

Code: 23ES1101

I B.Tech - I Semester – Regular Examinations - JANUARY 2024

BASIC CIVIL & MECHANICAL ENGINEERING

(Common for EEE, ECE, CSE)

Duration: 3 hours

Max. Marks: 70

Note: 1. This question paper contains two Parts: Part-A and Part-B.

2. Each Part contains:

- 5 short answer questions. Each Question carries 1 Mark and
- 3 essay questions with an internal choice from each unit. Each question carries 10 marks.

3. All parts of Question paper must be answered in one place.

BL – Blooms Level

CO – Course Outcome

PART – A

		BL	CO
1.a)	What is the scope of transportation engineering?	L1	CO1
1.b)	List out advantages of prefabricated structures.	L1	CO5
1.c)	What is surveying?	L1	CO2
1.d)	Basic differences between flexible and rigid pavements.	L1	CO3
1.e)	What are the functions of DAMS?	L1	CO4

		BL	CO	Max. Marks	
UNIT-I					
2	a)	Explain the necessity of civil engineering for society building.	L2	CO1	5 M
	b)	Discuss pre-fabricated construction techniques in detail.	L2	CO5	5 M
OR					
3	Elaborate the scope of any three civil engineering disciplines.		L2	CO1	10 M

UNIT-II					
4	a)	Define contour and discuss the characteristics of contours and give suitable sketches.	L2	CO2	5 M
	b)	Discuss briefly about prismatic compass.	L2	CO2	5 M
OR					
5	a)	The following staff readings were observed successively with a level. The instrument has been moved after 5 th and 11 th readings. 0.485, 1.210, 1.635, 3.395, 3.775, 0.650, 1.400, 1.795, 2.575, 3.375, 3.895, 1.735, 0.635, 1.605 m. Determine the R.L. of various points, if the first reading was taken with a leveling staff held on a bench mark of R.L of 100m using Raise and Fall method.	L2	CO2	6 M
	b)	Explain any two methods of leveling.	L2	CO2	4 M
UNIT-III					
6	a)	Explain the necessity of transportation for any country.	L2	CO3	5 M
	b)	What is mean by hydrology and state its importance?	L2	CO4	5 M
OR					
7	a)	Explain Tunnel and Airport engineering.	L2	CO3	5 M
	b)	Discuss quality and specifications of water.	L2	CO4	5 M

		brazing processes.			
	b)	Explain the working principle of Vapor Compression Refrigeration system with a neat sketch.	L2	CO2	5 M
UNIT-III					
12	a)	Discuss about the Hydro power plant with few advantages.	L2	CO3	5 M
	b)	Explain different types of Gear Drives and Chain Drives.	L2	CO3	5 M
OR					
13	a)	Explain different configurations of robot.	L2	CO3	5 M
	b)	Differentiate between Flat belt and V belt drives based on the applications.	L2	CO3	5 M

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Scheme of Valuation for PART-A

1. a) Presenting scope of transportation engineering – 1 mark
1. b) Listing advantages of prefabricated structures– 1 mark
1. c) Presenting surveying– 1 mark
1. d) Presenting differences between flexible and rigid pavements– 1 mark
1. e) Presenting the functions of dams– 1 mark

- 2.a) Explanation of the necessity of civil engineering for society building -5Marks
- 2.b) Explanation of pre-fabricated construction techniques in detail. -5Marks

3. Explanation of the scope of any three civil engineering disciplines-10Marks

- 4.a) Definition of contour - 1mark
Explanation of characteristics of contours with suitable sketches – 4marks
4. b) Explanation of prismatic compass – 5marks

5. a) Calculation R.L's using Rise and fall method – 6marks
5. b) Explanation of two methods of leveling – 4marks

6. a) Explanation of necessity of transportation – 5marks
- 6.b) Presenting hydrology- 1 mark
Explanation of importance of hydrology – 4marks

7. a) Explanation of Tunnel and Airport engineering – 5marks
- 7.b) Explanation of quality and specifications of water – 5marks

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BASIC CIVIL AND MECHANICAL ENGINEERING

Key for PART-A

1. a) **Scope of transportation engineering:** The development of a nation mainly depends on the communication facilities available. A nation's wealth is measured in terms of the road and railway facilities available. There are three modes of transportation, viz. land, water and air. This specialization deals with the design, construction and execution of the communication routes.

The different branches of transportation engineering include the following: highway engineering deals with the planning and designing of roads, railway engineering deals with the railway tracks, harbour engineering deals with the harbours and airport engineering deals with the airports.

