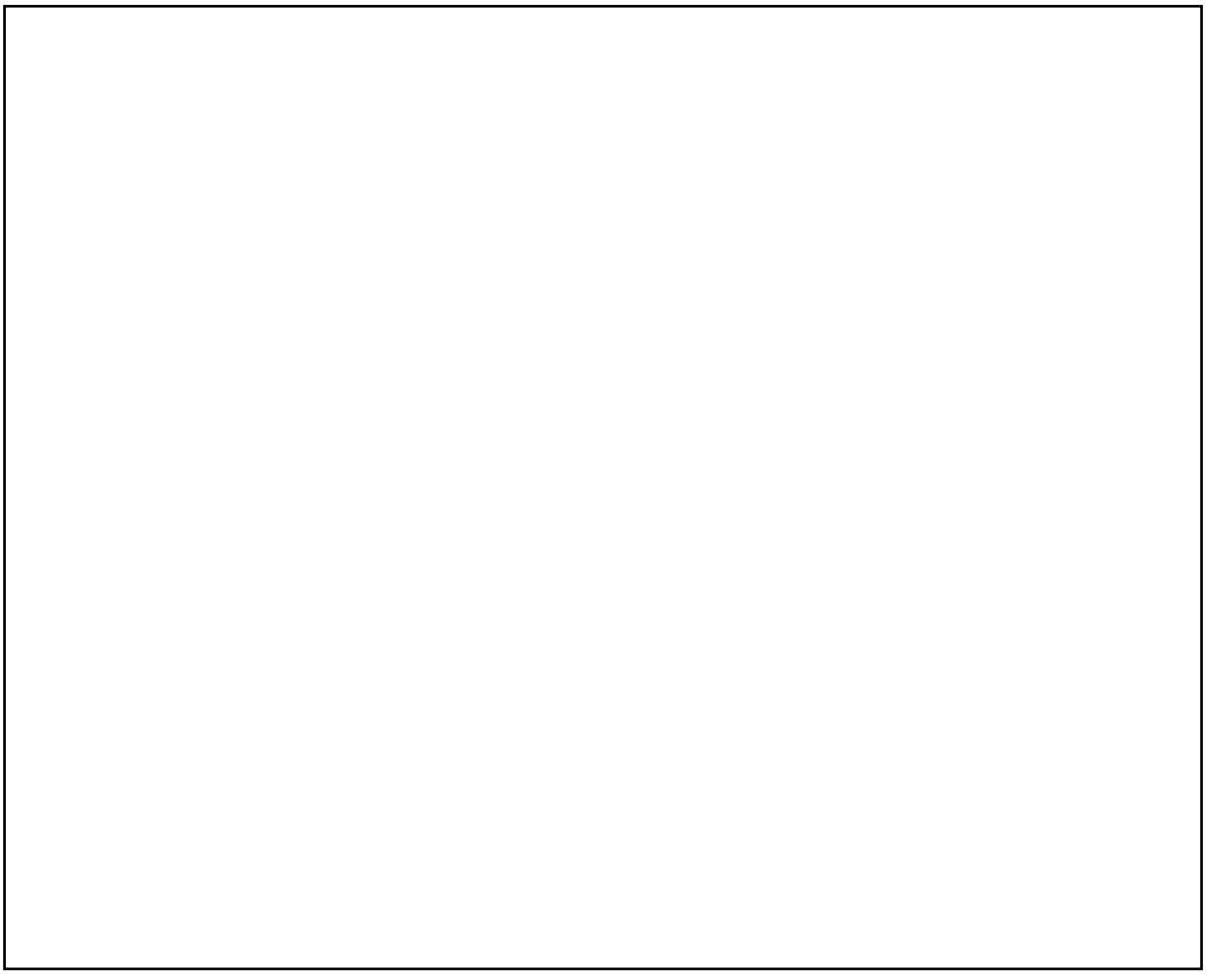
Result: Average horizontal angle is found to be ----------

Experiment No. 12

Objective: To study contouring and its characteristics.

