A Laboratory Manual for

Basic Civil Engineering (BE01000101)
(B.E. Semester 1& 2)

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Certificate

This is to certify that Mr. /Ms. _____ _____ Enrollment No. _____ Of B.E. Semester _____Civil Engineering of this Institute (GTU Code: 018) has satisfactorily completed the Practical / Tutorial work for the subject Basic Civil Engineering (**BE01000101**) for the academic year 202 -2 .

Place: DAHOD
Date: _____

Name and Sign of Faculty member

Head of the Department

Preface

The basic aim of laboratory/practical/field work is to enhance the required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psychomotor domain. By keeping this in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient focus is given to the practical work. It shows importance of enhancement of skills amongst the students and pays attention to utilize every second of time allotted for practical amongst students, instructors and faculty members to achieve relevant outcomes by performing the experiments rather than having merely study type experiments. It is must for effective implementation of competency focused outcome-based curriculum that every practical is keenly designed to serve as a tool to develop and enhance relevant competency required by the various industry among every student. These psychomotor skills are very difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual is designed to focus on the industry defined relevant outcomes, rather than old practice of conducting practical to prove concept and theory.

By using this lab manual students can go through the relevant theory and procedure in advance before the actual performance which creates interest and students can have basic idea prior to performance. This in turn enhances pre-determined outcomes amongst students. Each experiment in this manual begins with competency, industry relevant skills, course outcomes as well as practical outcomes (objectives). The students will also achieve safety and necessary precautions to be taken while performing practical.

This manual also provides guidelines to faculty members to facilitate student centric lab activities through each experiment by arranging and managing necessary resources in order that the students follow the procedures with required safety and necessary precautions to achieve the outcomes. It also gives an idea that how students will be assessed by providing rubrics.

Basics of civil engineering is the fundamental course which deals with the surveying, building planning and construction, materials. It provides a platform for students to apply the basic principles of civil engineering to solve real life problems.

Utmost care has been taken while preparing this lab manual however always there are chances of improvement. Therefore, we welcome constructive suggestions for improvement and removal of errors if any.

DTE's Vision:

- To provide globally competitive technical education.
- Remove geographical imbalances and inconsistencies.
- Develop student friendly resources with a special focus on girls' education and support to weaker sections.
- Develop programs relevant to industry and create a vibrant pool of technical professionals.

:: VISION STATEMENT OF THE INSTITUTE ::

To be a value-based engineering institute to disseminate globally acceptable education and nurturing research, innovation and entrepreneurship.

:: MISSION STATEMENTS OF THE INSTITUTE ::

1. To provide quality education in the engineering disciplines through creative balance of academics and extracurricular programs.
2. To provide learning environment for innovation and entrepreneurship.
3. To disseminate ethical values, social values and sensitivity towards environmental issues.

:: VISION STATEMENT OF THE CIVIL ENGINEERING DEPARTMENT ::

To be a recognized department in the field of civil engineering education to produce professional civil engineers, innovators and entrepreneurs for the development of the society.

:: MISSION STATEMENTS OF THE CIVIL ENGINEERING DEPARTMENT ::

1. To provide quality education to civil engineering undergraduates through creative balance of academic, professional and extra-curricular activities.
2. To impart knowledge in the field of civil engineering for the development of infrastructure facilities with environmental concern for betterment of the society.
3. To contribute in the nation's development through innovative ideas in the field of civil engineering.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

:: PROGRAM OUTCOMES (POs) ::

Program Outcomes (POs) as identified by National Board of Accreditation (NBA), India are the attributes that the students are expected to attain at the point of graduation. Following are the POs of B.E Civil Engineering program:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

:: PROGRAM SPECIFIC OUTCOMES (PSOs) ::

Program Specific Outcomes (PSOs) are what the graduates of a specific undergraduate engineering program should be able to do at the time of graduation.

Civil Engineering Graduates shall have

PSO 1: Ability to analyze, design, construct, maintain and rehabilitate the infrastructural projects, using the knowledge of subjects related to planning, construction, structural analysis and design, surveying, geotechnical, transportation, environment and water resource engineering as well as project management.

PSO 2: Ability to employ advanced civil equipments, software, and techniques, interact and work seamlessly in teams.

PSO 3: Ability to apply gained knowledge to choose from the innovative career paths, to be an entrepreneur, and a zest for higher studies.

:: PROGRAMME EDUCATION OBJECTIVES (PEOs) ::

Program Educational Objectives (PEOs) describe the career and professional accomplishments that programs are preparing graduates to attain within a few years (3-5 years) of graduation.

Following are the PEOs of B.E Civil Engineering Program:

1. Establish themselves as civil engineering professionals in government, public and private sectors
2. Manage infrastructural and sanitary facilities
3. Solve real world problems environmental concerns to serve society
4. Adapt to changing trends in analysis and design of civil engineering structures.
5. To do testing, survey and planning of civil engineering structures using modern tools

Practical – Course Outcome matrix

Course Outcomes (COs):

CO-1 Apply the basic knowledge of different building materials used in construction.

CO-2 Interpret plans, components and methods of construction for the building.

CO-3 Identify quality of water and wastewater and methods of water conservation.

CO-4 Know the use of basic equipment required for linear and angular measurements.

CO-5 Comprehend need and types of mass transportation systems and advances in civil engineering.

Sr. No.	Objective(s) of Experiment	CO 1	CO 2	CO 3	CO 4	CO 5
1.	Unit conversation Exercise.				√	
2.	Assignment based on building material and field visit for material identification.	√				
3.	Identification of components of building (field visit/models) and assignment related to it.		√			
4.	Planning of a residential building(plan, elevation& section of simple 1 room)		√			
5.	Linear and angular measurements (Chain and Compass) (in field with instrument)				√	
6.	Determine R.L of given point by Dumpy level/auto level (in field with instrument)				√	
7.	Assignment based on numerical of surveying and levelling.				√	
8.	Introduction to Theodolite & total station.				√	
9.	Presentation on BRTS/Metro/Monorail/Bullet train.					√
10.	Seminar on green building & smart city					√

Industry Relevant Skills

The following industry relevant competencies are expected to be developed in the student by undertaking the practical work of this laboratory.

1. Awareness of unit used in industry and their conversion
2. Awareness of market rates of construction material.
3. Recognize different components of building.
4. Sketch drawing of building.
5. Use chain, compass and dumpy level for surveying and basic information about total station and theodolite.
6. Estimation of brick masonry for a room.
7. Basic information of green building and smart city

Guidelines for the Faculty members

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain basic concepts/theory related to the experiment to the students before starting of each practical.
3. Involve all the students in performance of each experiment.
4. Teacher is expected to share the skills and competencies to be developed in the students and ensure that the respective skills and competencies are developed in the students after the completion of the experimentation.
5. Teachers should give opportunity to students for hands-on experience after the demonstration.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students by concerned industry.
7. Give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions or not.
8. Teacher is expected to refer complete curriculum of the course and follow the guidelines for implementation.

Instructions for Students

1. Students are expected to carefully listen to all the theory classes delivered by the faculty members and understand the COs, content of the course, teaching and examination scheme, skill set to be developed etc.
2. Students shall organize the work in the group and make record of all observations.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and build confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. apart from those included in scope of manual.
6. Student shall refer technical magazines and data books.
7. Student should develop a habit of submitting the experimentation work as per the schedule and s/he should be well prepared for the same.

Common Safety Instructions

Handle the instruments with care

Index
(Progressive Assessment Sheet)

Sr. No.	Objective(s) of Experiment	Page No.	Date of performance	Date of submission	Assessment Marks	Sign. of Teacher with date	Remarks
1.	Unit conversation Exercise.						
2.	Assignment based on building material and field visit for material identification.						
3.	Identification of components of building (field visit/models) and assignment related to it.						
4.	Planning of a residential building (plan, elevation& section of simple 1 room)						
5.	Linear and angular measurements (Chain and Compass) (in field with instrument)						
6.	Determine R.L of given point by Dumpy level/auto level (in field with instrument)						
7.	Assignment based on numerical of surveying and levelling.						
8.	Introduction to Theodolite & total station.						
9.	Presentation on BRTS/Metro/Monorail/Bullet train.						
10.	Seminar on green building & smart city						
Total							

Experiment No: 1
Unit conversation

Date:

Relevant CO: Explain terms used in engineering surveying, solve numerical problems, carry out primary surveys, prepare drawings from surveys, state functions and use of advanced survey instruments

Objectives:
(a) By understanding the basics of unit conversion, as well as some of the more advanced techniques, students can ensure that their calculations and projects are accurate and precise.

(b) To study Units of Various Physical Quantities and Conversion of Different Units of various Quantities worldwide (universally)

Theory:
ROLE OF UNITS
Physicists, like other scientists, make observations and ask basic questions. For example, how big is an object? How much mass does it have? How far did it travel? To answer these questions, they make measurements with various instruments (e.g., meter stick, balance, stopwatch, etc.).

The measurements of physical quantities are expressed in terms of units, which are standardized values. For example, the length of a race, which is a physical quantity, can be expressed in meters (for sprinters) or kilometers (for long distance runners). Without standardized units, it would be extremely difficult for scientists to express and compare measured values in a meaningful way (Figure).

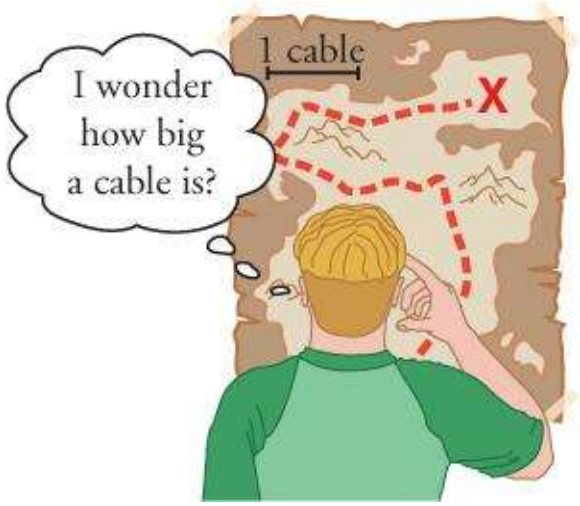


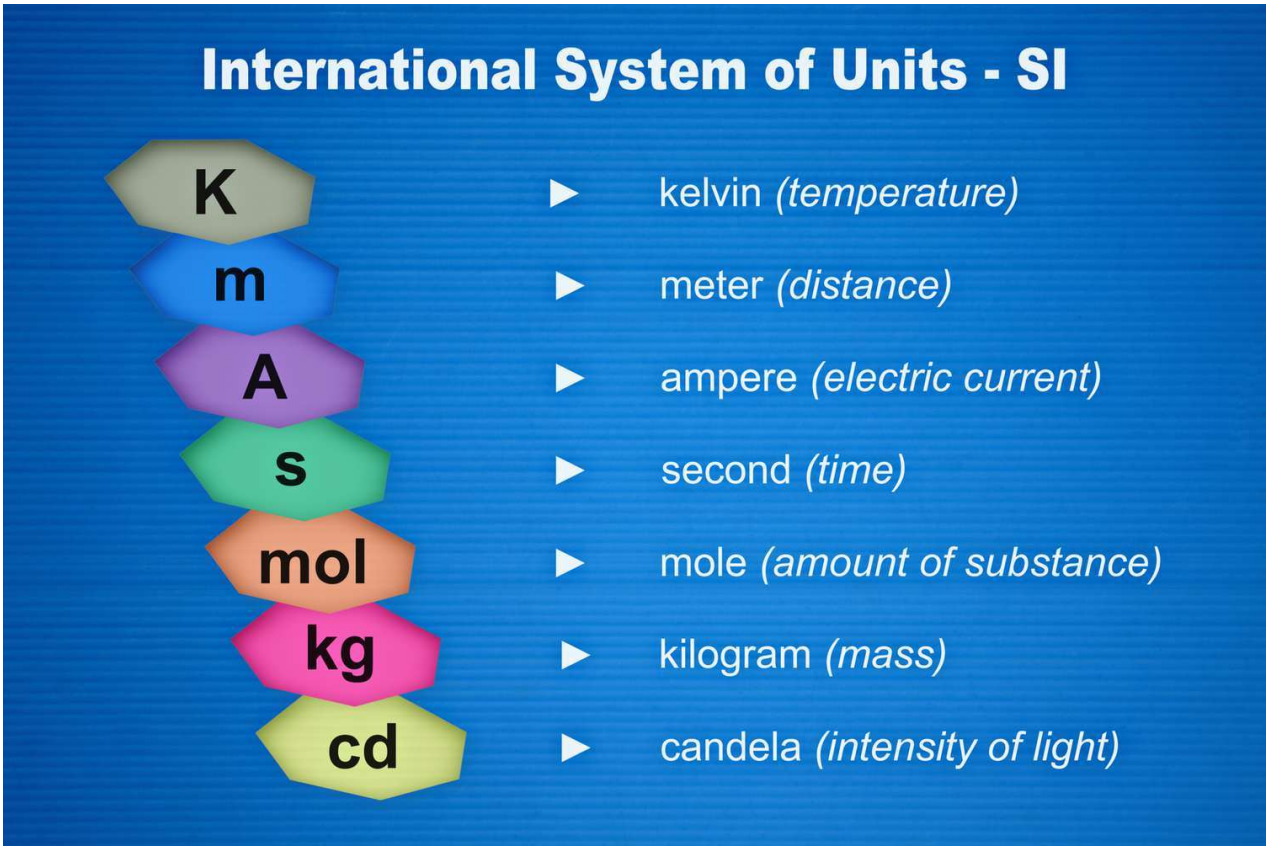
Figure Distances given in unknown units are maddeningly useless.
All physical quantities in the International System of Units (SI) are expressed in terms of combinations of seven **fundamental physical** units, which are units for: length, mass, time, electric current, temperature, amount of a substance, and luminous intensity.

SI Units: Fundamental and Derived Units

There are two major systems of units used in the world: **SI units** (acronym for the French Le System International d'Unités, also known as the metric system), and **English units** (also known as the imperial system). English units were historically used in nations once ruled by the British Empire. Today, the United States is the only country that still uses English units extensively. Virtually every other country in the world now uses the metric system, which is the standard system agreed upon by scientists and mathematicians.

SI units of Measurement

The measurement system which is internationally accepted now is the one suggested by the Eleventh general conference of weights and Measures held in 1960 in France, and is known as Systeme Internationale d' Unites or International System of Units abbreviated as SI units of measurement.
According to this system, there are seven basic or fundamental units and three supplementary units. All other units are made by mathematically combining the fundamental units. These are called **derived units**.



Quantity	Unit	Abbreviation
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s

Electric current	Ampere	A
Temperature	Kelvin	K
Luminous Intensity	Candela	cd
Matter	mole	mol

Fundamental/Basic quantities and their SI units

Physical Quantity	Unit	Symbol for the unit
Angle	Radian	rad
Solid Angle	Steradian	sr
Radioactivity	Becquerel	Bq

Supplementary quantities and their SI units

Physical Quantity	Unit	Symbol for the unit
Area	Square metre	m^2
Volume	Cubic metre	m^3
Density	kilogram per cubic metre	kg/m^3
Velocity	metre per second	m/s
Acceleration	metre per second squared	m/s^2
Force	Newton	N
Work, Energy	Joule	J
Power	Watt	W
Pressure	Newton per square metre	N/m^2
Surface tension	Newton per metre	N/m
Torque	Newton metre	Nm
Electric Charge	Coulomb	C
Electric potential	Volt	V
Electric resistance	Ohm	Ω
Magnetic induction	Tesla	T
Luminous flux	Lumen	*lm*

Different system of units

A system of units is a set of related units, including both the fundamental and derived units, which are used for calculations. Some units exist in more than one system of units.

The different system of units used for measurement of physical quantities are:

- **C.G.S Unit**

  The C.G.S. system of units (Centimeter, Gram, Second system) is a French system. This system deals with only three fundamental units – the Centimeter, Gram and the Second for length, mass and time respectively.

- **F.P.S Unit**

The F.P.S. system of units (Foot, Pound, Second system) is a British system. This system deals with only three fundamental units – the Foot, Pound and the Second for length, mass and time respectively.

- **M.K.S Units**

  The M.K.S. system of units (Metre, Kilogram, Second system) was set up by France. This system also deals with three fundamental units – the Metre, kilogram and the Second for length, mass and time respectively. This system is also called the metric system of units and is closely related to C.G.S system of units.

UNIT CONVERSION

Unit conversion is the process of expressing a measurement in one unit of measurement as another unit of measurement.

There are a few key steps to performing unit conversion. First, it is important to identify the starting unit of measurement and the desired unit of measurement. Next, we need to determine the conversion factor between the two units. This can be found through a variety of methods, such as looking up a conversion table or using a calculator or software tool. Finally, we apply the conversion factor to the starting measurement to obtain the desired measurement.

One of the most important aspects of unit conversion is ensuring that the resulting measurement is accurate and precise. This means using the correct conversion factor and performing the calculation correctly. It is also important to be consistent in the units of measurement used throughout a project or calculation.

There are many other unit conversion techniques and tools used in civil engineering, including software programs and online calculators. It is important for civil engineers to have a strong understanding of unit conversion in order to accurately and effectively communicate and work with measurements in their projects.

In conclusion, unit conversion is an essential aspect of civil engineering. It allows professionals to express measurements in a standardized manner and to work with a variety of units of measurement. By understanding the basics of unit conversion, as well as some of the more advanced techniques, civil engineers can ensure that their calculations and projects are accurate and precise.

Table 3: Length Units

Millimeters	**Centimeters**	**Meters**	**Kilometers**	**Inches**	**Feet**	**Yards**	**Miles**
mm	cm	m	km	in	ft	yd	mi
1	0.1	0.001	0.000001	0.03937	0.003281	0.001094	6.21e-07
10	**1**	0.01	0.00001	0.393701	0.032808	0.010936	0.000006
1000	100	**1**	0.001	39.37008	3.28084	1.093613	0.000621
1000000	100000	1000	**1**	39370.08	3280.84	1093.613	0.621371
25.4	2.54	0.0254	0.000025	**1**	0.083333	0.027778	0.000016
304.8	30.48	0.3048	0.000305	12	**1**	0.333333	0.000189
914.4	91.44	0.9144	0.000914	36	3	**1**	0.000568
1609344	160934.4	1609.344	1.609344	63360	5280	1760	**1**

Table 4:Area Units

Millimeter square	Centimeter square	Meter square	Inch square	Foot square	Yard square
mm^2	cm^2	m^2	in^2	ft^2	yd^2
1	0.01	0.000001	0.00155	0.000011	0.000001
100	**1**	0.0001	0.155	0.001076	0.00012
1000000	10000	**1**	1550.003	10.76391	1.19599
645.16	6.4516	0.000645	**1**	0.006944	0.000772
92903	929.0304	0.092903	144	**1**	0.111111
836127	8361.274	0.836127	1296	9	**1**

Table 5: Volumetric Units

Centimeter cube	Meter cube	Litres	Inch cube	Cubic feet	US gallons	US barrel (oil)
cm^3	**m^3**	**ltr**	**in^3**	**ft^3**	**US gal**	**US brl**
1	0.000001	0.001	0.061024	0.000035	0.000264	0.000006
1000000	**1**	1000	61024	35	264	6.29
1000	0.001	**1**	61	0.035	0.264201	0.00629
16.4	0.000016	0.016387	**1**	0.000579	0.004329	0.000103
28317	0.028317	28.31685	1728	**1**	7.481333	0.178127
3785	0.003785	3.79	231	0.13	**1**	0.02381
4545	0.004545	4.55	277	0.16	1.20	0.028593
158970	0.15897	159	9701	6	42	**1**

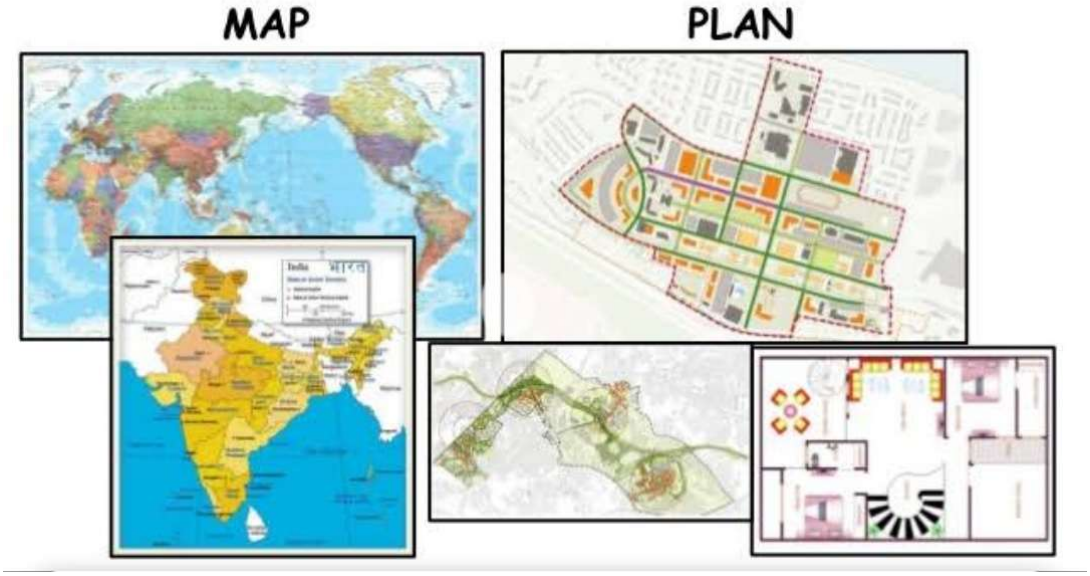
Grams	Kilograms	Metric tonnes	Short ton	Long ton	Pounds	Ounces
g	kg	tonne	shton	Lton	lb	oz
1	0.001	0.000001	0.000001	9.84e-07	0.002205	0.035273
1000	**1**	0.001	0.001102	0.000984	2.204586	35.27337
1000000	1000	**1**	1.102293	0.984252	2204.586	35273.37
907200	907.2	0.9072	**1**	0.892913	2000	32000
1016000	1016	1.016	1.119929	**1**	2239.859	35837.74
453.6	0.4536	0.000454	0.0005	0.000446	**1**	16
28	0.02835	0.000028	0.000031	0.000028	0.0625	**1**

Table 7: Density units

Gram/milliliter	Kilogram/meter cube	Pound/foot cube	Pound/inch cube
g/ml	kg/m^3	lb/ft^3	lb/in^3
1	1000	62.42197	0.036127
0.001	**1**	0.062422	0.000036
0.01602	16.02	**1**	0.000579
27.68	27680	1727.84	**1**

Table 8: Volumetric Flow Units

Liter/second	Liter/minute	Meter cube/hour	Cubic Feet/hour	Cubic Feet/hour	USgallon/ minute	US barrels/day
L/sec	L/min	M^3/hr	ft^3/min	ft^3/hr	gal/min	US brl/d
1	60	3.6	2.119093	127.1197	15.85037	543.4783
0.016666	**1**	0.06	0.035317	2.118577	0.264162	9.057609
0.277778	16.6667	**1**	0.588637	35.31102	4.40288	150.9661
0.4719	28.31513	1.69884	**1**	60	7.479791	256.4674
0.007867	0.472015	0.02832	0.01667	**1**	0.124689	4.275326
0.06309	3.785551	0.227124	0.133694	8.019983	**1**	34.28804
0.00184	0.110404	0.006624	0.003899	0.2339	0.029165	**1**



Representative fraction (RF)

A representative fraction (RF) is the ratio of distance on the map to distance on the ground.

$$\text{Representative factor} = \frac{\text{Distance of object on drawing}}{\text{Corresponding actual distance of object on ground}}$$

Scale

A scale is defined as the ratio of the linear dimensions of the object as represented in a drawing to the actual dimensions of the same.

Types of scale

- Plain scale
- Diagonal scale
- Chord scale
- Vernier scale

Review Questions:

- Convert 5 km into metres, feet, inch and mm.
- If 1 hectare is 10000 m^2 then 4 hectare is _____ m^2 and ft^2
- Convert 1 Acre into 1 Square yard if 1 Acre is 4047 m^2.
- Convert 50 tones to kg. _____
- Convert 9 m^3/hour of Flow in Cusec ($feet^3$/sec).
- Differentiate plan and map

MAP	PLAN

- Convert the following Scale into R.F.

a) 1cm=10km b) 1cm=400m c) 1cm=1000km d) 1cm=2.5km e) 1cm=5m

- Convert the Following R.F. into Scale

a) 1:50000 b)1:200000 c)1:750 d)1:50 e)1:7050

- A 10km long road is indicated in a map by a length of 10cm straight lines in map calculate R.F. and scale on map.
- Area of 49 cm^2 of a map represents an area of 2401 km^2 . Find R.F. and scale of map.
- A plan represents an area of 72000m^2 and measure (4x5) cm^2 find scale and R.F.
- A plan represent an area of 2560m^2 on ground is represents by 40cm^2 on map then find out scale and R.F.
- Find out which of the following scale is larger scale:

a.1cm = 8m b. 1cm = 5m

Experiment No: 2

Assignment based on building material and field visit for material identification.

Date:

Relevant CO: Describe types, properties and uses of various civil engineering materials, water and wastewater characteristics, and types of traffic signs, signals and intersections.
Objective: students will be able to understand basic knowledge of building materials

MATERIALS INFORMATIONS (AFTER MARKET SURVEY):

CEMENT	
Different brands available	
Grade	
Rate	
Types of cement	
Sizes of bags	

STEEL	
Type and Size	
Different brands available	
Rate	
Storage	
Any treatment to steel for protection	

BRICKS	
Type and size	
Different brands available	
Rate	
Storage	
Quality Testing	
Name of test carried out at site	

COARSE AGGREGATES	
Type and size	
Source	
Dealer	
Rate	
Storage	
Quality Testing	

FINE AGGREGATES	
Type and size	
Source	
Dealer	
Rate	
Storage	

Quality Testing	

CONCRETE	
Grade	
Cement Content	
Method of Mixing	
Workability	
Production Capacity	
Method of Transportation	
Compaction	
Method of Curing	

Activity
Construction Material chart preparation (group activity)
Presentation of Construction material (group activity)

Experiment No: 3

Identification of components of building (field visit/models) and assignment related to it.