1. b) **Note: Any TWO advantages listed below can be given 1 mark**

Advantages of prefabricated structures:

- Moving partial assemblies from a factory often costs less than moving pre-production resources to each site
- Deploying resources on-site can add costs; prefabricating assemblies can save costs by reducing on-site work
- Factory tools - jigs, cranes, conveyors, etc. - can make production faster and more precise
- Factory tools - shake tables, hydraulic testers, etc. - can offer added quality assurance
- Consistent indoor environments of factories eliminate most impacts of weather on production
- Cranes and reusable factory supports can allow shapes and sequences without expensive on-site false work
- Higher-precision factory tools can aid more controlled movement of building heat and air, for lower energy consumption and healthier buildings
- Factory production can facilitate more optimal materials usage, recycling, noise capture, dust capture, etc.
- Machine-mediated parts movement, and freedom from wind and rain can improve construction safety
- Homogeneous manufacturing allows high standardization and quality control, ensuring quality requirements subject to performance and resistance tests, which also facilitate high scalability of construction projects.
- The specific production processes in industrial assembly lines allow high sustainability, which enables savings of up to 20% of the total final cost, as well as considerable savings in indirect costs.

1. c) **Surveying** is the art of making measurements of objects on, above or beneath the ground to show their relative positions on paper. The relative position required is either horizontal, or vertical, or both.

1. d) Note: Any TWO differences listed below can be given 1 mark

Differences between Flexible pavements and Rigid Pavements:

S.No.	Flexible Pavement	Rigid Pavement
1.	It transfers the wheel load to subgrade by grain-to-grain mechanism.	It transfers the wheel load to subgrade by slab action.
2.	The initial construction cost is low.	The initial construction cost is high.
3.	It doesn't require joints.	It requires joints.
4.	Durability is low.	Durability is high.
5.	It doesn't distribute load uniformly. So, a good subgrade is required.	It distributes wheel load uniformly.
6.	There is no effect of temperature variation on stress variation.	Temperature variation affects the stress variation.
7.	The lifespan of flexible pavement is approximately 10 to 15 years.	The maximum lifespan of rigid pavement is approximately 20 to 30 years or more.
8.	Repair work is simple.	Repair work is complex.
9.	The maintenance cost is high.	The maintenance cost is low.
10.	It doesn't require curing.	It requires curing.
11.	Poor night visibility due to the use of asphalt.	Good night visibility due to the use of concrete.
12.	No glare due to sunlight. (Glare: Shine with a solid or dazzling light.)	High glare due to sunlight.
13.	Easy to locate and perform underground works like repairing or locating pipes.	Hard to perform underground works.
14.	Its thickness is less.	Its thickness is more.
15.	The bearing capacity of the subgrade influences design.	The bearing capacity of the subgrade doesn't influence its design.
16.	Aggregate and bitumen are used as the key materials.	Concrete and steel are used as key materials.
17.	Stability depends upon the interlocking of aggregates, particle friction, and cohesion.	Stability depends upon joints between the slabs of concrete.
18.	The settlement is permanent. It is not capable of resisting settlement.	It is capable of resisting settlements to some extent.
19.	It is susceptible to heat, oils, greases, and chemicals.	It is highly resistant to heat, oil, greases, and chemicals.
20.	Rolling (Compacting) of the surface is needed.	Rolling (Compacting) of the surface is not needed.
21.	It has a low flexural strength.	It has high flexural strength.
22.	The force of friction is less.	The force of friction is high.

1. e) **Functions of a dam:** *Irrigation, *Water supply, *Hydro power, *Flood control, *Recreation and *Breeding of fish by pisciculture department.

2. a) Necessity of civil engineering for society building:

- (i) Good planning of towns and extension areas in the cities. Each extension area should be self-sufficient in accommodating offices, educational institutions, markets, hospitals, recreational facilities and residential accommodation.
- (ii) Assured water supply.
- (iii) A good drainage system.
- (iv) Pollution free environmental conditions.
- (v) A well planned and built network of roads and road crossings.
- (vi) Railways connections to all important cities and towns.
- (vii) Airports and harbours of national and international standards.

2. b) Pre-fabricated construction techniques:

The most widely used form of prefabrication in building and civil engineering is the use of prefabricated concrete and prefabricated steel sections in structures where a particular part or form is repeated many times. It can be difficult to construct the formwork required to mould concrete components on site, and delivering wet concrete to the site before it starts to set requires precise time management. Pouring concrete sections in a factory brings the advantages of being able to re-use moulds and the concrete can be mixed on the spot without having to be transported to and pumped wet on a congested construction site. Prefabricating steel sections reduces on-site cutting and welding costs as well as the associated hazards.