Contouring: ----------

Contour line: ----------

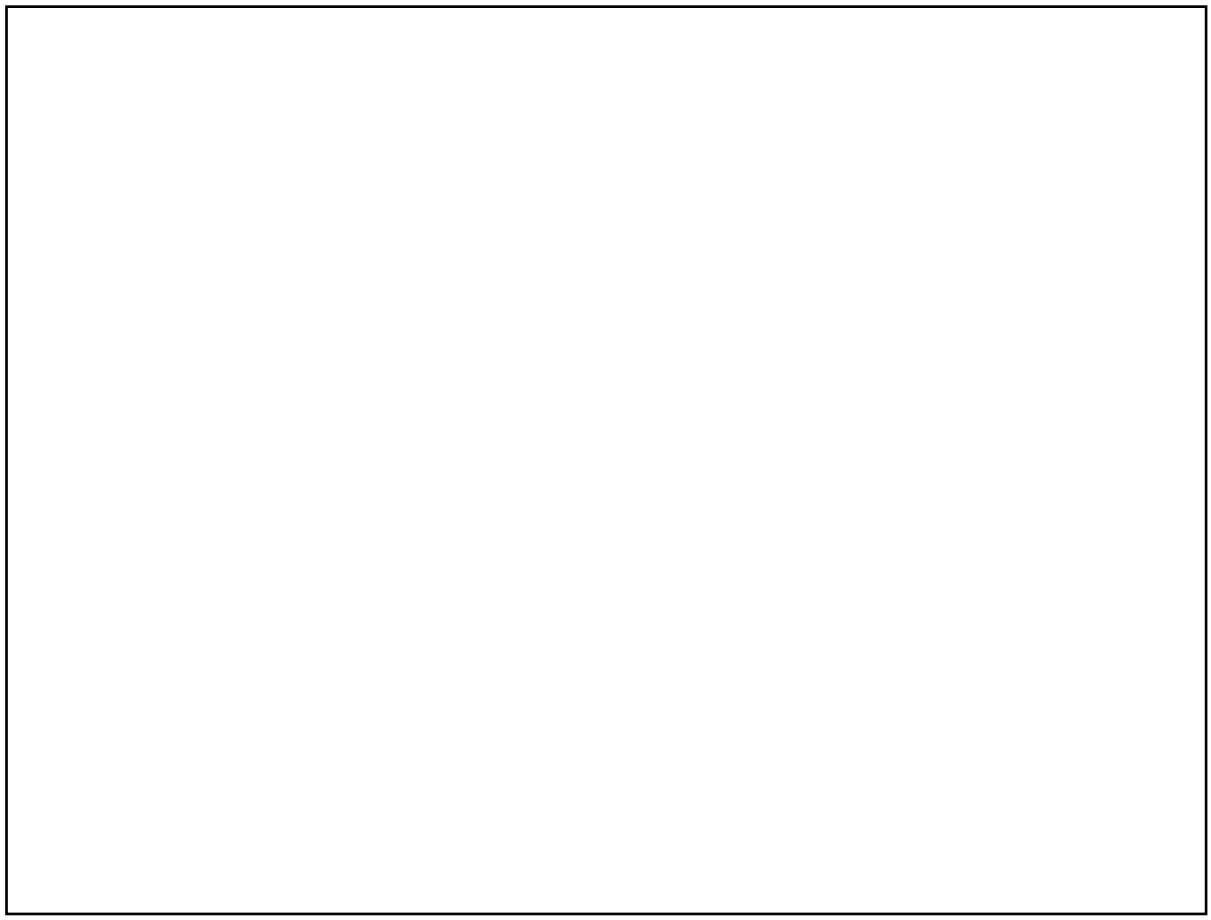


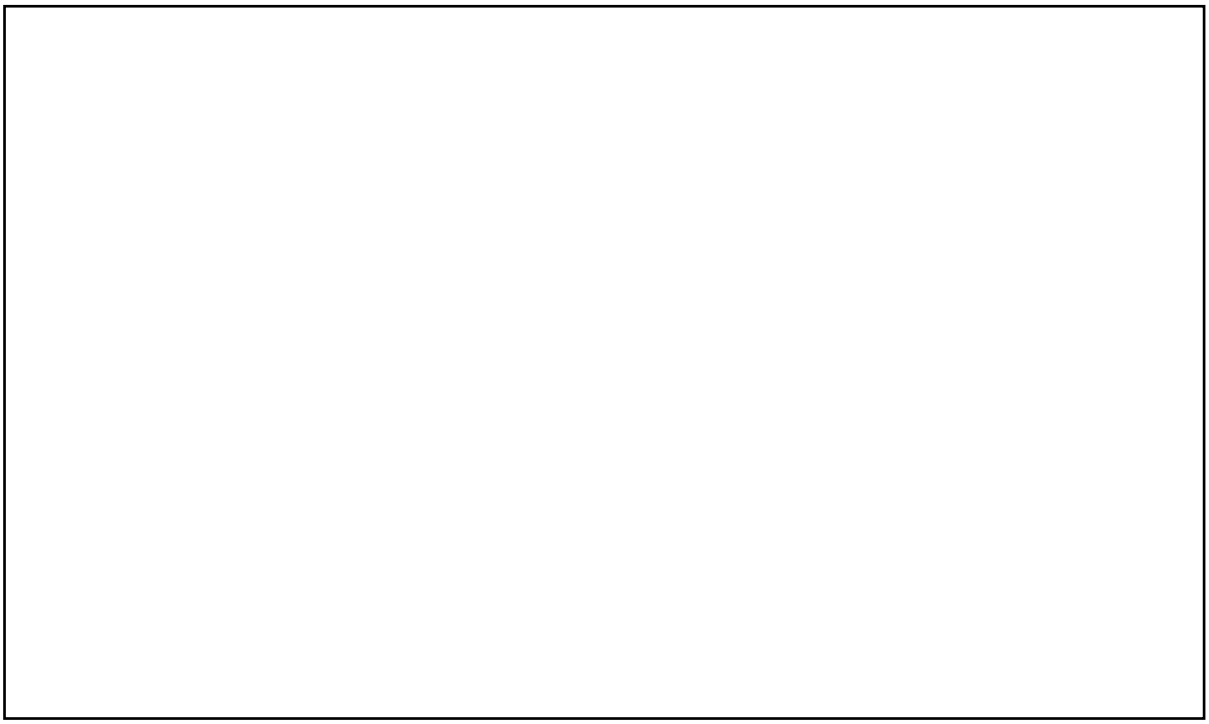
Contour interval: ----------

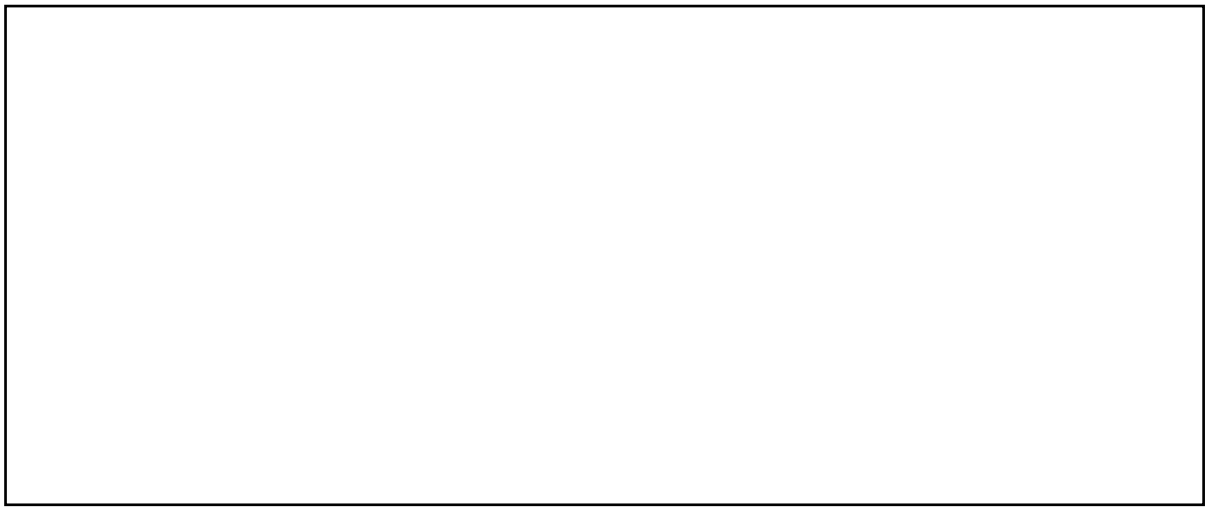
-

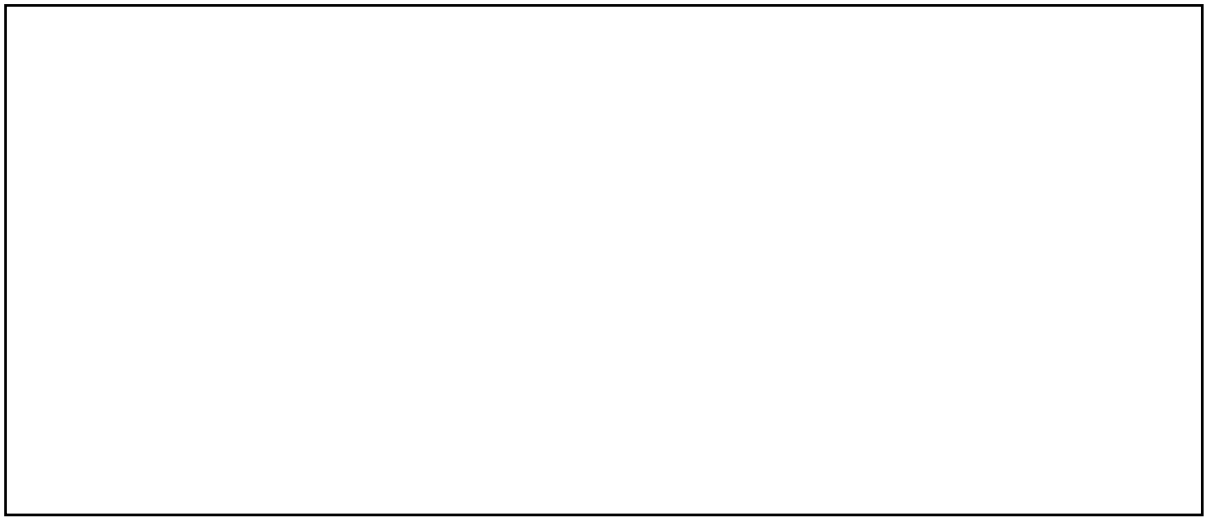
Horizontal equivalent: ----------

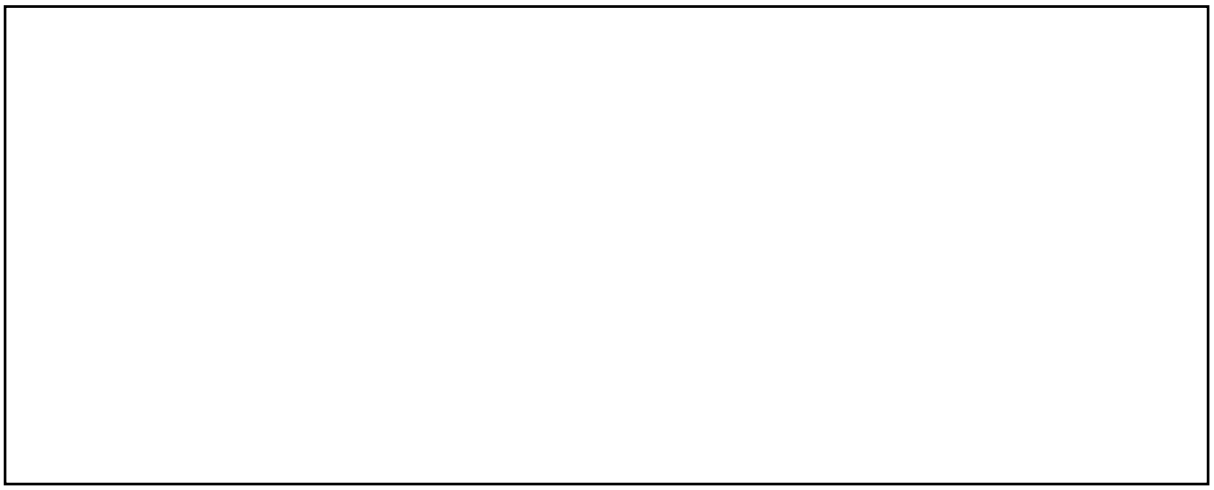
Characteristics of contours: ---------- ----------

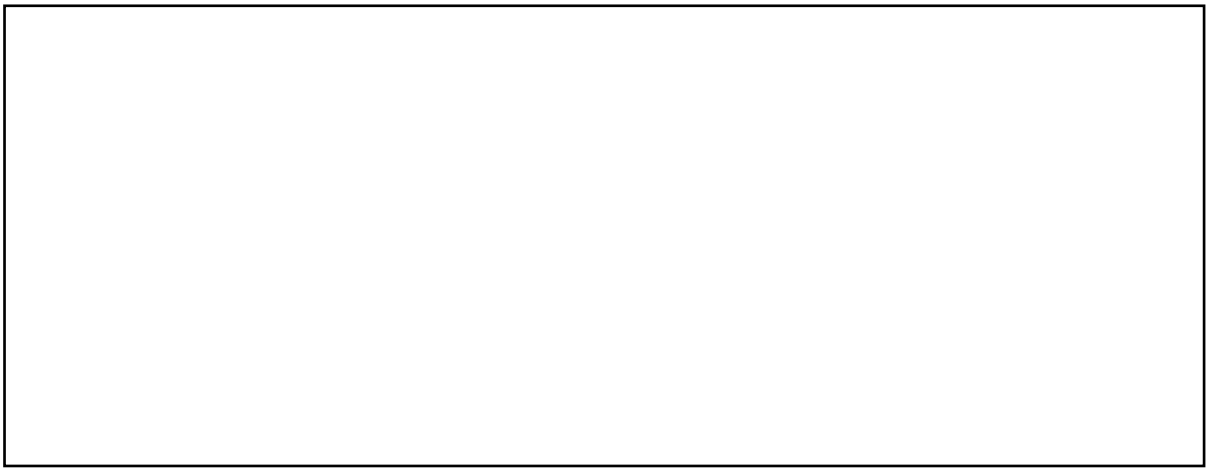


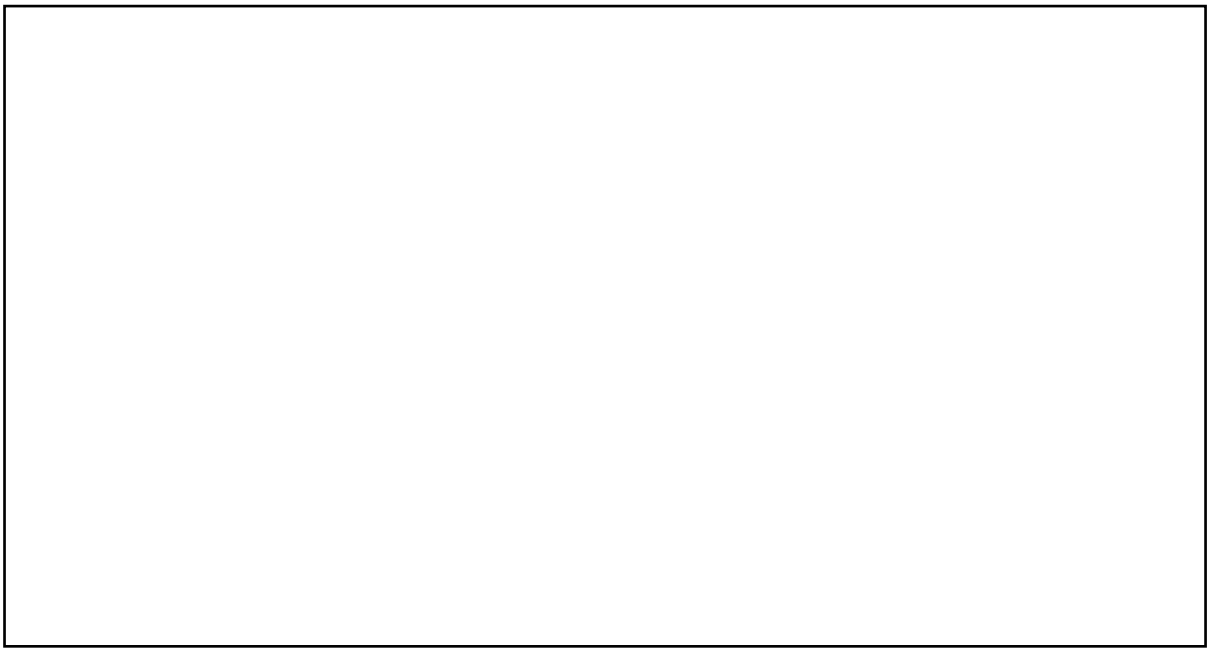


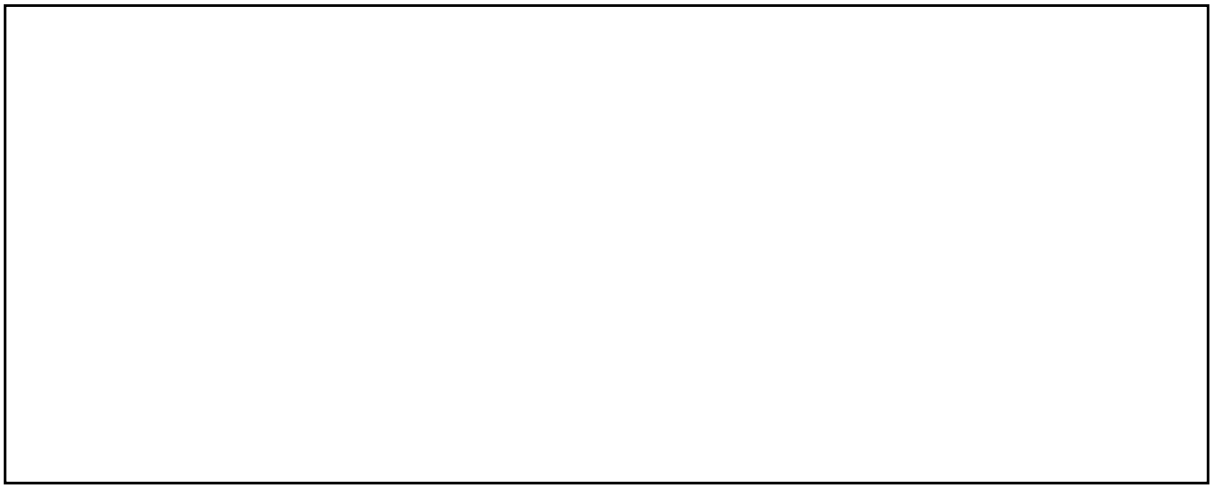


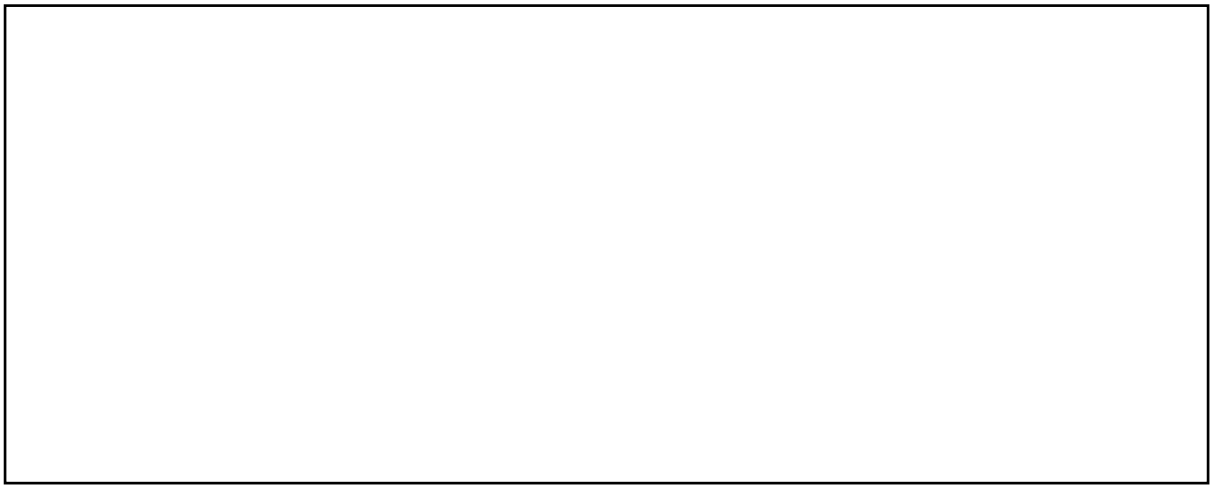


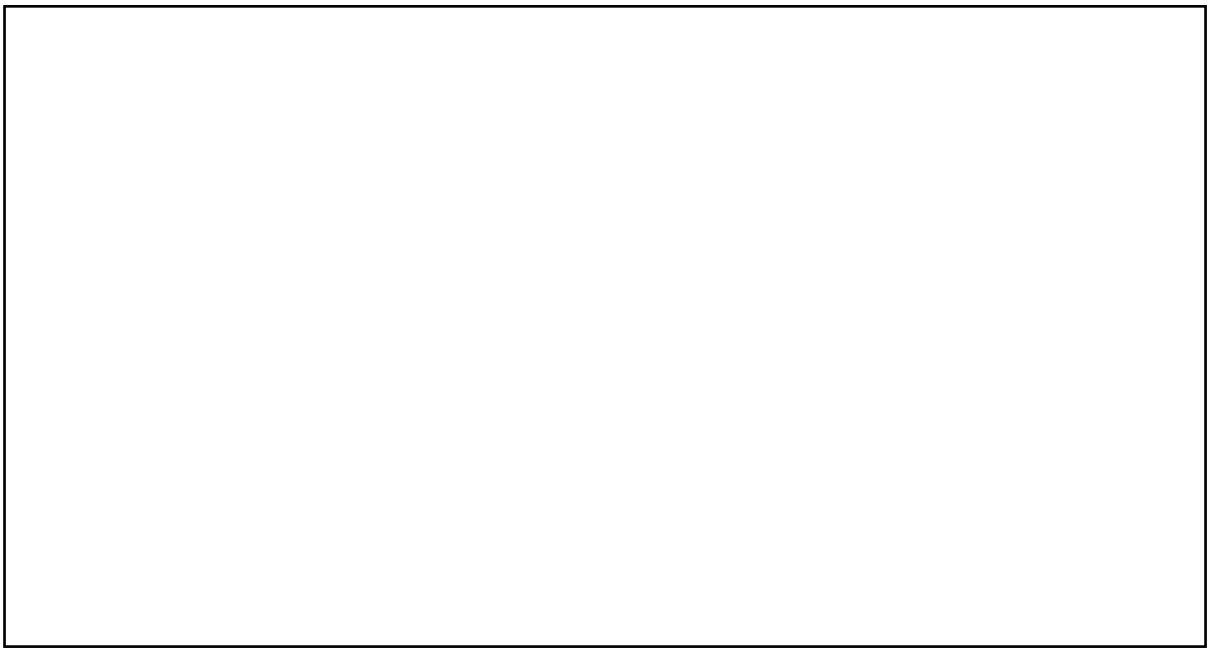












Uses of contour map: ----------

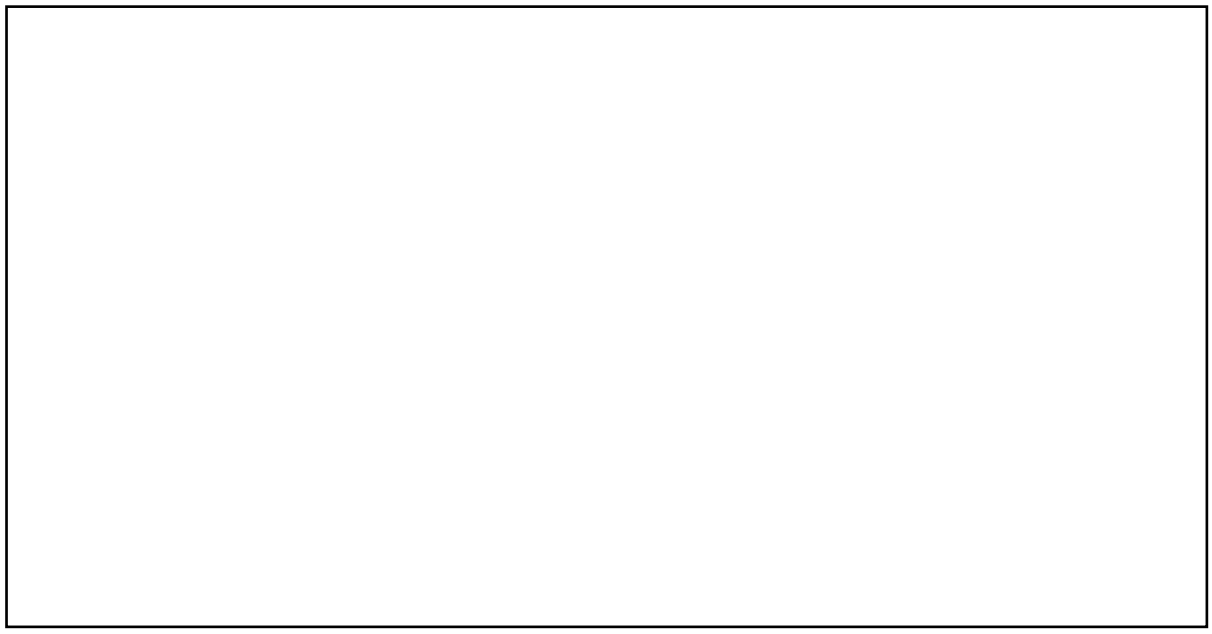
Method of interpolation of contours: ----------