Date:

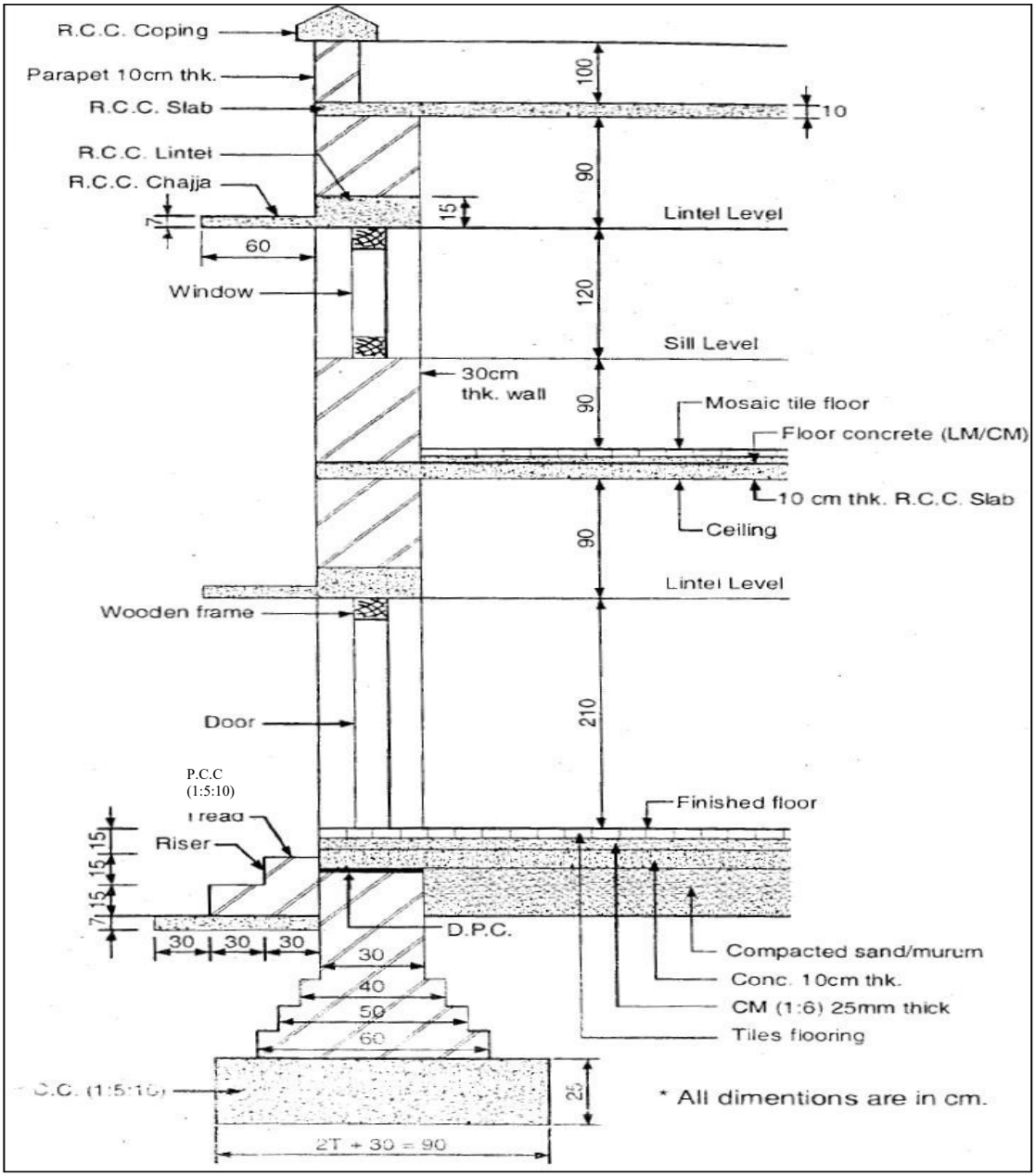
Relevant CO: Describe and sketch types, components and functions thereof loads acting on building, various symbols used in technical drawing and nominal dimensions of building

Objective: students will be able to understand basic knowledge of building components

Components of Building:

Sr. No.	Components of Building	Functions
(A)	**Sub-structure**	
1	Foundation	
(B)	**Super-structure**	
1	Plinth	
2	Damp Proof Course	
3	Walls	
4	Floor	
5	Column	
6	Beam	
7	Opening in walls	
	(a) Doors	
	(b) Windows	

	(c) Ventilators	
8	Sill	
9	Lintel	
10	Weather shed (Chhajja)	
11	Ceiling	
12	Roof	
13	Steps, Stair case & Lift	
14	Finishes for wall	
	(a) Plastering	
	(b) Painting/Varnishing/Polishing	
	(c) White washing	
15	Utility Fixtures	



VISIT TO A CONSTRUCTION SITE:

- Observing and learning about ongoing construction activities
- Seeing Different building components
- Collecting and learning about different building materials
- Observation on different construction tools and their usage
- On field group discussion on the building construction

A REPORT ON VISIT TO A CONSTRUCTION SITE:

Date of visit:

Name of the place visited

Ongoing construction activities

Building components seen on site

Building materials seen on site

Construction tools seen on site

Other General Observations

Sketch list (to be drawn in A3 Sketch/Drawing book)

Students shall draw the following sketches and show typical dimensions:

SR.NO	SKETCHES
1	Abbreviations
2	Symbols for materials, doors, windows, sanitary work, water supply & plumbing and electrical installations
3	Conventional symbols used in surveying
4	Sketches of shallow and deep foundations (Piles).
5	Bonds in brickwork (Stretcher, Header, English and Flemish bond)
6	Doors and windows
7	Components of stairs, sketches of stairs as per the types
8	RCC Lintel with Chajja
9	Slab and Beam
10	Trusses (King post, Queen post, Lean to roof)
11	Traffic signs and signal
12	Typical cross section of 30 cm thick wall (Building components)
13	Layout plan, key plan and site plan.

Experiment No: 4

Planning of a residential building (plan, elevation& section of simple 1 room)

Date:

Relevant CO: Outline and relate principles of building and town planning. Prepare detailed plan, elevation and sectional elevations of a small building unit.

Objective: student will be able to sketch a plan, elevation and section of room (Residential building).

IMPORTANT DEFINITIONS

- **PLAN**:

Plan is a sort of top view drawn at a predetermined level. It is generally prepared at sill level to get all details of doors and windows. To draw a plan, a building is imagined to be cut in horizontal plane at sill level and then it is seen from top with all the details.

- **ELEVATION**:

Elevation of building is drawn in vertical plane starting from ground level to roof level. Elevation may be front elevation or side elevation. Elevations are generally drawn above the plan by projecting vertical lines from plan starting from left end side to right end side of the building.

- **SECTION:**

It is also an imaginary view where it is imagined that an object to be detailed with section has been cut through and a part towards that viewer is removed leaving the other portion with interior leaving the other portion with interior exposed to view in vertical plane right from foundation level to top level.

SCHEDULES:

They give the details of Doors, Windows, Rooms and their finishing and details of reinforcements etc. on the drawing.

Name	Symbol	Size in m	Nos.
Door	D	1.20 X 2.00	1
	D1	1.00 X 2.00	2
	D2	0.90 X 2.00	2
Windows	W1	1.00 X 1.20	2
	W2	0.90 X 1.20	2
Ventilators	V	0.60 X 0.45	1

DETAILS: Details consist of the best views and cross sections which can describe the design and construction of particular element or part of a building. i.e. doors, windows, cupboards, stairs, reinforcement etc.

LANDSCAPE PLAN: This Plan is subsidiary plan supplied along with the plan, elevation and section to give the details of the layout of land.

SITE PLAN: this plan is also a subsidiary and gives the orientation of building and surrounding details, but helps to locate the building position on the site from boundaries.

KEY PLAN: The key Plan is a small-scale view in a drawing that indicates the location of a part in the drawing. A key plan contains the model grid and the part included in the drawing view.

LAYOUT PLAN: Layout Plan means a Plan indicating configuration and sizes of all Use Premises. Each Use Zone may have one or more than one Layout Plan depending upon the extensiveness of the area under the specific Use Zones and vice-versa.

FLOOR AREA TABLE:

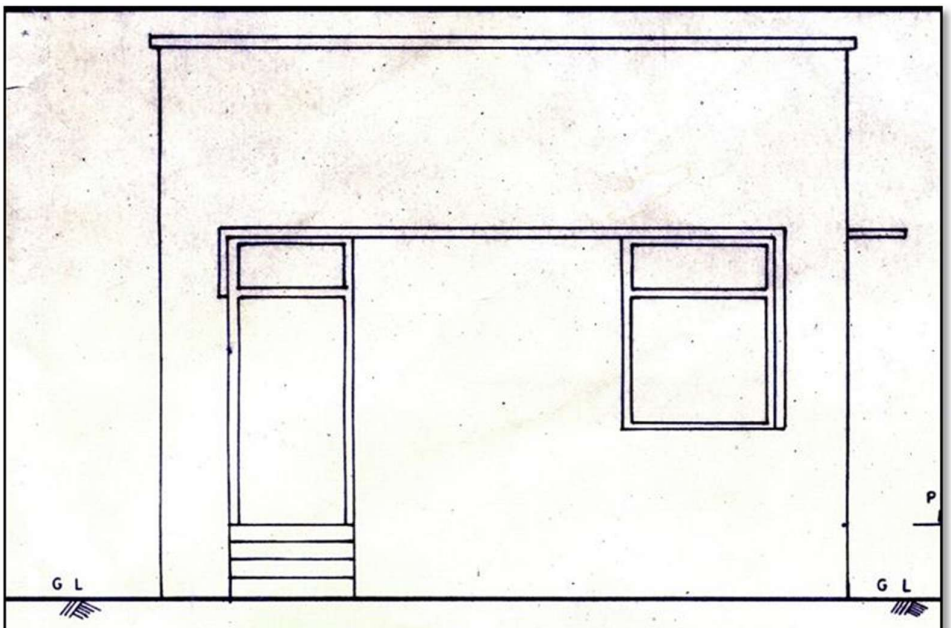
Sr. No.	Name of Room	Minimum Area (m^2)	Maximum Area (m^2)
1	Living Room	15	30
2	Bed Room	12	25
3	Guest Room	9.5	10
4	Kitchen	5.5	9
5	Dining Room	12	25
6	Store Room	5.5	9
7	Bathroom	1.8	3.5
8	Toilet	1.1	1.5

PROCEDURE OF DRAWING:

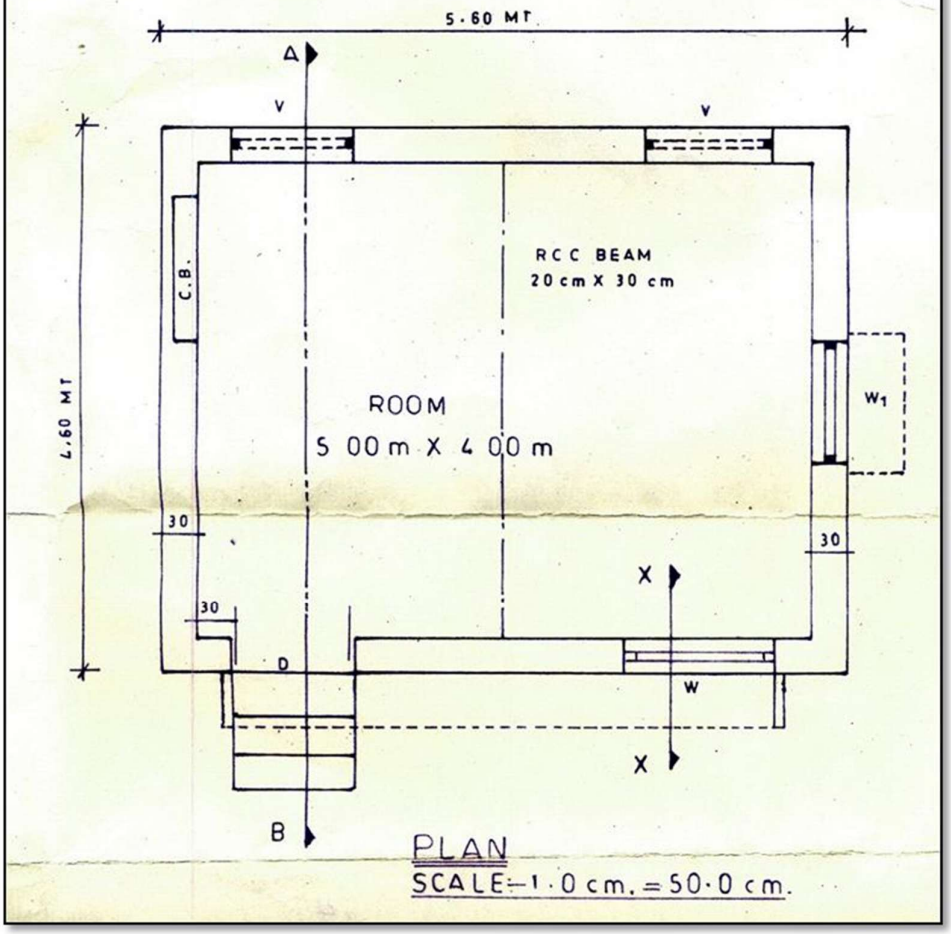
- Take appropriate scale to draw the plan, elevation and section for given residential building.
- The dimensions of line diagram are inside to inside dimensions.
- Dimensions of the rooms are given as 'Breadth x Length'.(Breadth in x-direction, Length in y-direction
- Wall thickness is to be considered 30 cm for main load bearing walls and 15 cm

/ 20 cm for partition walls.

- Openings of the building, i.e., doors, windows and ventilators are to be provided as per their location. The sizes of all the openings are not given, they should be assumed of standard size. Door (breath x height), Window (breath x height)
- To draw the elevation and section, chhajja / weather sheds are to be provided over openings located on outer walls of the building.
- When the heights or levels are not specified, then the standard dimensions for various building units should be assumed.

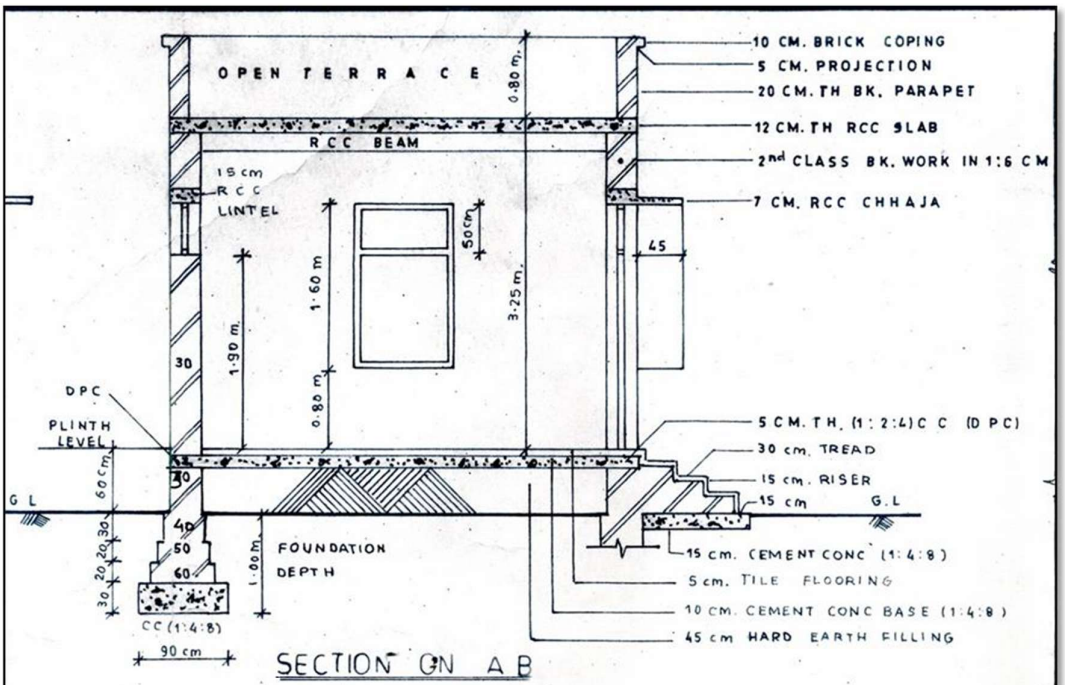


ELEVATION



PLAN

SCALE:- 1·0 cm. = 50·0 cm.



SECTION ON A B

REFERENCE

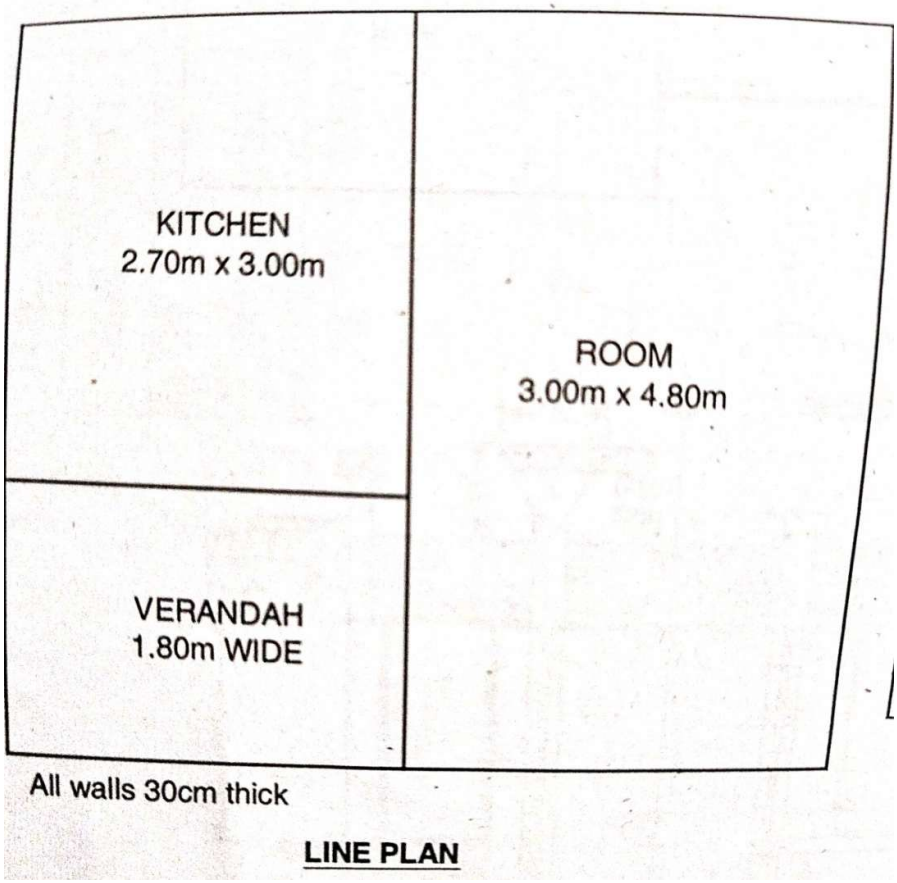
Sr no	NAME	CODE	Modular size	SIZE	DESCRIPTION
01	DOOR	D	10 D T 24	1·00 m. X 2·40 m.	FULLY PANELLED
02	WINDOWS	W	12 W T 16	1·20 m. X 1·60 m.	PARTLY GLAZED &
		W1	10 W1 T 16	1·00 m. X 1·60 m.	PARTLY PANELLED
03	VENTILATOR	V	10 V T 05	1·00 m. X 0·50 m.	FULLY GLAZED
04	CUP BOARD	C B	12 CBT 14	1·20 m. X 1·40 m.	WITH TWO SHUTTER

5 cm. TILE FLOORIN
WITH CM 1:6
BEDDING

45 cm. HARD
EARTH FILLING

G L

W1



Activity

Prepare a drawing of plan elevation and section of the given residential building and show the schedule of doors and windows. (Preferably A3 size sheet)

Experiment No.5

Linear and angular measurements (Chain and Compass) (in field with instrument)

Date:

Relevant CO: Explain terms used in engineering surveying, solve numerical problems, carry out primary surveys, prepare drawings from surveys, state functions and use of advanced survey instruments

OBJECTIVE:

To understand the method of linear measurements through chain survey. To do Chaining, ranging and offsetting a survey line on a level ground.

APPARATUS:

Metric Chain, Measuring Tape, Wooden Pegs, Hammer, Ranging Rods, Steel Arrows.

THEORETICAL BACKGROUND:

Chain Surveying or Chain triangulation:

It is method of surveying in which the area is divided into network of triangles and the sides of the triangle are directly measured on the field with a chain or a tape and no angular measurements are taken.

This type of surveying is used for smaller extent of area with simple details and ground is fairly level.

Terms related with Chain Surveying:

i. Main station
ii. Subsidiary or Tie station
iii. Base line
iv. Survey line
v. Check line
vi. Tie line

Basic Operations in Chain Surveying:

(i) Chaining

The method of taking measurements with the help of a chain or a tape is termed as chaining.

(ii) Ranging

When the length of a line exceeds the length of the chain, to proceed in a straight line, intermediate points are needed to be established between the two stations. The processof establishing intermediate points on a straight line between two endpoints is known as ranging.

Methods of ranging

Direct Ranging

By Eye
By Line Ranger

Indirect Ranging or Reciprocal Ranging

(iii) Offsetting

The method of locating (positioning) objects from the survey line by means of linear measurement (distance between survey line and object), right or left of the survey lineis called as offsetting and lateral measurements (distances) are called offsets.

Types of Offsetting:

(a) Perpendicular offset and (b) Oblique offset

PROCEDURE:

- Main stations A and B are first marked at some unknown distance with pegs and ranging rods to make them visible.
- To accurately measure the length of the line, a chain that has been folded is laid between the station locations.
- The chainman at the station A (At start of a line) is called as follower and who drag the chain forward along the line is called as leader. The followers place one of handles of the chain in contact with peg at station A.
- If the length of the survey line is greater than one chain length, intermediate points arelocated, in order to pull the chain along a straight line. At the end of chain length, leader holds the rod vertically, approximately in line and then faces the follower. When intermediate ranging rod M is fixed on a straight line by direct observation, the process is known as direct ranging which is explained below.
- The follower stands half a meter behind ranging rod at A by looking towards the line AB. The follower directs the leader to move ranging rod to the left or right until the three ranging rods at A, M and B come exactly at same straight line.

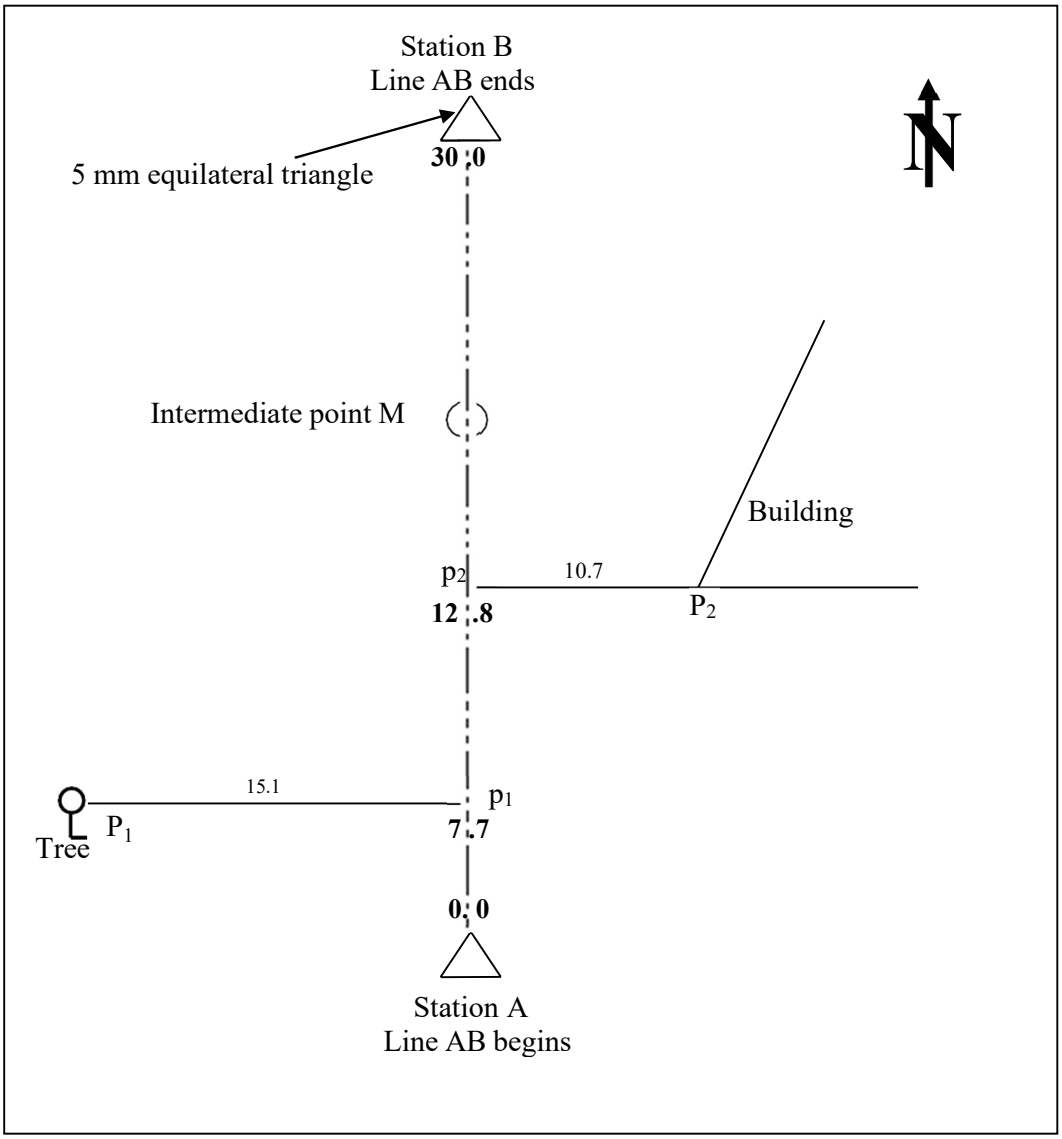
The code of signals are used as below:

Sr. No.	**Signals Given by the Follower**	**Meaning of the Signal**
1	Rapid sweep with right hand	Move considerably to the right
2	Rapid sweep with left hand	Move considerably to the left
3	Slow sweep with right hand	Move slowly to the right
4	Slow sweep with left hand	Move slowly to the left

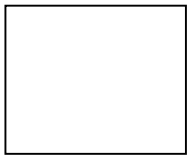
5	Right arm extended	Continue to move to left
6	Left arm extended	Continue to move to left
7	Right arm up and move to the right	Plumb the rod to the right
8	Right arm up and move to the left	Plumb the rod to the left
9	Both hands above head and brought down	Ranging is correct
10	Both arms extended forward horizontally andthe hands brought down quickly.	Fix the ranging rod

- The leader takes the other handle of the chain, arrows, ranging rod & walks in the forward direction dragging the chain with him.
- After the chain stretched completely along the line, the follower step on one side of line with the ranging rod touching the handle.
- The follower directs the leader to stand exactly in the line.
- The leader puts a scratch at the position of rod & insert an arrow. He then moves forward with chain handle removing arrows and ranging rod till the follower reaches the next peg point.
- During this procedure details which are right or left of chain line are located by perpendicular lateral measurement are taken from object to chain line is called perpendicular offsets.
- Perpendicular offsets are taken by swinging the tape on chain line smallest distance is considered as perpendicular offsets. Find also the chainages (distance on chain).
- The distance of offset on chain line is from starting point A(Station A).
- Measure all perpendicular offsets and corresponding chainages till the station B is reached.

Finally record the survey line AB and offsets in the field book.


Station B
Line AB ends
5 mm equilateral triangle
30 .0
N
Intermediate point M
Building
p2
10.7
12 .8
P2
15.1
p1
P1
Tree
7 .7
0. 0
Station A
Line AB begins

FIELD BOOK ENTRY PAGE



Objective: - Study of Prismatic Compass & to determine fore and back bearing of survey line and find Included Angles.

INSTRUMENT:-
Tripod, Prismatic compass, ranging rods, measuring tapes, Wooden Pegs, hammer.

Theory

When the starting point does not coincide with the end point, as shown in figure (a) the traverse is called as **open or unclosed traverse** and when the traverse starting point coincide with the end point as shown in the figure (b) the traverse is called as **closed traverse.**

Fore Bearing :- The bearing of a line in the direction of progress of the survey is called fore bearing.

Back Bearing :- The bearing of a line in the opposite direction of progress of survey is known as back bearing.

TEMPORARY ADJUSTMENTS OF A PRISMATIC COMPASS

The Prismatic Compass is set up at a point say station A. The following temporary adjustments are needed to be carried out at each set Up of Instrument.

Centering:
Centering is the process of keeping the instrument exactly over the station. It is carried out by dropping a piece of stone so that it falls on the top of the pegs fixed at station point.

Leveling:
Prismatic compass is leveled by means of ball and socket arrangement so that the graduated ring may swing freely.

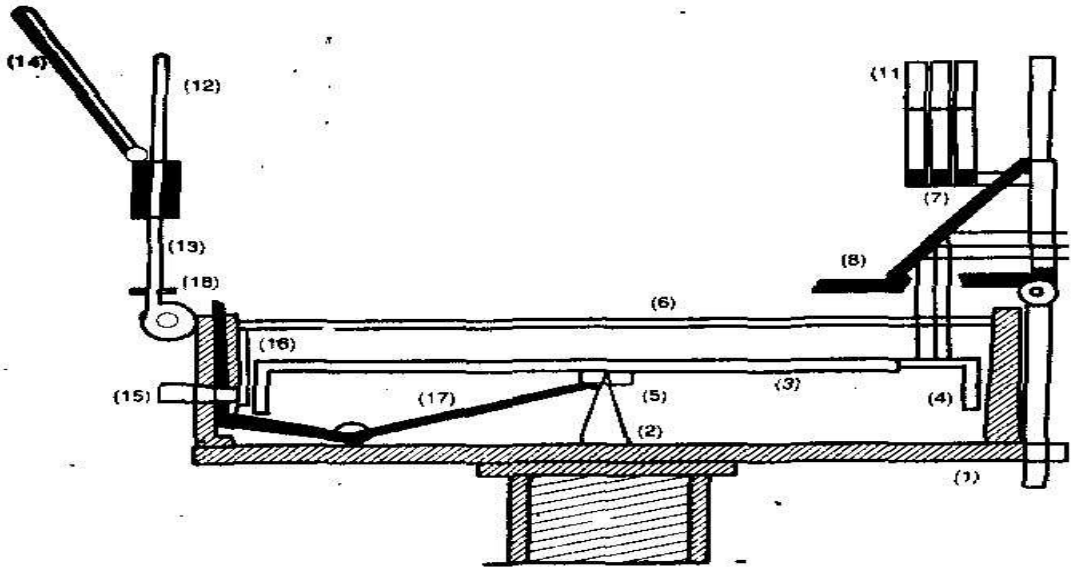
Focusing the prism:
The reflecting prism is adjusted to the eye sight of the observer by raising or lowering then stud until the graduations are seen sharp and clear.

PROCEDURE

- The compass is mounted on al light tripod over station A.
- After fixing the compass, the temporary adjustment should be carried out i.e centering and leveling.
- The centering over the station point is generally carried out by dropping a small stone from center of tripod so that it falls on the peg marking of station point A.
- The compass should be leveled by edge or roller pen, by means of ball and socket joint so that the graduated ring rotates freely without touching either the bottom of box ore glass cover on top.
- Now raise or lower the prism till graduations on the ring are clearly visible.
- After centering and leveling, the compass over station A, the ranging rod at required station say B is bisected perfectly by sighting through a slit of prism and cross hair of sight vane.
- This time the graduated pin may rotate rapidly. The break pin is pressed very gently to

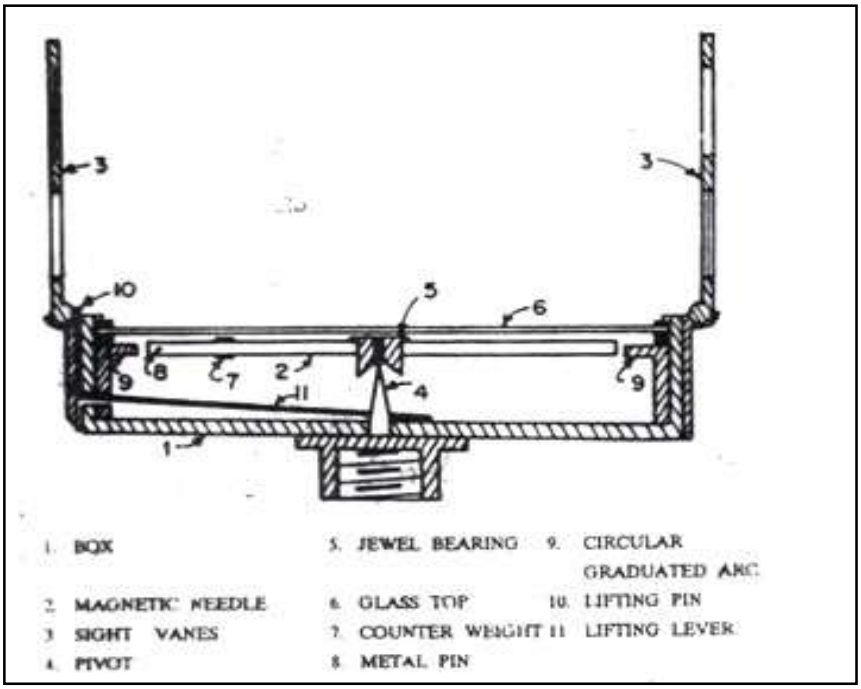
stop this rotation. When the ring comes to rest the box is struck very lightly to verify horizontal of the ring and frictional effect is taken from the graduated ring through glass in the prism. This reading will be the magnetic bearing of line called F.B

- Measure the length between stations A & B with the help of measuring tape.
- Now shift the instrument setup at next point B and do the procedure 2 to 8 also take back bearing of station A.
- Follow the same procedure for four to five points.
- Find out included angles using fore bearing & back bearing.



(1)	Compass	(7)	Prism	(13)	Horse hair
(2)	Pivot	(8)	Prism Cap / Cover	(14)	Reflecting mirror
(3)	Magnetic needle	(9)	Sighting slit / eye slit	(15)	Brake pin
(4)	Graduated Ring	(10)	Eye hole	(16)	Spring brake
(5)	Agate cap	(11)	Sun glass	(17)	Lifting lever
(6)	Glass Cover	(12)	Object vane	(18)	Lifting pin

Prismatic compass



Surveyor's compass

Closed Traverse

Station	Line	Length in m	F.B	B.B	Diff.	Angle	Correction	Corrected Angle

Experiment No.6

Determine R.L of given point by Dumpy level. (In field with instrument)

Date:

Relevant CO: Explain terms used in engineering surveying, solve numerical problems, carry out primary surveys, prepare drawings from surveys, state functions and use of advanced survey instruments

Objective: - To find reduced level of various points by simple leveling.

INSTRUMENT: - Dumpy level, tripod, leveling staff, pegs, hammer.

.

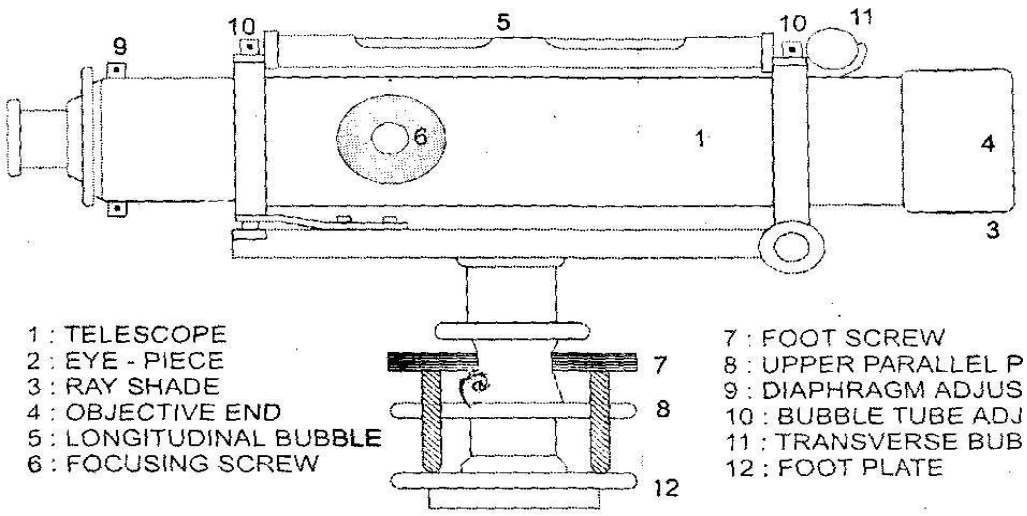
PROCEDURE:

- The instrument is fixed on the tripod at station say O
- The tripod legs are adjusted at a convenient height. Any two legs of the tripod are fixed on the ground by pressing with the hand. The movement of the third leg is made in such a way that the bubble remains in the center.
- The actual leveling is then done by moving the screws on the leveling head. For three screws and both the foot screws are either moved inward or outward till bubble is in the center.
- The telescope then turned through 90○ so that the telescope is now over the third screw. Now move third screw inward or outward till the bubble is in the center. Then the telescope is brought in its original position.
- The procedure is carried out till the bubble remains in the center in both the position i.e. explain in procedure 3 & 4.
- Now focused the eye piece so that the cross-hairs are clearly seen.
- The telescope is then directed towards the staff held vertically at bench mark (B.M) say station A and by turning the focusing screw. Parallax is removed and reading is taken called Back Sight (B.S) reading (first reading).
- Find out height of instrument using the following formula.

HI = Reduced Level (R.L) of B.M + B.S

- Now staff is held vertically at next station B. The telescope is then directed towards the staff at B. The reading is called Intermediate Sight (IS).
- Find out the reduced level of B. = H.I – I.S at station B.
- Similar procedure is repeated for remaining stations.
- Last reading of leveling process is called Fore Sight (F.S)
- Find out the R.L of last station, then R.L of last station = H.I – F.S
- Apply the arithmetic check to verify the calculation by height of

Instrument & and Rise & Fall methods.



DUMPY LEVEL

Height of Instrument Method

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

Check:- ∑ B.S - ∑ F.S. = Last R.L – First R.L

Rise and Fall Method

In rise and fall method, the height of instrument is not at all calculated but the difference of level between consecutive points is found by comparing the staff readings on the two points for the same setting of the instrument. Rise and fall is calculated using following formula. If the reading is positive then it is rise and if the reading is negative then the reading is called fall. The figure for rise and fall worked out thus for all the points

give the vertical distance of each point above or below the preceding one, and if the level of any one point is known then the level of the next will be obtained by adding its rise or subtracting its fall, as the case maybe.

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

Check:- ∑ B.S - ∑ F.S. = Last R.L – First R.L = ∑ Rise - ∑ Fall

Experiment No.7

Assignment based on numerical of surveying and levelling.

Date:

Relevant CO: Explain terms used in engineering surveying, solve numerical problems

Tutorial- I

Surveying Examples

	LINEAR MEASUREMENT	**Mapped With**
1	The length of a line was measured with 20 m chain and it worked out to be 530.00 m. It was subsequently found out that the chain was 0.04 m too long. What is the true length of line?	CO4
2	A 30 m chain was found to be 0.15 m too long after chaining a distance of 5000 m. It was found to be 0.3 m too long after measuring a total distance of 10000 m. At the start of the work, the chain was tested and was found to be exactly 30 m in length. Find out the correct length of the measured distance.	CO4
3	A field was measured with a 20 m chain and was found to be 18.32 hectares. It was afterwards found that the chain was 0.07 m too short. Find out the true area of the field.	CO4
4	A 20 m chain was found to be 10 cm too long after chaining a distance of 1500 m. It was found to be 18 cm too long at the end of one day's work after chaining the total distance of 3900 m. Find the true distance if chain was correct before the commencement of work.	CO4
5	The length of a chain line when measured with 20 m chain was found to be 1432 m. But when a 30 m chain which was 0.65 m too short was used for the purpose, the line was found to be 1445 m long. Find the error in 20 m chain.	CO4

Tutorial- II

Surveying Examples

	ANGULAR MEASUREMENT	**Mapped With**
1	The following bearings were taken on a closed traverse ABCD find out internal angles and correct them if necessary **Line** **FB** **BB** AB 55°30' 235°00' BC 113°00' 293°30' CD 190°00' 10°00' DA 279°00' 99°00'	CO4
2	Given below are the bearings of lines of a closed traverse ABCD. Calculate the interior angles. **LINE** **F.B.** AB N45°E BC N75°E CD S35°W DA N65°W	CO4
3	The following are the F.B & B.B of lines of a closed traverse. Calculate the interior angles of the traverse. **LINE** **F.B.** **B.B.** AB 150°15' 330° BC 20°30' 200°30'	CO4

	CD	295°45'	115°45'	
	DE	218°	38°	
	EA	120°30'	300°30'	
4	The magnetic bearing of a line AB is N 25° 30' E. Calculate the true bearing of the line if declination is 2° E.			CO4
5	Calculate included angles and also apply necessary checks. Following are the bearings of a closed traverse ABCDEA			CO4

Line	**AB**	**BC**	**CD**	**DE**	**EA**
F.B.	140°30’	80°30’	340°00’	290°30’	230°30’
B.B.	320°30’	260°30’	160°00’	110°30	50°30’

Tutorial- III

Surveying Examples

	LEVELLING	**Mapped With**
1	The following sequential readings were taken on a sloping ground. The first reading was taken on a BM of 50.000 m. Find out RL of each point and apply arithmetical check 0.450,0.560, 0.785,1.200,2.500,3.480,0.320,0.655,0.985,1.300	CO4
2	The following consecutive readings were taken with a dumpy level along a chain line at a common interval of 5m. The position of the instrument was changed after 3rd, 7th and 10th readings. Draw out the form of a level book and enter the readings properly. Assume RL of 1st point as 50.0 meter. Calculate RL of all the points and apply usual Checks. Use HI method. The readings are 0.350,0.580,0.645,1.850,1.935,2.450,1.750,0.360,0.720,1.200,0.920,0.630.	CO4
3	The following consecutive readings were taken with a dumpy level and 4 m leveling staff on continuous sloping ground at 30 m intervals. 0.680, 1.455, 1.855, 2.330, 2.885, 3.380, 1.055, 1.860, 2.265, 3.540, 0.835, 0.945, 1.530 and 2.250. The RL of starting point was 80.750 m. Rule out page of a level book and enters the above readings. Find RL of other points by Rise and Fall method and apply necessary checks. Also determine gradient of a line joining first and last point.	CO4
4	The following readings were taken on continuously falling ground with a staff of 4 m: 0.400, 0.765, 1.270, 2.560, 3.220, 3.950, 0.390, 1.690, 3.500, 0.800, 1.920, 2.450, 3.980.Enter the readings in the page of level book and calculate the RLs of all the points if the first reading was taken on benchmark of 100.00 m.	CO4
5	The following consecutive readings were taken with a level and a 4 m staff at a common interval of 30 m. The first reading was taken at B.M. having R.L 100 m. The instrument was shifted after the 4th and 9th readings. Rule out a page of a level book, enter the readings given and calculate the reduced levels of the points by the collimation method. Also apply arithmetic checks. Consecutive readings are: 2.650, 1.745, 0.260, 2.525, 2.160, 1.235, 0.870, 1.365, 0.625, 1.790 and 2.535.	CO4

Experiment No.8

Introduction to Theodolite & total station.

Date:

Relevant CO: Explain terms used in engineering surveying, solve numerical problems, carry out primary surveys, prepare drawings from surveys, state functions and use of advanced survey instruments

Objective: - Students will be able to explain working of theodolite and total station

Questions

- Conduct demonstration of theodolite and total station in lab for basic understanding.
- Draw a neat sketch of a theodolite showing its various parts.
- State application of Total station

Experiment No.9
Presentation on BRTS / mass transportation system (city bus)

Date:

Relevant CO: Recognize, summarize and explore technological advancements in different fields of civil engineering

Objective: To give overview about BRTS/ mass transportation system(city bus)

o

Activity:

Arrange visit of mass transportation system (if possible)

OR

Prepare presentation on mass transportation (group of student)

Experiment No.10

Seminar on green building & smart city

Date:

Relevant CO: Recognize, summarize and explore technological advancements in different fields of civil engineering.

Objective: To make student aware about concept of green building & smart city

Activity

Prepare presentation on Green building & smart city (by group of student)