Prefabrication techniques are used in the construction of apartment blocks, and housing developments with repeated housing units. Prefabrication is an essential part of the industrialization of construction. The quality of prefabricated housing units has increased to the point that they may not be distinguishable from traditionally built units to those that live in them. The technique is also used in office blocks, warehouses and factory buildings. Prefabricated steel and glass sections are widely used for the exterior of large buildings.

Detached houses, cottages, log cabin, saunas, etc. are also sold with prefabricated elements. Prefabrication of modular wall elements allows building of complex thermal insulation, window frame components, etc. on an assembly line, which tends to improve quality over on-site construction of each individual wall or frame. Wood construction in particular benefits from the improved quality. However, tradition often favors building by hand in many countries, and the image of prefab as a "cheap" method only slows its adoption. However, current practice already allows the modifying the floor plan according to the customer's requirements and selecting the surfacing material, e.g. a personalized brick facade can be masoned even if the load-supporting elements are timber.

Today, prefabrication is used in various industries and construction sectors such as healthcare, retail, hospitality, education, and public administration, due to its many advantages and benefits over traditional on-site construction, such as reduced installation time and cost savings. Prefabrication is being used in single-story buildings as well as in multi-story projects and constructions. Prefabrication is providing the possibility of applying it to a specific part of the project or to the whole of it.

3. Note: Any THREE disciplines explained below can be given 10 marks

Disciplines in Civil Engineering:

Structural Engineering: Structural engineering is the most important specialization in civil engineering. The construction of a structure needs efficient planning, design and method of construction to serve the purpose fully. Generally there are five major steps in any construction project. These include the following:

1. Positioning and arranging the various parts of the structure into a definite form to achieve best utilization.
2. Finding out the magnitude, direction and nature of various forces acting on the structure.
3. Analyzing the structure to know the behaviour of the various parts of the structure subjected to the above forces.
4. Designing the structure such that its stability under the action of various loads is ensured.
5. Executing the work with selected construction materials and skilled workers.

Geotechnical Engineering: For the efficient functioning of any structure built on earth, the behaviour of soil must be known. Geotechnical engineering gives the basic idea about the soil. This branch also deals with the following aspects:

1. The properties and behaviour of soil as a material under "soil mechanics".
2. The various types of foundations for a structure, for a machine, etc. and their suitability.
3. Geotechnical engineering also deals with the analysis, design and construction of foundation.

Transportation Engineering: The development of a nation mainly depends on the communication facilities available. A nation's wealth is measured in terms of the road and railway facilities available. There are three modes of transportation, viz. land, water and air. This specialization deals with the design, construction and execution of the communication routes.

The different branches of transportation engineering include the following: highway engineering deals with the planning and designing of roads, railway engineering deals with the railway tracks, harbour engineering deals with the harbours and airport engineering deals with the airports.

Environmental Engineering: Without food man can survive for days but not without water. The responsibility of providing potable (drinking) water to the public and disposing the waste water safely is that of a civil engineer. The sources of water are precipitation and underground water. Water supply engineering deals with the location, collection of water, its treatment methods, tests for standard limits and efficient supply of water.

Used water, solid wastes, toxic wastes, etc., cannot be disposed directly since these affect the environment. Hence these have to be treated and tested for the standard limits and then disposed. Sanitary engineering deals with the collection of used water, their treatment methods and effective disposal which safeguards the whole world. The natural and artificial wastes generated and released into the atmosphere have upset the natural equilibrium. Anthropogenic or human-induced pollutants have overloaded the system.

The role of an environmental engineer is to build a bridge between biology and technology by applying all the techniques to the job of cleaning the debris. Environmental engineering deals with the methods of protecting the environment from the deleterious effects of human activity which would result in the improvement of environmental quality for the well-being of mankind.

Water resources (Irrigation) Engineering: Irrigation may be defined as the process of supplying water by man-made methods for the purpose of land cultivation. Irrigation engineering includes the study and design of works related to the control of river water and the drainage of waterlogged areas. Thus, irrigation engineering deals with the controlling and harnessing of various resources of water, by constructing dams, reservoirs, canals, head works and distribution channels to the cultivable land.

4. a) A **contour** may be defined as an imaginary line passing through points of equal elevation.

Characteristics of contours:

1. Contour lines must close, not necessarily in the limits of the plan.
2. Widely spaced contour indicates flat surface.
3. Closely spaced contour indicates steep ground.
4. