

BASIC CIVIL ENGINEERING

INTRODUCTION

1

PREVIOUS YEARS QUESTIONS

I. SHORT ANSWER TYPE QUESTIONS

Q.1 Define the floor space index?

[R.T.U. 2018]

Ans. Floor Space Index (FSI) : This is also referred to as Floor Area Ratio (FAR), is the ratio of developed floor space on a piece of land to the amount of raw space available on that land. Municipal zoning ordinances may establish the FSI within a particular range to limit the amount of construction and the size of buildings in a particular area. Because the FSI is a measure of the combination of the height and footprint of a building, using it to regulate size allows more flexibility in building design than using either of the measurements by themselves.

FSI means the ratio between the area of a covered floor (Built up Area) to the area of that plot (land) on which a building stands.

$$FSI = \frac{\text{Floor space covered in all floors}}{\text{Area of the plot}}$$

Q.2 What do you mean by construction management?

Ans. Construction Management : Construction Engineering is a discipline of Civil engineering which deals with design, planning and construction of every type of structure, viz, buildings, roads, bridges, dams, tunnels and airports etc. Construction management can be further divided into following majors:

- (i) Building Materials
- (ii) Building Construction
- (iii) Building Technology

Q.3 Write basic responsibilities of a civil engineer.

Ans. The basic responsibilities of a civil engineer are planning and designing a structure and analyzing its various aspects, making a regular inspection in the site to ensure that the construction is going according to the plan and making the necessary amendments in the project, if required during the course of construction.

Q.4 List out the sub-branches of civil engineering.

Ans. Civil Engineering is sub divided into many branches, mainly:

- (1) Structural Engineering
- (2) Geotechnical Engineering
- (3) Environmental Engineering
- (4) Transportation Engineering
- (5) Water Resources Engineering
- (6) Surveying
- (7) Construction Engineering

Q.5 What is work of structural engineers?

Ans. Structural engineers often work alongside civil engineers and architects as part of a construction team.

Q.6 Define infrastructure.

Ans. Infrastructure, in general, defines as a set of facilities through which goods and services are provided to the public, infrastructure is the stock of basic facilities and capital equipment needed for the functioning of a country or area; the term to refer collectively to the roads, bridges, rail line,

and similar public works that are required for an industrial economy, or a portion of it, to function.

II. LONG ANSWER TYPE QUESTIONS

Q1 Explain the importance of a Civil Engineer in society? [R.T.U. 2018]

Ans. Importance of a Civil Engineer in Society : Civil engineering is the stream of engineering which is related to human being in their daily life. From construction work to water supply to waste water, civil engineering is required at every place. There are so many role of civil engineer in society, few of them are listed under :

(i) **Design and construction of buildings:** The main role of a civil engineer considered is to design and build structures. Civil engineers are involved in creating structures for human shelter, office and other such activities. From the design work to execution work a civil engineer holds the complete responsibilities.

(ii) **Construction of roads:** Roads are the main mode of transportation in any part of the world. Civil engineer construct roads not only for the betterment of human being in comfort sense but also for the commercial sense as roads are main means of transporting goods as well. Economy of any country is governed by the conditions of roads of that country.

(iii) **Design and construction of bridges:** Bridges are the structure which are built over water bodies, valleys or even roads in order to cross these physical obstacles comfortably and still not closing the way underneath. Bridges are built since ages by civil engineers. Site investigation to design to execute and to operate and maintenance of bridge, a civil engineer is involved in every step of work of bridge construction.

(iv) **Design and construction of dams:** A dam is a barrier or obstacle to restrict flow of water of any surface or underground streams in order to create reservoirs for storage of water. These reservoirs not only suppress the floods but also are used for providing water for irrigation work, human consumption, generation of electricity, industrial benefits and many other works. Geological investigations for selection of dam, design and analysis of dams, construction of dams and their operation and maintenance are done by a civil engineer.

(v) **Water supply:** A civil engineer is responsible for converting water from river or lakes to potable water suitable for human consumption. Water treatment plants are designed

various physical and chemical attributes of water are brought under safe limits prescribed for human consumption for drinking purposes.

(vi) **Waste water management:** The waste water released from toilets or kitchens of a household or waste water released from industries stands as a big challenge for a civil engineer to be disposed safely. Waste water treatment plants are created by civil engineers for treating the waste water depending on the amount of waste in it. Such water after treatment is reused for agriculture purposes. Even in some countries of world like Singapore, Australia and Namibia the waste water is used for drinking purposes too.

(vii) **Irrigation works:** Irrigation work is carried out by civil engineers teamed up with agriculture engineers. Civil engineers are responsible for providing required amount of water to fields by constructing dams and canals and regulate water to the fields.

(viii) **Surveying work:** Civil engineer does the surveying work. Surveying work includes measurement of distances horizontally as well as vertically. Surveying is used for commencement of any construction work as we need to first establish the outlines of the structure. Also for creating maps surveying is done.

Q2 What are the impacts of infrastructural development on economy of country? [R.T.U. 2018]

OR

Discuss the role of civil engineer in society.

Ans. Impacts of infrastructural development on economy of country : Infrastructure, in general, defines as a set of facilities through which goods and services are provided to the public. Infrastructure is the stock of basic facilities and capital equipment needed for the functioning of a country or area, the term to refer collectively to the roads, bridges, rail line, and similar public works that are required for an industrial economy, or a portion of it, to function. Infrastructure includes in its broadest term the following:

Economic Infrastructure :

- (1) Transport
 - Roads
 - Railways
 - Shipping ports and harbours
 - Airports
 - Transport equipments
- (2) Communication
 - Ports
 - Telegraphs

- Telephones
- Radio
- Television
- Cinema etc.

(3) Energy/Power

- Coal
- Electricity
- Wind power
- Solar energy
- Oil

(4) Intermediate goods and output

- Gas and bio-gas
- Minerals
- Steel
- Metal other than steel
- Basic chemicals
- Fertilizers and pesticides

(5) Increasing productivity of natural resources

- Reclamation of land
- Irrigation
- Drainage
- Land reshaping
- Afforestation
- Science and technology
- Teaching basic and applied research
- National laboratories
- Liaison with production units

(7) Information system

- Mass media
- Libraries and museums
- Fairs and exhibitions
- Books and journals

Q3 Write the scope of civil engineering.

Ans. Scope of Civil Engineering : A Civil Engineer is invariably required in all types of works related to infrastructure development. Civil Engineering, the core branch of engineering, has a lot of scope. The scope can be understood in two ways, firstly as per the development of infrastructure in India and secondly the type of jobs available for a civil engineer in India.

Infrastructure sector is a key driver for the Indian economy. The sector is highly responsible for propelling India's overall development and enjoys intense focus from Government for initiating policies that would ensure time-bound creation of world class infrastructure in the country. In 2016, India jumped 19 places in World Bank's Logistics Performance Index (LPI) 2016, to rank 35th amongst 160 countries. Construction Development sector (townships, housing, built up infrastructure and construction development projects) has received billions and billions of foreign direct investment (FDI) in recent years. So it is easily understood that the demand for civil engineer in India is growing exponentially and will remain so in coming future.

Depending upon the interest of a civil engineer there are two types of jobs available for a civil engineer:

- (1) Technical jobs
- (2) Non-technical jobs

Q4 Explain the growth of economy of any country lies in the development of its infrastructure.

Ans. Any country's economy directly gets affected by the status of infrastructural development. More the development regarding infrastructure more the economy flourished of a country. The role of infrastructure in spearheading economic development of a country and also setting its pace can hardly be over emphasized. Like a foundation in an edifice, the place of infrastructure as well as its soundness, are crucial to the nation's total development. The economic growth of a country has evidently happened hand in hand with the development of its infrastructure. To quote famous economist Dr. V.K.R.V. Rao, "the link between infrastructure and development is not a once for all affair. It is a continuous process and progress in development has to be preceded accompanied and followed by progress in infrastructure. If we are to fulfill our declared objectives of a self-accelerating process of economic development".

Infrastructure development is one of the major factors contributing to overall economic development in many ways, such as:

- (1) Direct investment in infrastructure creates production facilities and stimulates economic activities;
- (2) It reduces transaction costs and trade costs, improving competitiveness; and
- (3) It provides employment oppoR.T.U. nities and physical and social infrastructure to the poor.

SURVEYING 2

PREVIOUS YEARS QUESTIONS

I. SHORT ANSWER TYPE QUESTIONS

Q.3 What is the object of surveying? [R.T.U. 2018]

OR
Write the objects of surveying.

Ans. The objects of surveying are:

- (1) To take measurements in order to determine relative positions between points situated above, on or beneath the ground.
- (2) To locate points on the ground from the plans or maps.

Q.2 What is Representative fraction? [R.T.U. 2018]

Ans. **Representative Fraction** : A representative fraction (RF) is the ratio of distance on the map to distance on the ground. Representative fractions are expressed in the form of 1 followed by a : (colon) and then a number, where the one is the numerator in the fraction, the colon represents the division operation, and the other number is the denominator. Thus, a scale of 1:24,000 can be expressed mathematically as $1/24,000$. In fact, on some maps, you will see the RF represented using a division sign.

Q.3 Explain the indirect ranging? [R.T.U. 2018]

OR
Define reciprocal ranging.

Ans. **Reciprocal Ranging** : When the end points of a survey line is not inter-visible due to high intervening ground or if the

two stations are very far from each other, direct ranging is not possible. In such cases indirect ranging is done. Indirect ranging is also known as Reciprocal ranging.

Q.4 What is Magnetic declination? [R.T.U. 2018]

Ans. **Magnetic Declination** : A compass does not point to the true north - except by coincidence in some areas. The compass needle is attracted by magnetic force produced in the outer liquid part of the Earth's core, which varies in different parts of the world and is constantly changing. The magnetic north pole is currently located in the Barfin Island region of Canada, and from the UK, is west of true north. The direction in which the compass needle point is known as Magnetic North, and the angle between Magnetic North and the True North direction is called magnetic declination or variation.