By Arithmetical calculation: ----------

Experiment No. 13

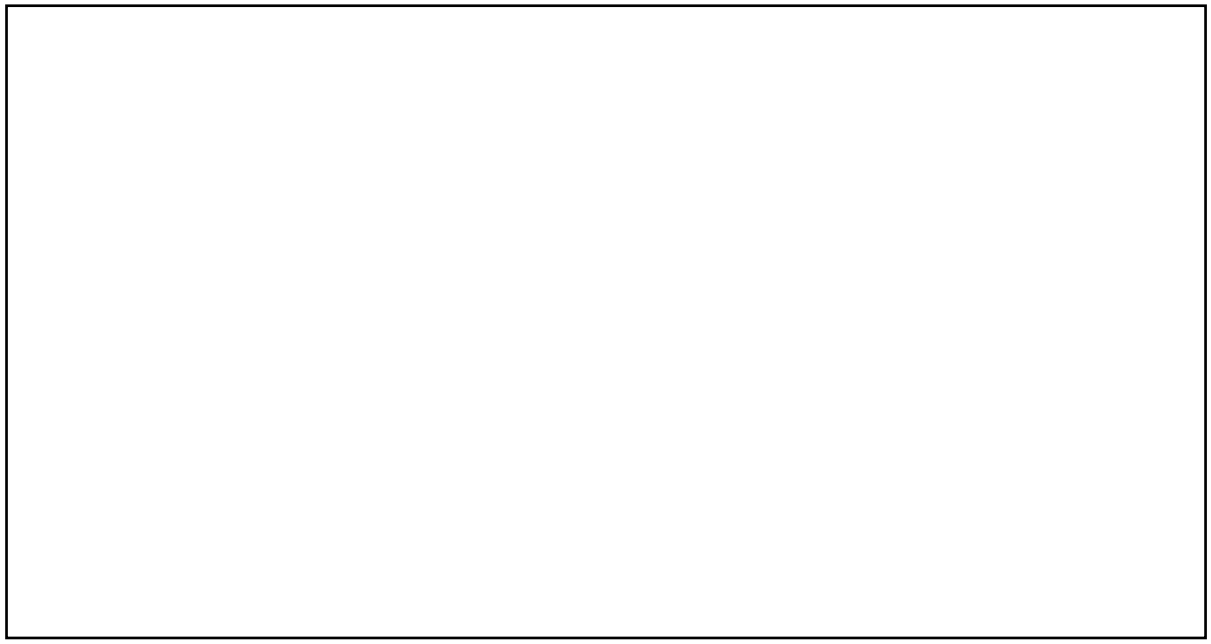
Objective: To calculate the areas from offsets to a base line.