Q.5 Explain the height of instrument? [R.T.U. 2018]

Ans. **Height of Instrument** : A surveying term used in spirit levelling for the height of the line of sight of a levelling instrument above the adopted datum, in trigonometric levelling for the height of the center of the theodolite above the ground or station mark, in stadia surveying for the height of the center of the telescope of the transit or telescopic alidade above the ground or station mark, and in differential levelling for the height of the line of sight of the telescope at the levelling instrument when the instrument is level.

Q.6 What do you mean by surveyor.

Ans. **Surveyor** : In surveying, we take measurements in the field. A person (or set of persons) performing various operations to obtain such measurements is known as a Surveyor.

Basic Civil Engineering

Q.7 How relative position between two points can be determined? Explain.

Ans. The relative position between two points can be determined by measuring

- (1) Horizontal distance and angle between the two points and
- (2) Vertical distance and angle between the two points.

Q.8 Define surveying.

Ans. **Surveying** : "The science and art of determining the relative positions of various points above, on or below the surface of earth."

Q.9 Write difference between plans and maps.

Ans. A plan graphically represents the features on or near the earth's surface as projected on a horizontal plane. A plan depicts the horizontal distance on the sheet so horizontal distances are measured between various points on the earth's surface.

A map is generally drawn on a relatively small scale. A map generally shows some additional features like contours, hachure etc. to indicate the uneven nature of the ground.

Q.10 Write different types of chains in surveying.

Ans. **Types of Chains in Surveying**

- (i) Engineer's chain
- (ii) Gunter's chain
- (iii) Revenue chain
- (iv) Band chain or Steel band

Q.11 Explain the term tape corrections.

Ans. A tape is more precise than a chain so for important or precise work a tape is generally used and because of this reason the corrections are known as "Tape corrections".

Q.12 Define bearing.

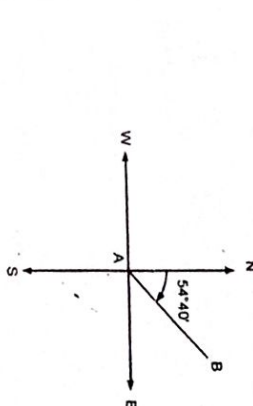
Ans. The reference direction from which position of any line is referred is known as 'meridian'. Angle measured from meridian is called the 'bearing' of line. There are three types of bearing:

- (i) True bearing
- (ii) Magnetic bearing
- (iii) Arbitrary bearing

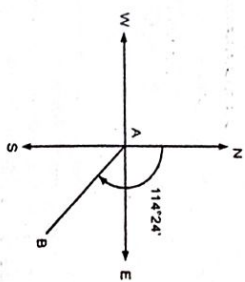
Q.13 Convert the following whole bearings to quadrantal bearings.

- (i) $54^\circ 40'$
- (ii) $114^\circ 24'$

Ans. (i) $54^\circ 40'$



(ii) $114^\circ 24'$



II. LONG ANSWER TYPE QUESTIONS

Q.1 What is local attraction? How is it detected and eliminated? [R.T.U. 2018]

Ans. **Local Attraction** : A magnetic meridian at a place is established by a magnetic needle which is uninfluenced by other attracting forces. However, sometimes, the magnetic needle may be attracted and prevented from indicating the true magnetic meridian when it is in proximity to certain magnetic substances. Local attraction is a term used to denote any influence, such as the above, which prevents the needle from pointing to the magnetic North in a given locality. Some of the sources of local attraction are: magnetic in the ground, wire carrying electric current, steel structures, railroad rails,

Q.2 The length of a line measured with a 20 meter chain was found to be 250 meters. Calculate the true length of the line, if the chain was 10 cm too long?

[R.T.U. 2018]

Ans. Given, $l = 20$ m

Measured length = 250 m

If the chain was 10 cm too long than,

True length, $L = \frac{l}{l'} \times \text{Measured length}$

$$L = \frac{20.10}{20} \times 250 = 251.25 \text{ m}$$

Q.3 Write a short note on total station. [R.T.U. 2018]

OR

Write important operations of total station.

Ans. Important Operations of Total Station

(i) **Distance Measurement:** Electronic distance meter consists as the major part of a total station. Range of EDM varies from 2.8 km to 4.2 km. The accuracy of measurement varies from 5 mm to 10 mm per kilometer for linear measurement and $1''$ to $20''$ for angular measurement. The distance measured is always sloping distance from instrument to the object. For measurement of horizontal angles any convenient direction may be taken as reference direction whereas for vertical angle measurement zenith direction is taken as reference direction.

(ii) **Data Processing:** Total station is provided with an inbuilt microprocessor. The microprocessor averages multiple observations. When we provide instrument as well as target height from ground, with help of slope distance and horizontal and vertical angles the microprocessor computes the coordinates. The processor is capable of applying temperature and pressure corrections to the measurements, if atmospheric temperature and pressures are supplied.

(iii) **Display:** Electronic display unit is capable of displaying various values when respective keys are pressed. The system is capable of displaying horizontal distance, vertical distance, horizontal angle, vertical angle, difference in elevations of two observed points and all the three coordinates of the observed points.

(iv) **Electronic Book:** Total station has the capability of saving point data. The capacity of electronic note book varies from 2000 to 4000 point data. The data can be downloaded to computer and the note book can be reused to store more data.

Q.4 Define levelling. Explain spirit levelling.

[R.T.U. 2018]

Ans. Levelling: Levelling is a branch of surveying used for finding the elevations of points with reference to a point whose elevation is known or assumed. The point whose elevation is known or assumed is called datum or benchmark. Levelling is also used to establish points if their elevations are given, with respect to any datum or benchmark. The objects of levelling are:

1. To find the elevations of various points with reference to any known or assumed benchmark.
 2. To establish various points of given elevation with reference to any known or assumed benchmark.
- Levelling provides vertical control in surveying opposite to Chain or Compass surveying which provides horizontal control.

Spirit Levelling (Direct Levelling): It is that branch of levelling in which the vertical distances with respect to a horizontal line (perpendicular to the direction of gravity) may be used to determine the relative difference in elevation between two adjacent points. A horizontal plane of sight tangent to level surface at any point is readily established by means of a spirit level or a level vial. In spirit levelling, a spirit level and a sighting device (telescope) are combined and vertical distances are measured by observing on graduated rods placed on the points. The method is also known as direct levelling. It is the most precise method of determining elevations and the one most commonly used by engineers.

Q.5 Explain ranging out survey lines. [R.T.U. 2018]

OR

Discuss direct ranging in detail.

Ans. Ranging Out Survey Lines: When linear measurements are taken on ground between two points, chain or tape need to be stretched straight along the line joining those two points. This line is known as 'Survey line' or 'Chain line' and the end points are known as 'Stations'. If the distance between two stations is less than the length of chain then the chain can be stretched directly between the two stations. But when the distance between two stations is greater than the chain length, then we need to establish some intermediate points (stations) which are in line with the two end stations. This process of establishing intermediate points between two stations is known as 'Ranging out survey lines' or simply 'Ranging'. There are two methods of ranging:

- (1) Direct ranging
- (2) Indirect ranging

BCE-7

1. Direct Ranging: Direct ranging is done when the two survey stations of a survey line are inter-visible and chain can be laid on ground easily. Direct ranging can be done by:

(i) **By eye judgment:** Let A and B be two stations of a survey line and the distance need to be determined of this line by chaining. So we need to stretch the chain straight along line AB. Let us assume that the length of line AB is more than the chain length so we need to establish some intermediate points in order to ensure that the chain is stretched straight. In direct ranging by eye judgment, minimum three ranging rods are required, one each on end stations A and B and one used for establishing intermediate point. As shown in figure 1 ranging rods are erected on station A and B and a surveyor will stand about 2 meter behind the ranging rod at A. An assistant with the third ranging rod will stand in between the points A and B holding the ranging rod vertically. The distance between point A and the assistant standing with the third ranging rod should be little less than one chain length. The surveyor at station A will direct the assistant to move right or left transverse to the chain line, till the assistant is in line with A and B. When the third ranging rod will be perfectly in straight line to AB the surveyor will not be able to see the ranging rod at B as through ranging rod at A, he can see only the third ranging rod. At this instant he will signal the assistant to erect the ranging rod at that point and thus an intermediate point (C in figure 1) will be established. The chain is then stretched between points A and C. As the distance between point A and C is kept slightly less than a chain length so when the chain is stretched it surpasses point C. Now the third ranging rod is pulled out and erected at the point where the chain ends and thus the distance between A and C becomes as one chain length. Now the ranging rod at station A will be pulled out and an arrow will be put in place. The assistant will take this ranging rod with him and will now stand between point C and B. The surveyor will signal him to move left or right transverse to chain line and like this other intermediate points will be established.

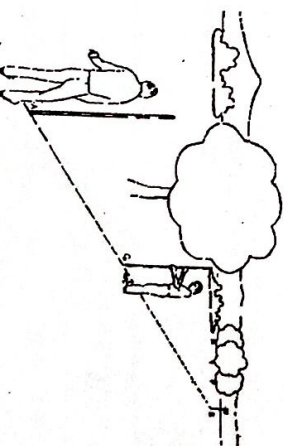


Fig. 1

(ii) By a line ranger: A line ranger is a surveying instrument used for establishing intermediate points during ranging without actually going to either end of a survey line. The biggest advantage of a line ranger is that no assistance is required while using line ranger and the surveyor himself can establish intermediate points.

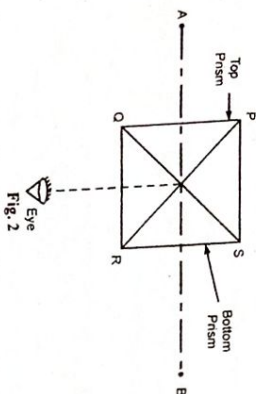


Fig. 2

A line ranger consists of two right-angles isosceles triangular prisms placed one above the other. In figure 2 the diagonal of the two prisms are silvered so as to form the reflecting surfaces to reflect incidental rays. In order to hold the instrument in hand a handle with a hook is provided at the bottom of line ranger. The use of hook is to attach a plumb bob it transfer the point on the ground.

Let a survey line AB is to measure with help of chain and point C need to be established through ranging by a line ranger. Two ranging rods are fixed on the two stations A and B. The surveyor will hold the line ranger in his hand at the level of his eye, and will stand at any point C very near the line AB, as judged by eye. Now he will observe the ranging rod at A through the upper prism PQR. The ray of light from A enters the upper prism, gets reflected from the silvered diagonal PR and enters the eye at right angles to the line AB, as the incident ray makes an angle of 45° with the reflecting surface. Now surveyor will observe ranging rod at B through the lower prism SQR. The ray of light from B enters the lower prism, gets reflected from the silvered diagonal SQ and enters the eye at right angles to the line AB.

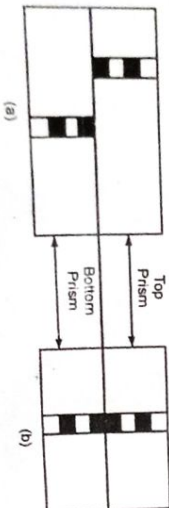


Fig. 3

If the images of the ranging rods at A and B are seen in vertical line (figure 3 b) then the point C is in line to survey

line AB. If the point at which the line ranger is held is not exactly on line AB, the two images will appear separate (figure 3 a). In such case surveyor will move the instrument slightly sideways until the two images appear exactly one over the other. Now surveyor will transfer the point to the ground by hanging a plumb bob from the hook on the handle.

2. Indirect Ranging: When the end points of a survey line is not intervisible due to high intervening ground or if the two stations are very far from each other, direct ranging is not possible. In such cases indirect ranging is done. Indirect ranging is also known as Reciprocal ranging. In reciprocal ranging minimum 4 ranging rods are required.

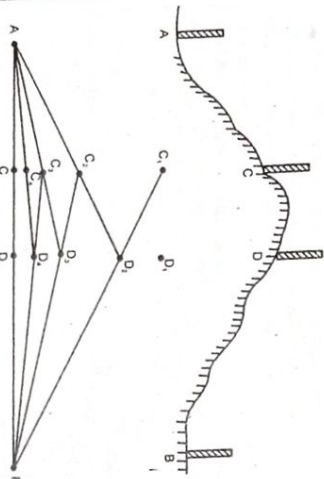


Fig. 4

Let us assume there are two stations A and B which are not intervisible. In figure two ranging rods will be fixed on two stations A and B. Now two assistant will take two ranging rods and take positions at C_1 and D_1 in such a way that the assistant at C_1 can see the ranging rods at D_1 and B, similarly assistant at D_1 can see the ranging rods at C_1 and A. Now the assistant standing at C_1 will direct the assistant at D_1 to move a new position D_2 in such a way that now C_1, D_2 and B are in one line. Now assistant at D_2 will direct the assistant at C_1 to move to a new position C_2 in such a way that now D_2, C_2 and A are in one line. Now the assistant at C_2 will direct the assistant at D_2 to move to a new position D_3 in such a way that C_2, D_3 and B are in one line. Now assistant at D_3 will direct the assistant at C_2 to move to a new position C_3 in such a way that D_3, C_3 and A are in one line. This process will continue till two points C and D will be established in such a way that the assistant at C will find point C, D and B in one line and simultaneously assistant at D will find point D, C and A in one line. Thus all four points A, C, D and B are in one line.

Q.6 What are the basic systems of notation of bearings?

[R.T.U. 2018]

Ans. Basic Systems of Notation of Bearings: There are two systems which are used to measure bearing, namely:

- (1) Whole circle bearing system (W.C.B.)
- (2) Quadrantal bearing system or Reduced bearing system (Q.B. or R.B.)

(i) **Whole circle bearing system (W.C.B.):** In W.C.B. system of measurement of bearing, bearing of a line is measured clockwise relative to magnetic north direction. As the name suggests, the whole circle is used so we can conclude that the whole circle bearing varies from 0° to 360° . In figure 21, magnetic north, south, east and west are shown as N, S, E, and W respectively. The whole circle bearing of line OA is θ_1 , OB is θ_2 , OC is θ_3 , and OD is θ_4 . As shown in the figure, all the angles are measured from magnetic north clockwise. Prismatic compass works on this system.

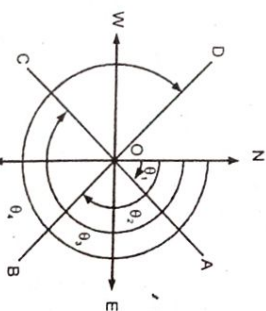


Fig. 21

(ii) **Quadrantal bearing system or Reduced bearing system (Q.B. or R.B.):** In the second method of bearing system, the magnetic bearing of any line is measured relative to magnetic north or magnetic south. The line is measured relative to either north or south, whichever is the nearest. The bearing is either measured in clockwise or anticlockwise direction. The position of line determines in which direction the bearing should be measured. It is apparent that only a quadrant of circle is getting used in this system. Hence it is known as the quadrantal system. The quadrant in which the line lies is also noted along with the bearing. First the direction North or South is written followed by the angle made by north

or south and then east or west is written depending upon the quadrant in which the line is lying. The bearing measured using this system is called Quadrantal bearing or reduced bearing. Since the quadrant of the circle is used in bearing, therefore, it is clear that the value of quadrantal bearing varies from 0° to 90° .

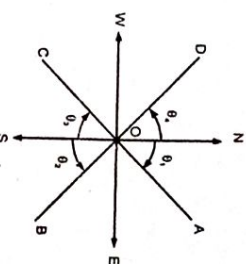


Fig. 22

In figure 22, the line OA is closer to magnetic north. Therefore, from magnetic north, angle θ_1 will be the reduced bearing of line OA. The line lies in the first quadrant of circle, which is also known as the N-E quadrant. Hence, the reduced bearing of line OA will be N θ_1 E. Similarly line OB is close to the magnetic south. Therefore, the angle θ_2 will be measured from magnetic south for line OB and from the opposite direction of clock i.e. counter-clockwise. The quadrant along with the reduced bearing of line OB will be S θ_2 E. Now it can be easily seen that S θ_3 W will be the reduced bearing of line OC and N θ_4 W will be the reduced bearing of line OD. Surveyor compass works on Q.B. system.

Q.7 Explain the concept of unit of measurement in detail.

Ans. In surveying we need to measure:

- (1) Horizontal distance and angle between two points
 - (2) Vertical distance and angle between two points
- So we need both linear and angular measures.

1. Linear Measures

According to the Standard of Weights and Measures Act (India), 1976 the unit of measurement of length is meters. Before the metric units introduced in India, feet and inches were the used units for length. Table is showing the basic linear measurement units, both in metric as well as British system.

The following are the types of scale :

- (1) Plain Scale
- (2) Diagonal Scale
- (3) Scale of Chords

1. Plain Scale

A plain scale is used to measure distances in two digits (Unit and tenth). For example cm and mm, meter and decimeter etc.

2. Diagonal Scale

The diagonal scale can measure distances up to three digits (Unit, tenth and hundredth e.g. meter, decimeter and centimeter or yard, feet and inches etc.). This scale works on the principle of equal triangle.

3. Scale of Chords

The scale of chords can be used for angle measurement. If we have to make an angle on the drawing sheet and we do not have a protractor then this scale is very useful.

Q.9 Discuss various types of tapes used in surveying.

Ans. Tape : For higher accuracy in linear measurements tapes are invariably used in surveying. Tapes are classified as per the material used in their manufacturing and can be of following types:

(i) **Linen or cloth tape:** These are closely woven linen or synthetic material and are varnished to resist the moisture. Linen tapes are available in lengths of 10 meters, 20 meters, 25 meters and 30 meters and width of 12 to 15 mm. The main disadvantage of linen tape is that it is affected by moisture and gets shrunk. Also its length gets altered with stretching. They are usually encased in plastic boxes with recessed handles.

(ii) **Metallic tape:** Metallic tapes are light and flexible. They do not break easily. They are used in places, where minimal error in length does not have any major effect. Metallic tapes are made in length of 2, 5, 10, 20, 30 and 50 meters. The metal ring is fitted towards the outer end in a tape of length 10, 20, 30 and 50 meters and the metal strip is tied to its width. This metal strip protects the tape. This type of tape is used only in simple survey work but not used to measure length accurately.

(iii) **Steel tapes:** Steel tapes are more accurate than metallic tapes. They are made of steel or stainless steel strips. Steel tapes consist of a light strip of width 6 to 10 mm and

are more accurately graduated. Steel tapes are available in length of 1 meter, 2 meter, 10 meter, 20 meter, 30 meter and 50 meter. At the end of the tape a brass ring is attached, the outer end of which is zero point of the tape. Steel tapes cannot be used in ground with vegetation and weeds.

(iv) **Invar tapes:** These tapes are made of Nickel-steel alloy (nickel 36% and steel 64%) known as invar. These tapes have very low coefficient of thermal expansion ($0.122 \times 10^{-6}/^{\circ}\text{C}$). These tapes are made in the form of a ribbon of 6 mm width and are available in lengths of 20 m, 30 m, 50 m and 100 meters. These tapes are kept on reels of large diameter to avoid kinking. Invar tapes are highly precise and less affected by temperature changes. The disadvantage of invar tapes is that they are very soft so gets deformed easily. Also it undergoes small changes in length as time goes on. So it is always advisory to determine the length and coefficient of thermal expansion of invar tapes from time to time.

Q.10 The following readings are taken from a level: 1.885, 2.770, 1.585, 1.985, 2.115, 1.660, 0.985, 1.110, 0.765, 0.885 and 1.005. Instrument is shifted once after sixth reading.

Enter the above reading in a level field book and compute the reduced level of all stations using height of instrument method. The first reading was taken when a staff was held at a benchmark of 101.500 meter.

Ans. The problem will be solved by height of instrument method as explained above. Number of stations will be $11 - 1 = 10$. The calculation is tabulated as follows:

Station	B.S.	I.S.	F.S.	H.I.	R.L.	Remarks
1.	1.885			103.385	101.500	Bench mark
2.		2.770			100.615	
3.		1.585			101.800	
4.		1.985			101.400	
5.		2.115			101.270	
6.	0.985		1.660	102.710	101.725	Turning point 1
7.		1.110			101.600	
8.		0.765			101.945	
9.		0.885			101.825	
10.			1.005		101.705	
	Σ B.S. = 2.870		Σ F.S. = 2.665			

$$\Sigma \text{B.S.} - \Sigma \text{F.S.} = 2.870 - 2.665 = 0.205 \text{ m}$$

Also Last R.L. - First R.L.

$$= 101.705 - 101.500 = 0.205 \text{ m}$$

As $\Sigma \text{B.S.} - \Sigma \text{F.S.} = \text{Last R.L.} - \text{First R.L.}$ (checked)

Q.11 The following bearings were observed with help of a prismatic compass. Calculate the interior angles.

Line	Bearing
AB	57°42'
BC	129°23'
CD	194°56'
DE	250°0'
EA	57°42'

Ans. Figure shows the traverse ABCDEA with 5 survey lines, namely AB, BC, CD, DE and EA. When only bearing is given, it means it is fore bearing only unless otherwise stated. Back bearings can be calculated with help of equation (1).

Fore bearing = Back bearing $\pm 180^{\circ}$

Included angle = Back bearing of previous line - Fore bearing of next line

Back bearing of line AB = $57^{\circ}42' + 180^{\circ} = 237^{\circ}42'$

Back bearing of line BC = $129^{\circ}23' + 180^{\circ} = 309^{\circ}23'$

Back bearing of line CD = $194^{\circ}56' - 180^{\circ} = 14^{\circ}56'$

Back bearing of line DE = $250^{\circ}0' - 180^{\circ} = 70^{\circ}0'$

Back bearing of line EA = $340^{\circ}12' - 180^{\circ} = 160^{\circ}12'$

Now included angles can be calculated by using equation

(2) as the traverse runs in clockwise direction.

$\angle A = \text{Back bearing of line EA} - \text{Fore bearing of line AB}$
 $= 160^{\circ}12' - 57^{\circ}42' = 102^{\circ}30'$

$\angle B = \text{Back bearing of line AB} - \text{Fore bearing of line BC}$
 $= 237^{\circ}42' - 129^{\circ}23' = 108^{\circ}19'$

$\angle C = \text{Back bearing of line BC} - \text{Fore bearing of line CD}$
 $= 309^{\circ}23' - 194^{\circ}56' = 114^{\circ}27'$

$\angle D = \text{Back bearing of line CD} - \text{Fore bearing of line DE}$
 $= 14^{\circ}56' - 250^{\circ}0' + 360^{\circ} = 124^{\circ}56'$

$\angle E = \text{Back bearing of line DE} - \text{Fore bearing of line EA}$
 $= 70^{\circ}0' - 340^{\circ}12' + 360^{\circ} = 89^{\circ}48'$

Sum of included angle = $102^{\circ}30' + 108^{\circ}19' + 114^{\circ}27' + 124^{\circ}56' + 89^{\circ}48' = 540^{\circ}0'$, hence OK.

So the included angles of the pentagon ABCDE are:

$$\begin{aligned}\angle A &= 102^\circ 30' \\ \angle B &= 108^\circ 19' \\ \angle C &= 114^\circ 27' \\ \angle D &= 124^\circ 56' \\ \angle E &= 89^\circ 48'\end{aligned}$$

□□□

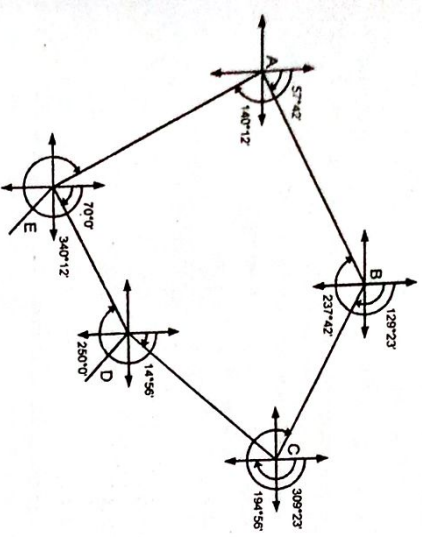


Fig.

PREVIOUS YEARS QUESTIONS

BUILDINGS

I. SHORT ANSWER TYPE QUESTIONS

Q.1 What is the main function of alumina in brick?

[R.T.U. 2018]

Ans. Alumina is the main constituent of clay. It acts as a cementing material in raw brick. Brick clay is plastic due to the presence of alumina. This plasticity ensures that bricks can be molded. An excess amount of alumina in clay may cause the bricks to shrink, warp or crack on drying and burning as any other cementing material.

Q.2 What is the initial setting time for ordinary portland cement as per IS specifications? [R.T.U. 2018]

Ans. Initial setting time is that time period between the time water is added to cement and time at which 1 mm square section needle fails to penetrate the cement paste, placed in the Vicat's mould 5 mm to 7 mm from the bottom of the mould. Division on setting time of cement is based on initial setting time of cement and final setting time of cement.

At normal construction the cement paste / mortar/concrete (CEMENT + WATER = PASTE, PASTE + FINE AGGREGATE = MORTAR, MORTAR + COARSE AGGREGATE = CONCRETE) time is required for mixing, transporting, placing, compacting and finishing. During this time the above mentioned cement paste/mortar/concrete must be in plastic condition which is termed as initial setting time of cement.

Q.3 Define the term construction material. Write different construction materials.

Ans. Any material which is used for construction purposes is termed as building material or construction material.

- | | |
|--------------|------------|
| (1) Stone | (2) Bricks |
| (3) Cement | (4) Mortar |
| (5) Concrete | (6) Steel |

Q.4 Write the three uses of bricks.

Ans. Uses of Bricks

- (1) Bricks are used in structural purposes, for foundation and for construction of walls of any size.
- (2) Bricks are used for construction of floors.
- (3) Bricks are used for decorative or ornamental purposes, as for construction of arches and cornices. Bricks can be carved in a variety of colors, textures, bonds and joints.

Q.5 What are the properties of cement.

- Ans. (i) Strength (ii) Fineness (iii) Resistant to moisture (iv) Setting of cement (v) Plasticity (vi) Workable

Q.6 Write the types of buildings.

Ans. Types of buildings :

- (1) Residential Buildings
- (2) Educational Buildings
- (3) Institutional Buildings
- (4) Assembly Buildings
- (5) Business Buildings
- (6) Mercantile Buildings
- (7) Industrial Buildings
- (8) Storage Buildings
- (9) Hazardous Buildings

Ventilation is referred as the supply of outside air into a building through windows or other openings due to wind outside and convection effects arising from temperature or vapour pressure difference or both between inside and outside of the building. Ventilation of a building is essential because of various functional requirements, such as :

- (1) To create air movements
- (2) To maintain conditions suitable to the contents of the space
- (3) To prevent undue concentration of body odours, fumes, dust, bacteria carbon dioxide, moisture etc.
- (4) To remove the products of combustion, body heat and heat liberated from the operation of certain equipments.

Natural ventilation is provided through windows or ventilators whereas artificial (mechanical) ventilation is provided by fans etc.

Q.4 Explain the basic concept of R.C.C. [R.T.U. 2018]

OR

Discuss basic concept of RCC. Write its properties, advantages and uses.

Ans. Basic Concept of R.C.C. : Concrete is very strong in compression but weak in tension. Its resistance is so low that plain concrete can be used only when there is only pure compression. Steel is equally strong in compression and tension but due to its length, steel may not develop its full strength in compression due to buckling, whereas steel can develop its full strength in tension. When steel and concrete combination is used, both the materials take the stresses they are most suitable for. This combination of steel and concrete is known as 'reinforced cement concrete' or R.C.C. as steel provides reinforcement (strength) to concrete cement.

Main properties of R.C.C. :

- (1) The concrete grips fast with steel surface and is able to transfer the stresses which it cannot resist itself.
- (2) Both concrete and steel have almost same coefficient of thermal expansion, and thus no internal stresses due to temperature variation arises.
- (3) Concrete coats the surface of steel, thus protects it from corrosion.

Advantages of R.C.C. :

- (1) It is economical in ultimate cost.
- (2) It is fire resisting.
- (3) It is almost impermeable.
- (4) It is durable.
- (5) The maintenance cost of R.C.C. is very little.
- (6) It cannot be attacked by termites.

- (7) It can be moulded into any size when it is fresh.
- (8) R.C.C. structure can be designed for any desired load.
- (9) Constituent of R.C.C. are easily obtainable.

Uses of R.C.C. :

- (1) R.C.C. is used as a structural element, like in footings, columns, beams, lintels, staircases.
- (2) R.C.C. is used for the construction of storage structures like water tanks, dams etc
- (3) R.C.C. is used for the construction of big structures like bridges, retaining walls, docks, harbours etc.
- (4) R.C.C. is used in precast structures like railway sleepers, electric poles etc.
- (5) R.C.C. is used for constructing tall structures like multistory building, chimneys, towers etc.
- (6) R.C.C. is used for pavement construction like roads or airport pavements.
- (7) R.C.C. can be used for constructing hazardous buildings like chemical storage, atomic plants etc.

Q.5 Write the components of a building. [R.T.U. 2018]

OR

What do you mean by building construction. Write components of building and their functions.

Ans. Building construction deals with various processes of construction and elements involved in the same.

Components of Building and Their Functions

A building consists of following three parts:

(i) **Foundation:** Foundation is the lowest part of a building which is below the surface of the surrounding ground. It is in direct contact with sub-strata and transmits all the loads to the soil beneath.

(ii) **Plinth:** Plinth is the middle part of a building, from the surface above the ground to surface of the floor immediately above the ground. It transfers the load to foundation.

(iii) **Super Structure:** The part constructed above the plinth level (or ground floor level) is known as super structure.

In general, a building is made of the following structural components:

- (1) Foundation
- (2) Plinth
- (3) Walls
- (4) Floors

BCE.16

- (5) Doors and windows
- (6) Sills, lintels and weather shades
- (7) Roofs
- (8) Staircases
- (9) Finishes
- (10) Utility fixtures

Q.6 Write a short note on building bye-laws? [R.T.U. 2018]
OR

What do you mean by Building By-laws. Write its aspects.

Ans. Building By-Laws : Whenever there is a construction work is planned, firstly it is designed. The main questions arises during designing is that what things one should keep in mind while designing. Different people have different design requirements. The design used by one may affect other people living in the vicinity. If it effects adversely, one of the many conditions that will result from this will be frequent brawls and fights with the neighbors and the locality members. There should be some standards on which building designs can be based. Keeping this need of standardization in mind there was a need to formulate certain rules and regulations that one should follow while constructing a building. Therefore, some rules and regulations were formed by government to regulate the construction of the buildings known as Building by laws or Building Regulation.

The by-laws govern the following aspects:

- (1) Line of building frontages
- (2) Built up area of buildings
- (3) Open space around buildings and their heights
- (4) Provision of size, height and ventilation of rooms and apartments
- (5) Water supply and sanitary provisions
- (6) Structural design or sizes and sections

Q.7 What are the qualities of good bricks? [R.T.U. 2018]

Ans. Qualities of Bricks :

- (1) **Size and Shape:** A good quality brick should be uniform in size and should have rectangular plane surfaces with parallel sides and sharp straight right angled edges. Its surface should not be too smooth or otherwise the mortar will not stick to it. Alumina imparts plasticity to bricks. Presence of silica prevents cracking, shrinking and warping of raw bricks. An excess of alumina causes shrinkage and warping of bricks during drying and burning.

- (2) **Colour:** A good quality brick should have uniform colour. Oxides of iron imparts red colour to the bricks. Uniformity of colour in bricks is an indicator of uniformity in the chemical composition and thoroughness in the burning of bricks. Colour of a good quality brick may be deep red, cherry or copper colour.
- (3) **Texture:** Texture of a good quality brick should be fine, compact and uniform.
- (4) **Compactness:** Good quality bricks should be sound and compact.
- (5) **Hardness:** A good quality brick should be sufficiently hard that if scratching it by finger nail it should not be able to make any impression.
- (6) **Soundness:** When two good quality bricks are struck against each other, there should be a 'metallic ringing' sound. An experienced engineer can easily identify such sounds.
- (7) **Durability:** Salt attack hampers the durability of brick. The presence of excess soluble salts in brick also causes efflorescence. The percentage of soluble salts (sulphates of calcium, magnesium sodium and potassium) should not exceed 2.5% in brunt bricks.
- (8) **Water Absorption:** A good quality brick must not absorb more than 20% of its dry weight in water when it is kept immersed for 24 hours. Also after 24 hours of immersing, bricks should not show deposits of white salts when allowed to dry in shade.
- (9) **Crushing Strength:** Crushing strength of good bricks should be of the order of 10 N/mm^2 and in any case it must not be below than 5.5 N/mm^2 .
- (10) **Brick Earth:** The brick should be moulded from good brick earth. Free from vegetable matter, stones, gravel, kankar or any harmful salts.
- (11) **Thermal Conductivity:** The thermal conductivity of bricks should be low as it is desirable that the building built with them should be cool in summer and warm in winter.

Q.8 Write properties and uses of concrete.

Ans. Properties of Concrete

- (1) **Compressive Strength:** Concrete has high compressive strength. Concrete is known by its grade

1. Mandatory Signs: These signs are used to ensure free movement of traffic and make the road users cognizant of certain laws and regulations, restrictions and prohibitions. Violation of these signs is an offence, as per law. Some mandatory signs are shown in figure 1.

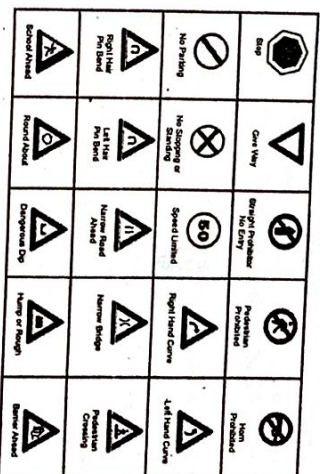


Fig. 1

2. Cautionary Signs: These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation. Some cautionary signs are shown in figure 2.

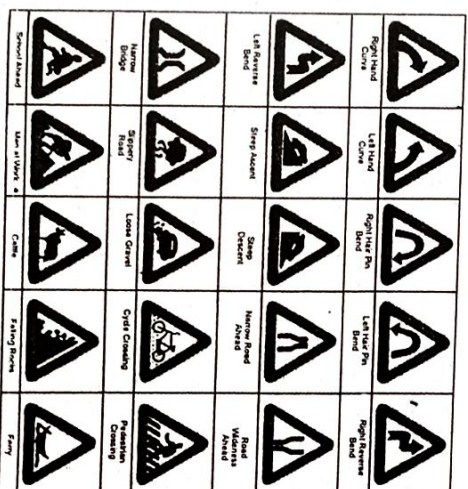


Fig. 2

3. Informative Signs: These signs guide the road users about destinations, distance, alternative routes, and prominent locations like food joints, public toilets, nearby hospitals, etc. Some informative signs are shown in figure 3.

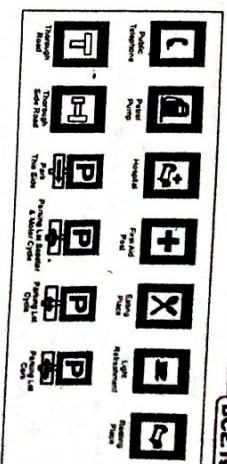


Fig. 3

Q2. Write the characteristics of various modes of transportation. [R.T.U. 2018]

Ans. Characteristics of Various Modes of Transportation :

1. Roadways : The most convenient and 'nearest to the people' mode is roadways. Roadways have the maximum flexibility in terms of route, direction, time, speed of travel etc. Characteristics of roadways can be listed as under:

- Road transport requires a relatively small investment for the government.
- Roads are used by various types of road vehicles, like passenger cars, buses, trucks, two and three wheeled automobiles, pedal cycles and even animal drawn vehicles. Road transport is the only mode through which door to door service can be provided.
- Road transport completely offer a freedom to road users to transfer the vehicles from one lane to another and from one road to another according to the need and convenience.
- For short distance travel, road transport saves time.
- Road transport is the only means of transport offer itself to the whole community alike.
- 2. Waterways :** Water transport is the cheapest and the oldest mode of transport. It operates on a natural track and hence does not require huge capital investment in the construction and maintenance of its track except in case of canals. The cost of operation of water transport is also very less. It has the largest carrying capacity and is most suitable for carrying bulky goods over long distances. It has played a very significant role in bringing different parts of the world closer and is indispensable to foreign trade.

PREVIOUS YEARS QUESTIONS

TRANSPORTATION 4

I. SHORT ANSWER TYPE QUESTIONS

Q.1. Why road traffic signs are used?

Ans. Traffic signs give information about the road conditions ahead, provide instructions to be followed at the major crossroads or junctions, warn or guide drivers, and ensure proper functioning of road traffic.

Q.2. What is transportation? Why it is necessary?

Ans. Movement of humans, animals or goods from one place to another is known as transportation. Transportation contributes to the economic, industrial, social and cultural development of any country. Transportation is the key for economic development of any country or region as every commodity produced viz. food, industrial products etc. needs transportation at all stages from their production (or manufacturing) to distribution.

Q.3. What are mandatory signs?

Ans. Mandatory Signs: These signs are used to ensure free movement of traffic and make the road users cognizant of certain laws and regulations, restrictions and prohibitions. Violation of these signs is an offence, as per law.

Q.4. Write the difference between cautionary signs and informative signs.

Ans. Cautionary Signs: These signs make the road users conscious of hazardous conditions on the road beforehand.

II. LONG ANSWER TYPE QUESTIONS

Q.1. Explain the various road traffic signs. [R.T.U. 2018]

Ans. Road Traffic Signs :

Traffic signs are the silent speakers on the road. Be it the person behind the wheel or a pedestrian, having a sound knowledge about road safety is absolutely necessary for all before hitting the roads. Traffic signs give information about the road conditions ahead, provide instructions to be followed at the major crossroads or junctions, warn or guide drivers and ensure proper functioning of road traffic. Being unaware of road signs is akin to throwing caution to the wind. It can lead to loss of life and property. A person is supposed to be familiar (get through a written or oral test) with the traffic signs and symbols before acquiring a driving license in India. Road safety signs are primarily of three types:

- Engineering
- Enforcement
- Education

BCE-20

The main characteristics of waterways are:

- (i) Rivers or oceans are a natural highway which does not require any cost of construction and maintenance. Even the cost of construction and maintenance of canals is much less and they are used, not only for transport purposes but also for irrigation, etc.
- (ii) It can carry much larger quantities of heavy and bulky goods such as coal, timber etc.
- (iii) It provides much more flexible services than railways and can be adjusted to individual requirements.
- (iv) The risks of accidents and breakdowns, in this form of transport, are least as compared to any other form of transport.
- (v) Speed of inland water transport is very slow and therefore this mode of transport is unsuitable where time is an important factor.
- (vi) It can be used only in a limited area which is served by deep canals and rivers.
- (vii) Rivers and canals cannot be operated for transportation throughout the year as water may freeze during winter or water level may go down during summer. Similarly oceans have tides or storms which become unsuitable for transportation.

3. Airways : Air transport is the most recent mode of transport. It is the gift of the 20th century to the world. The two world wars gave a great impetus to the development of air transport in almost all the countries of the world. The peculiar characteristic of air transport is that it does not need a specific surface track for its operations. It has no physical barriers as in the case of other mode of transport. Political boundaries are also immaterial although it has to observe the requirements of the International Law. The supreme advantage of air transport lies in its quickness. It is the fastest mode of transport. But the cost of its operation is very high and thus it is suitable for only rich passengers, mails and light and costly cargo. However, in advanced countries like U.S.A., Germany, etc. it offers a tough competition to the railways.

Main characteristics of airways are:

- (1) Air transport provides unbroken journey over land and sea. It is the fastest and quickest means of transport.

Basic Civil Engineering

- (2) Air transport has the highest speed among all the modes of transport.
- (3) Preferred for long distance transport, especially for human beings and small cargo.
- (4) Air transport requires special preparations like wheelers links, meteorological stations, flood lights, searchlights etc.
- (5) Airplanes run on liquid fuel, generally a special blend known as jet fuel.
- (6) It is not used for mass public transport.

Q.3 Write a short note on road safety measures.

[R.T.U. 2018]

OR

Write detailed note on road safety measures.

Ans. Road Safety Measures : The various measures to decrease the accident rates may be divided into three groups:

- (i) Engineering (ii) Enforcement (iii) Education

1. Engineering Measures

(i) **Road Design:** The geometric design features of the road such as sight distances, width of pavement, horizontal and vertical alignment design details and the intersection design elements are checked and corrected if necessary. The pavement surface characteristics including the skid resistance values are checked and suitable maintenance steps are taken to bring them upto the design standards.

(ii) **Preventive Maintenance of Vehicles:** The braking system, steering and lighting arrangements of vehicles playing on the roads may be checked at suitable intervals and heavy penalties levied on defective vehicles.

(iii) **Before and After Studies:** The record of accidents and their patterns for different locations are maintained by means of collision and condition diagrams. After making the necessary improvements in design and enforcing regulation, it is again necessary to collect and maintain the record of accidents 'before and after' the introduction of preventive measures to study their efficiency.

(iv) **Road Lighting:** Proper road lighting can decrease the rate of accidents during night, due to poor visibility. Lighting

Basic Civil Engineering

is particularly desirable at intersections, bridge sites and at places where there are restrictions to traffic movements.

2. Enforcement Measures

(i) **Speed Control:** To enable drivers of vehicles to develop correct speed habits tachometers may be fitted so as to give the record of speeds. Surprise checks on speed should also be done time to time.

(ii) **Traffic Control Device:** The Signals may be redesigned or signal system may be introduced if necessary. Similarly proper traffic control device like signs, markings or channelizing islands may be installed wherever necessary.

(iii) **Training and Supervision:** The transport authorities should be strict in testing and issuing license to drivers especially drivers of public service vehicles or taxis.

(iv) **Medical Check:** The drivers should be tested for vision and reaction periodically.

(v) **Observance of Law and Regulation:** Traffic laws and regulations must be followed by each and every person who is driving any kind of vehicle.

3. Educational Measures

(i) **Education to Road Users:** It is most important to educate the road users for the various precautionary measures to use the road way facilities with safety.

(ii) **Safety Drive:** Imposing traffic safety week when the road users are properly directed by the help of traffic police and transport staff is a common means of training. Road users should be taught about the do's and don'ts by means of films and documentaries.

Q.4 Explain various causes of accidents in detail.

Ans. There are four basic elements in a traffic accident:

- (1) The road users
- (2) The vehicles
- (3) The road and its condition
- (4) Environmental factors like traffic weather etc.

The road users responsible for the accident may be the driver of one or more vehicles involved, pedestrians or the passengers. Vehicles involved in the accident may also be

defective. The geometric features of the road may be in a nutshell, to a combination of particular factors.

- (i) D

cause of accident is his or her phone, seen

- (ii) S

easy way to slower you auto accident

- (iii) D

to focus on operating causes accident

- (iv) I

and you happen to quickly or

- (v) R

accidents slick and often while bra when it r

- (vi) I

intersect The main wasteage

- (vii) I

ignored, result. E drivers impact

- (viii) I

parts, an accident

IMPORTANT QUESTIONS

I. SHORT ANSWER TYPE QUESTIONS

Q.1 What are the types of pollution?

Ans. Types of pollution :

- (a) Air pollution
- (b) Water pollution
- (c) Land (soil) pollution
- (d) Noise pollution
- (e) Radioactive pollution
- (f) Thermal pollution

Q.2 What do you mean by basics of species?

Ans. Species, such as the quetzal, ahuehuete (Montezuma cypress), jaguar, dahlia, crocodile, and the monarch butterfly are the units in which we categorize all living things, including human beings. A species is a group of organisms that can reproduce and create fertile offspring.

In general, individuals of a species are recognizable because they are similar in form and function. Often, however, individuals of a species are very different. For example, male and female birds of the same species are very different, tadpoles are very different to frogs, and caterpillars are very different to butterflies. The opposite can also be true: some species appear very similar and are difficult to distinguish at times, even with the most expert eye.

Q.3 Define biodiversity?

Ans. "Biodiversity" means presence of different kinds of living organisms in a particular ecosystem. It includes complete spectrum of living organisms from microscopic level (bacteria,

virus, fungi etc.) to macroscopic level (birds, insects, reptiles, mammals, fishes etc.).

Biodiversity also differs from one ecosystem to another. For example, in a forest, we may find a wide variety of plant and animal life. Variation in plants may range from small herbs to large trees. Animals may range from small (microscopic ones) to large mammals. In other words, biodiversity can also be defined as a totality of genes, species and ecosystems in a region.

Q.4 What do you mean by collection of waste water?

Ans. Waste water is generated by mainly kitchen and bathrooms. This water is rich in washing powder, oil, and detergents etc. so it does not give any foul smell. But the water coming out from toilets contains faecal matter which is biodegradable and gives foul smell.

Both types of waste water are transported through underground pipe lines connected to main drain of the house. These pipe lines are made up by cement, china clay or plastic. These pipe lines are then connected to inspection chamber.

Q.5 Write down the types of Solid waste.

Ans. Types to Solid waste:

- Household waste also called municipal waste
- Industrial waste
- Agricultural waste
- Biomedical waste
- Hazardous waste

Q.6 Define Global Warming.

Ans. Global warming is termed to be the increase in the average temperature of Earth's oceans and near surface air.

This has been happening in the recent decades and is expected to continue. In fact the term global warming is said to be a specific example of climatic changes. In scientific and common terms, global warming refers to recent warming and also implies a human influence on the same.

The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the observed temperature increases since the middle of the 20th century and it was caused by increasing concentrations of greenhouse gases resulting from human activity such as fossil fuel burning and deforestation. It also concludes that variations in natural phenomena such as solar radiation and volcanoes produce most of the warming from pre-industrial times till 1950 and afterward had a small cooling effect.

II. LONG ANSWER TYPE QUESTIONS

Q.1 Discuss the effects and control of soil pollution.

Ans. Land or Soil Pollution : Land is equally important to humans and other living organisms. The upper part or layer of the land is called the soil. It is the most fertile part of the land. Soil is a very important natural source in which physical, chemical and biological activities continuously take place. Country's economy depends on the soil.

Any physical or chemical changes in soil conditions that may adversely affect the growth of plants and other organisms living in the soil is known as soil pollution. Bacteria and fungi decay the plant animal wastes and dead organisms, convert them into nitrates, phosphates and other nutrients. The use of large amount of fertilizers decreases the ability of bacteria to decay wastes and produce nutrients. Pesticides harm the bacterium and other organisms in the soil. Erosion also causes a lot of damage to the soil. Careless farming and land construction causes erosion.

Sources of Soil Pollution

1. Since agriculture is becoming more and more intensive, increased quantities of fertilizers, pesticides etc. are used. The residues of these pollute the soil.
2. Industrial discharge and urban solid wastes are the major sources of soil pollution.
3. Other sources of soil pollution include waste water and faulty sanitation.

Pollutants of Soil Pollution

1. Chemicals like zinc, cadmium, aluminium, copper, mercury from industrial wastes reach the soil directly or indirectly.

2. Organic insecticides like DDT, benzene etc. accumulate in soil and have deleterious effect on plant growth.
3. Improper and continuous use of fertilizers, pesticides alters the basic composition of soil and makes the soil toxic.

Effects of Soil Pollution

1. Various types of chemicals like acids, alkalis, pesticides, heavy metals etc. from the industrial discharges change the physical, chemical and biological properties of the soil. The pathogenic bacteria and viruses in the sewage waste cause various types of diseases such as diarrhoea, cholera, typhoid, plague etc. It decomposes the organic matter producing toxic gases.
2. Salts tend to accumulate in the soil causing salinization which leads to death of plants.
3. Plants also absorb the pollutants and store them in their stems and leaves which affects the humans.
4. The radio-isotopes in the soil enter the food chain, replace essential elements in the body and cause abnormalities. The radio-isotopes in the soil emit radiations in to the environment.

Salination of Soil

Increase in concentration of soluble salts in the soil is called **salination**. It degrades the quality of land. Salinization can occur in any region and is generally caused due to the continuous use of irrigation water which contains salts.

Normally, plants have a lower concentration of water than the surrounding soil. So water flows from soil into plants. But if soil is saline, it has a lower concentration of water than plants and thus water starts flowing out of the plants into the soil. So plants cannot tolerate saline soil.

The salts move up from lower layers to top layers by capillary action and gets deposited on surface which creates a lot of problem for the plants. Excessive use of fertilizers like sodium nitrate causes salinization of soil. In coastal regions, winds bring lot of salt from sea water to land causing the increase in concentration of salts in soil.

Processes like dilution, vapor extraction, bio remediation etc. can reduce this soil pollution.

Control of Soil Pollution

1. The industrial wastes should be properly treated before discharging them into the soil.

2. The methods like dilution, vapor extraction and bio remediation improve the quality of soil by decreasing the pollutants.
3. Biodegradable organic wastes should be used for generation of biogas.
4. Microbial degradation of biodegradable substances should be done.
5. Biological pest control methods should be used to reduce the level of pesticides.
6. Chemical fertilizers should be replaced by biofertilizers.
7. Mining techniques should be improved to reduce the spread of mine dust.
8. Pneumatic pipes, special pits should be used for collecting and disposing wastes.
9. For bulk transfer of various wastes to discharge sites, transfer stations should be made at different points.
10. The waste materials like paper, glass and plastics should be recycled.

Q.2 Describe briefly sources and effects of ground water contamination.

Ans. Sources of Groundwater Contamination : Ground water can become contaminated from natural sources or numerous types of human activities. Residential, municipal, commercial, industrial, and agricultural activities can all affect ground water quality. Contaminants may reach ground water from activities on the land surface, such as releases or spills from stored industrial wastes, from sources below the land surface but above the water table, such as septic systems or leaking underground petroleum storage systems; from structures beneath the water table, such as wells; or from contaminated recharge water.

The following are the main sources of ground water contamination:

1. Natural sources
2. Septic systems
3. Improper disposal of hazardous waste
4. Releases and spills from stored chemicals and petroleum products
5. Landfills

Selection of the appropriate remedial technology is based on site-specific factors and often takes into account cleanup goals based on potential risk that are protective of human health and the environment. The technology selected is one that will achieve those cleanup goals. Different technologies are effective for different types of contaminants, and several technologies are often combined to achieve effective treatment. The effectiveness of treatment depends in part on local hydrogeological conditions, which must be evaluated prior to selecting a treatment option. Given the difficulty and high costs of cleaning up a contaminated aquifer, some communities choose to abandon existing wells and use other water sources, if available. Using alternative supplies is probably more expensive than obtaining drinking water from the original source. A temporary and expensive solution is to purchase bottled water, but it is not a realistic long-term solution for a community's drinking water supply problem. A community might decide to install new wells in a different area of the aquifer. In this case, appropriate siting and monitoring of the new wells are critical to ensure that contaminants do not move into the new water supplies.

Q.3 Explain Composition of solid waste.

Ans. Composition of Solid Waste : Solid waste may be any garbage, refuse, sludge and other discarded material which may be solid, liquid, semisolid having gaseous material obtained from industrial, commercial, mining, and agricultural operations, and also from community activities (like construction waste, household junk such as furniture, appliances and equipments etc.). Typical solid wastes are leather, rubber, plastics, food wastes, paper, wood and other combustible and non combustible materials. Table 1 shows the composition of a common solid waste.

Table 1

No.	Type of Solid Waste	Percentage	No.	Type of Solid Waste	Percentage
1	Organic matter	60%	6	Textile	05%
2	Paper	10%	7	Rubber	01%
3	Plastics	05%	8	Wood	05%
4	Glass	02%	9	Metals	01%
5	Leather	01%	10	Fine fractions (< 10 mm)	07%

Disposal of solid wastes is commonly done by dumping on land or into water, incineration or long term storage in secured facility. All these methods have negative impact on the environment and are proved to be hazardous for the human health as incineration causes pollution in air while land filling contaminates the surface and ground water. United Nations Development Programme estimated more than five million people die every year from diseases related to inadequate waste disposal system. Table 2 shows the effective time taken by the disposed wastes for their disintegration.

Table 2

Types of Solid Waste	Approximate Time it Takes to Degrade the Litter
Organic waste such as vegetable and fruit peels, leftover foodstuff, etc.	A week or two
Paper	10-30 days
Cotton cloth	2-5 months
Wood	10-15 years
Woollen items	1 year
Tin, aluminium, and other metal items such as cans	100-500 years
Plastic bags	One million years
Glass bottles	Undetermined

To overcome the serious threat of solid waste in the society there is a need to accept the concept of waste management to handle the solid waste generation, its handling, transportation, storage, recycling and disposal in an organized constructive way.

Q.4 Explain harmful effects of air pollution.

Ans. Harmful Effects of Air Pollution

1. Effects of Air Pollution on Human Health : The air we breathe has not only life supporting properties but also life damaging properties. Under ideal conditions the air we inhale has a qualitative and quantitative balance that maintains the well being of man, but when the balance among the air components is disturbed, or in other words, if it is polluted, it may affect human health.

Average man breathes 22,000 times a day and take 16 kg of air each day. Which is much greater than the consumption of food and water. It has been estimated that a man can live for 5 weeks without food, for 5 days without water, but only for 5 minutes without air.

All the impurities in the inhaled air do not necessarily cause harm. Depending upon the chemical nature of the

pollutants, some may cause harm when present in air in small concentrations and others may do so only if they are present in high concentrations. The duration of exposure of the body is also an important factor. Therefore the prime factors affecting human health are,

- Nature of the pollutants
- Concentration of the pollutants
- Duration of exposure
- State of health of the receptor and
- Age-group of the receptor.

The effects of air pollution are observed greatly among seniors, children, infants, asthmatics and people with chronic diseases of lungs or heart are thought to be at great risk.

Mechanism of Action of Air Pollutants : The effects of air pollution on human health generally occur as a result of contact between the pollutants and the body. Normally, body contact occurs at the surface of the skin and exposed membranes. Contact with exposed membrane surfaces is of utmost importance because of their high absorptive capacity compared to that of the skin. Air-borne gases, vapors, fumes, mists, and dusts may cause irritation of the membranes of the eyes, nose, throat, larynx, tracheobronchial tree and lungs. Some irritants even reach the mucosa of the digestive tract.

Health Effects

- Eye irritation.
- Nose and throat irritation.
- Irritation of the respiratory tract.
- Gases like hydrogen sulphide, ammonia and mercaptans cause odor nuisance even at low concentrations.
- Increase in mortality rate and morbidity rate.
- A variety of particulates, particularly pollens, initiate asthmatic attacks.
- Chronic pulmonary disease like bronchitis, and asthma, is aggravated by a high concentration of SO_2 , NO_2 , particulate matter, and photochemical smog.
- Carbon monoxide ties up the haemoglobin in the blood and consequently increases stress on those suffering from cardiovascular and pulmonary disease.
- Hydrogen fluoride causes diseases of bone (fluoride), and mottling teeth.
- Carcinogenic agents cause cancer.
- Dust particles cause respiratory diseases. Diseases like silicosis, asbestosis, etc. result from specific dusts.

- Certain heavy metals like lead may enter the body through the lungs and cause poisoning.
- Effect of radioactive fallout : The biological effects of radiation may be somatic or genetic damage. In somatic damage the exposed individual is affected, while in genetic damage the future generations become the victims.

Radioactive fallout from testing of nuclear weapons causes,

- Cancer
- Shortening of life span
- Genetic effects or mutation.

One significant point we have to note about the effect of radioactive fallout is, it causes long range effects affecting the future of man and hence the future of our civilization.

2. Effects of Air Pollution on Animals : The mechanism by which farm animals gets poisoned is entirely different from that by which human beings exposed to polluted atmospheres are poisoned. In case of farm animals, it is a two step process :

- Accumulation of the air-borne contaminant in the vegetation and forage;
- Subsequent poisoning of the animals when they eat the contaminated vegetation.

In case of human beings working in polluted atmospheres in factories, the concern is for the harmful substance that is directly inhaled. In the case of farm animal cattle, the danger obviously is not the result of inhaling the polluted air, but rather the ingestion of forage which has become contaminated with pollutant like fluorine from the air.

The three pollutants responsible for most live stock damage are fluorine, arsenic and lead. These pollutants originate from industrial sources or from dusting and spraying.

(a) Fluorine : Of all farm animals, cattle and sheep are the most susceptible to fluorine toxics. Horse appears to be quite resistant to fluorine poisoning. Poultry are probably the most resistant to fluorine poisoning. Lack of appetite, rapid loss in weight, decline in health and vigor, lameness, periodic diarrhea, muscular weakness and death, characterize the acute form of fluorine poisoning. It may also result in considerable increase of bone fluorine. But acute poisoning due to fluorides is unlikely in majority of the cases.

Fluorine is a cumulative poison under conditions of continuous exposure to sub-acute doses. Fluorine is also a protoplasmic poison. It has a marked affinity for calcium and interferes with normal calcification. Animals have been reported to be more resistant than humans to dental mottling. Cattle and sheep are the most frequently affected animals.

Teeth in the process of formation are easily affected. Hence tooth symptoms are a sensitive and unique criterion of chronic fluorosis. Excessive wearing of incisor and molar teeth may occur at high levels of fluoride intake.

Bone lesions may develop at any age. A bony over growth may be observed on the leg bones, jaw bones and ribs. Their appearance indicates that there has been a high fluoride intake over long period. Lameness may occur as a result of this over growth on the leg bones. This may be followed by stiffness of joints. Effects of fluorides on skeletal structures are usually of a permanent nature.

Symptoms of advanced fluorosis include lack of appetite, general ill health due to malnutrition, lowered fertility, reduced milk production and growth retardation. The symptoms developed in other species such as rabbits, horses and poultry are similar to that for cattle and sheep, i.e., mottling, staining and wearing of the teeth, bony over growth on the skeleton, stiffness and lethargy and general ill health from malnutrition and starvation.

(b) **Arsenic** : Arsenic occurs as an impurity in many ores and in coal. It has been reported to cause poisoning of live stock near various industrial processes and smelters. Just like most of other industrial air contaminants, arsenic may spread over a considerable area from a stack source. Arsenic is used in some insecticides. The use of insecticides in dusts or sprays on plants can lead to poisoning of cattle. In acute cases the symptoms are severe salivation, thirst, vomiting, uneasiness, feeble and irregular pulse and respiration. The animal stamps, lies down and gets up. There is diarrhea, and the faeces have a garlic odor and sometimes bloody. Ears become cold, body trembles and develops abnormal temperature and convulsion. Death may occur in a few hours or some days.

Arsenic appears to have a depressing effect upon the central nervous system. The animal becomes dull, and exhibits a lack of appetite, with a resulting weight loss. Also, there may be chronic cough and diarrhea may occur continuously. There may be thickening of the skin, anemia and abortion or sterility. Chronic poisoning can result in eventual paralyzing and death.

Arsenic as well as its soluble compounds is extremely poisonous. It has been reported that sheep has been poisoned by as little as 0.25 to 0.50 gms of arsenic daily, where as cattle and horses may tolerate 1.3 to 1.9 gms daily. It has also been reported from laboratory experiments that 10 mg of arsenic per kilogram of body weight per day has produced chronic arsenic poisoning in guinea pigs.

(c) **Lead** : Lead contamination of the atmosphere takes place on account of various industrial sources such as smelters,

also used in dusts and sprays containing lead arsenic. In case of acute lead poisoning the onset is sudden and the course relatively short. Prostration, staggering and inability to rise are prominent symptoms. The pulse is always fast but weak. Some animals may fall suddenly, stiffen the legs and have convulsions. There is complete loss of appetite, paralysis of the digestive tract and diarrhea. Other nervous symptoms in cattle are grinding of the teeth and rapid chewing of the cud. In case of horses, it may result in complete loss of appetite, nervous depression, lethargy and death.

Chronic lead poisoning has been observed frequently in horses that have been grazing on forage near smelters, lead mines, and in orchards that have been sprayed. Paralysis of the muscles of the larynx and difficulty in breathing are the main symptoms. Convulsions may occur from the paralysis of the throat, and the difficulty in breathing may be unusually severe and persistent, during and after exercise.

Lead is a cumulative poison. Therefore, the continuous ingestion of even very small daily doses will be finally as effective as one toxic dose. Hence in case of slight contamination death can occur after many months and in case of severe contamination death can occur within 24 hours.

It has also been reported that inadequate calcium in diet increases the retention of lead in the animal body. Low calcium diets may result in lead storage of as much as five times more when compared to that found in animals that receive sufficient amounts of calcium. However, extra quantity of calcium above the amount considered sufficient will not offer additional protection against poisoning.

It is also reported that pollution is now beginning to affect pets and domestic animals in Tokyo and other smog affected cities. Canine patients are found to be suffering from bronchitis, asthma and lack of appetite. Many dogs also suffer from coughs, nose and throat diseases due to increasing air pollution. It is interesting to note that average life of pets in Japan is seven to eight years, whereas in developing countries they enjoy a life span of 12 to 13 years. Radioactive fallout from the nuclear bomb testing in the atmosphere ionizes the radiation, which have severe biological effects. The effect of radiation on animals are similar qualitatively to those of human beings. The effects may be either acute radiatic effect or delayed long term effect. Symptoms of acute radiation injury develop within a period of hours to week following exposure. Only fall-out occurring close to the nuclear bomb test site can produce acute radiation effects, because of high degree of radiation received by the animal body.

The long term effects are :

- Cancer (including Leukemia)
- Shortening of life span
- Transient or mutation effect.

For these effects to get manifested, it takes generally several years even generations in case of genetic changes.

3. **Effects of Air Pollution on Plants** : Air pollution has long been known to have an adverse effect on plants. At first, it was only sulphur dioxide that was considered the dangerous pollutant. Now with the advent of various pesticides and new industrial processes, the range of harmful pollutants has multiplied tremendously. Sometimes, vegetation over 150 kilometers away from the source of the pollutant has been found to be affected.

Structure of a Normal Leaf : Knowledge of the structure of a leaf will help us to understand why damage occurs to plants on account of air pollutants. A generalized diagram of the structure of a normal leaf is given in Fig. 4. If we examine a leaf, one will normally see a network of denser structures, the veins, all interconnected to the base or stem of the leaf. The leaf veins act as the transport system for water and food, just like blood vessels in animals. The leaf tissue is in layer with a skin or epidermis layer on top and bottom and the photosynthesis cells in between.

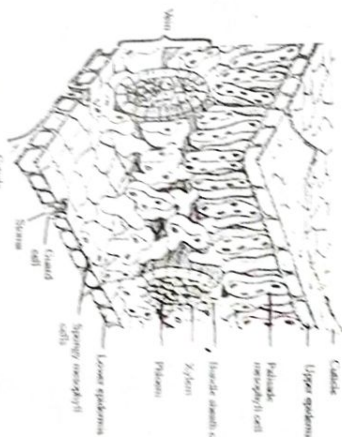


Fig. 4 : Cross section of a leaf

The stomata are the entrances in the leaf bottom (and in some leaves in the top) through which CO_2 enters to play its role in the photosynthesis process. These openings are protected by pairs of specialized guard cells which open and close to allow gases to enter or leave the leaf. Such gases, of course, include pollutants like sulphur dioxide. The primary factor which controls gas absorption by the leaves is the degree of opening of the stomata. When the stomata are wide open, absorption is maximum and vice versa. Consequently, the same condition that enhance the absorption of the gas (CO_2 for photosynthesis purpose), predispose the plant to injury (by absorbing pollutant gas like SO_2).

The pollutants like, sulphur dioxide, hydrogen fluoride, chlorine, HCl , PAN , nitrogen oxides, NH_3 , mercury, ethylene, smog, herbicides (sprays of weed killers) etc., interfere with plant growth and the phenomenon of photosynthesis. Smog, dust etc., reduce the amount of light reaching the leaf and also by clogging the stomata may reduce carbon dioxide intake to some extent and thus interfere with photosynthesis.

Forms of Damage to Leaves : Damage to leaves takes several forms :

- Necrosis** : Necrosis is the killing or collapse of tissue.
 - Chlorosis** : Chlorosis is the loss or reduction of the green plant pigment, chlorophyll. The loss of chlorophyll usually results in a pale green or yellow pattern. Chlorosis generally indicates a deficiency of nutrient required by the plant. In many respects, it is analogous to anemia in animals.
 - Abscission** : Leaf abscission is dropping of leaves.
 - Epinasty** : Leaf epinasty is a downward curvature of the leaf due to higher rate of growth on the upper surface.
- Tissue severely injured by air pollutants often has a characteristic color. Bleaching is associated with sulphur dioxide, yellowing with ammonia, browning with fluoride. A silvering or bronzing of the under surface of some leaves is associated with PAN injury. Phototoxicant is the name given to plant damaging substances.

Kinds of Injury to Plants

(a) **Acute Injury** : It results from short time exposure to relatively high concentrations, such as might occur under fumigation conditions. The effects are noted within a few hours to a few days and may result in visible markings on the leaves due to a collapse and death of cells. This leads to necrotic patterns, that is, areas of dead tissue.

(b) **Chronic Injury** : It results from long term low level exposure and usually causes chlorosis or leaf abscission.

(c) **Growth or Yield Retardation** : This injury is in the form of an effect on growth without visible markings (invisible injury). Generally a suppression of growth or yield occurs.

While deciding about the type of injury the plant has suffered, one must carefully distinguish between adverse effects caused by air pollution and adverse effects resulting from other factors. Plant disease may show symptoms which are very similar to those caused by air pollution. High temperatures, poor plant care, shortage of nutrients and water may also cause an appearance which is similar to that of a

plant damaged by air pollution. It may also be due to insect damage. Therefore, while diagnosing the effects of air pollution one must consider factors such as plant disease, nutrition history, weather damage, and the nature of pollutants in the area.

The effects of various pollutants like sulphur dioxide, ozone, fluorides etc., on plants is shown in table.

Table : Effects of Pollutants of Plants

S. No.	Pollutant	Dose	Effect
1.	Sulphur dioxide	Mild Severe	Interveinal chlorotic bleaching of leaves Necrosis in interveinal areas and skeletonized leaves
2.	Ozone	Mild Severe	Flecks on upper surfaces, premature aging and suppressed growth. Collapse of leaf, necrosis and bleaching
3.	Fluorides	Cumulative effect	Necrosis at leaf tip

4. Effects of Air Pollution on Materials : Presence of SO_2 , acid gases cause corrosion of metallic surfaces and tarnishing. They readily damage the building materials like limestone, marble etc. and also affect paints, paper and leather. Paints are discolored by H_2S , SO_2 and other particulates. Paper become brittle and leather undergo disintegration by SO_2 and other gases. Photochemical oxidants affect the material like textile fibres, rubber plants etc.

5. Effects of Air Pollution on Climate : Destruction of forests and excessive burning of fuels in industries and automobiles is responsible for increase in CO_2 concentration in the atmosphere causing change in climate of earth by changing the factors controlling the climate. Increase in CO_2 concentration causing **greenhouse effect**. Rise in global temperature may lead to melting of glaciers and polar ice caps, flooding of low-lying coastal towns etc. Pattern of rainfall, if changed (*i.e.* acid rain) will affect agricultural output. Thus acid rains are becoming a major political issues and there is an urgent need for regular monitoring of forecast of acidification of our environment.

The thinning of ozone layer in stratosphere by action of aerosols exposes the earth harmful U-V radiations and this will cause blindness, sunburn, inactivation of proteins, RNA, DNA etc.

□□□