Mid-ordinate rule: ----------



Average ordinate rule: ----------

Trapezoidal rule: ----------



Simpson's one third rule: ----------

Problem 1: A series of offsets were taken from a chain line to a curved boundary line at intervals of 15 metres in the following order

0, 2.65, 3.80, 3.75, 4.65, 3.60, 4.95, 5.85 m.

Compute the area between the chain line, the curved boundary and the end offsets by
(a) Average ordinate rule (b) Trapezoidal rule (c) Simpson's rule

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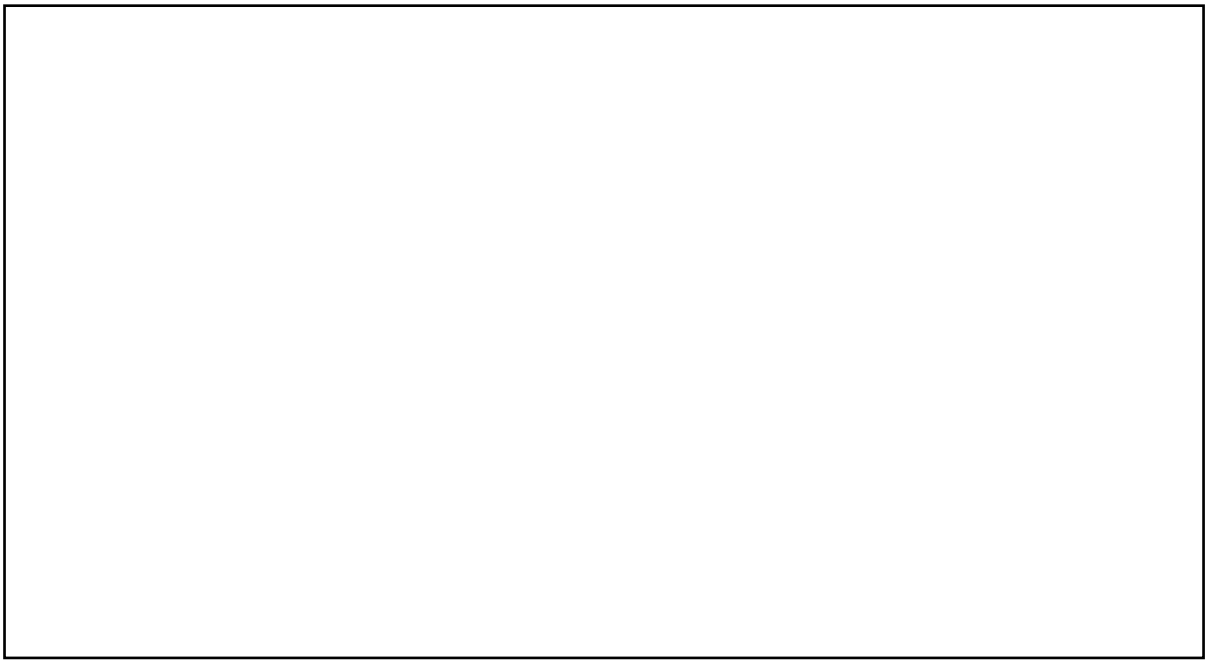
Offsets at irregular intervals: ----------



Problem 2: The following offsets were taken from a chain line to a field boundary at different points.

Chain distance (m)	0	10	20	30	40	60	80	100	120	150	180
Offset (m)	10	12	15	18	20	22	25	23	20	15	12

Calculate the area enclosed by Trapezoidal Rule and Simpson's Rule.

Experiment No. 14

Objective: To study about the site selection and preparation of building plans.

Setting out a building: ----------

Procedure: ----------

Experiment No. 15

Objective: To study the various steps involved in design of water ways.

Water ways: ----------

Steps involved in design of water ways:

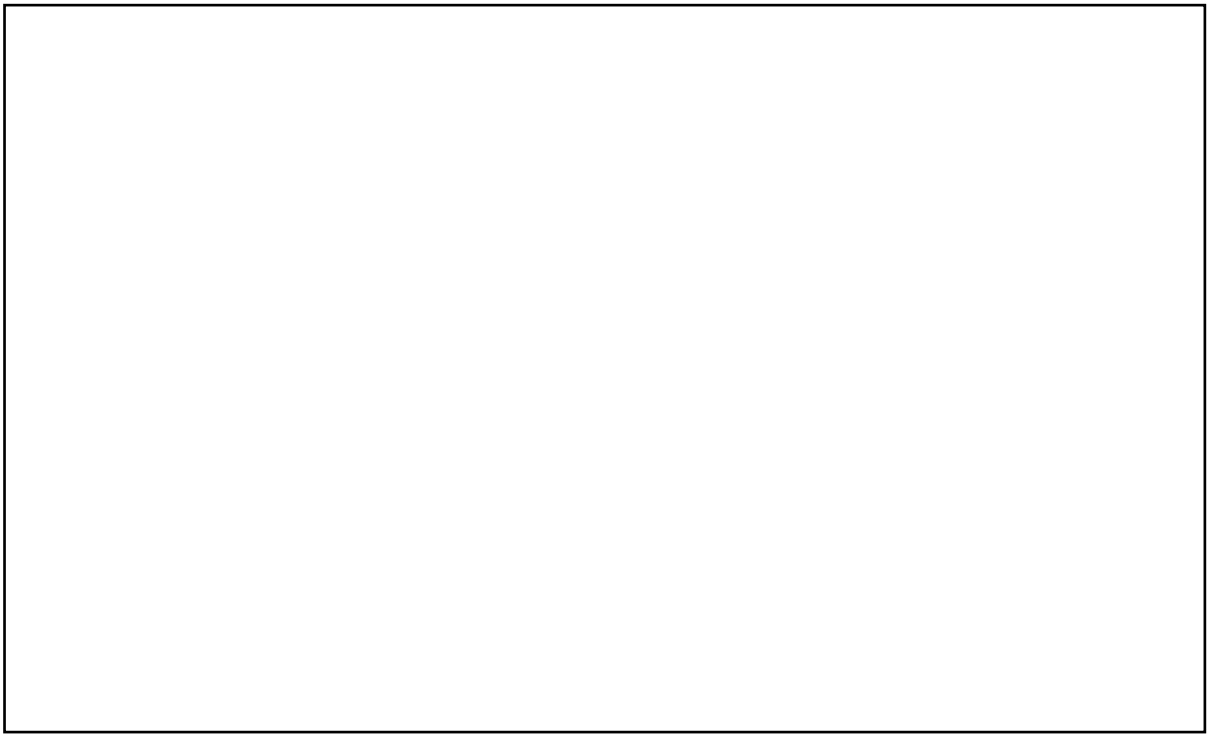
Experiment No. 16

Objective: To study the design of retaining walls.

Retaining walls: ----------

Types of Retaining Walls: ----------

Design of Masonary Retaining Walls: ----------



Experiment No. 17

Objective: To study the steps involved in design of check dams.

Check dam: ----------

Design criteria for check dam structures:

Distance between check dams and effective check dam height: ----------

---

Drainage area: ----------

Height: ----------

Number of check dams needed along a channel: ----------

-

Maximum discharge and spillway dimensions: ----------

-

Spillway design: ----------

Experiment No. 18

Objective: To study the design of simple wooden beam bridge.

Beam bridge: ----------

-

Steps involved in design of beam bridge: ----------

CONVERSION OF W.C.B. INTO R.B.

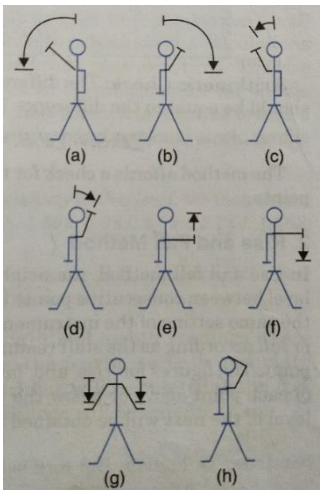
Line	W.C.B. between	Rule for R.B.	Quadrant
AB	0° and 90°	R.B. = W.C.B.	NE
AC	90° and 180°	R.B. = 180° – W.C.B.	SE
AD	180° and 270°	R.B. = W.C.B. – 180°	SW
AF	270° and 360°	R.B. = 360° – W.C.B.	NW

Conversion of R.B. into W.C.B.

Line	R.B.	Rule for W.C.B.	W.C.B. between
AB	N α E	W.C.B. = R.B.	0° and 90°
AC	S β E	W.C.B. = 180° – R.B.	90° and 180°
AD	S θ W	W.C.B. = 180°+ R.B.	180° and 270°
AF	N Φ W	W.C.B. = 360° – R.B.	270° and 360°

HAND SIGNALS DURING OBSERVATION WHILE LEVELLING

Refer figure	Signal	Message
(a)	Movement of left arm over 90°	Move to my left
(b)	Movement of right arm over 90°	Move to my right
(c)	Movement of left arm over 30°	Move top of staff to my left
(d)	Movement of right arm over 30°	Move top of staff to my right
(e)	Extension of arm horizontally and moving hand upwards	Raise height peg or staff
(f)	Extension of arm horizontally and moving hand downwards	Lower height peg or staff
(g)	Extension of both arms and slightly thrusting downwards	Establish the position
(h)	Extension of arms and placement of hand on top of head	Return to me



OFFSETS AT REGULAR INTERVALS

Mid-ordinate rule: The area is calculated by the formula-

$$\text{Area} = \Delta = \text{Average ordinate} \times \text{Length of base}$$
$$= \frac{O_1+O_2+.....+O_n}{n} L$$

Where, $O_1, O_2...$ = the ordinates at the mid-points of each division
L = length of base line = nd
d = distance of each division

Average ordinate rule: The area is calculated by- Δ = Average ordinate x Length of base

Trapezoidal rule: The area is calculated by-

$$\Delta = \left\{\frac{O_o + O_n}{2} + O_1 + O_2 + \cdots O_{n-1}\right\} d$$

The trapezoidal rule may be expressed as follows:
Add the average of the end offsets to the sum of the intermediate offsets. Multiply the total sum thus obtained by the common distance between the ordinates to get the required area.

Simpson's one-third rule: The area is calculated by-

$$\Delta = \frac{d}{3}[(O_o + O_n) + 4(O_1 + O_3 + \cdots + O_{n-1}) + 2(O_2 + O_4 + \cdots + O_{n-2})]$$

Simpson's third rule may be stated as follows: The area is equal to the sum of the two end ordinates plus four times the sum of the even intermediate ordinates plus twice the sum of the odd intermediate ordinates, the whole multiplied by one-third the common interval between them.

Offsets at irregular intervals: The area of each trapezoid is calculated separately and then added together to calculate the total area.

$$\Delta = \frac{d_1}{2}(O_1 + O_2) + \frac{d_2}{2}(O_2 + O_3) + \frac{d_3}{2}(O_3 + O_4)$$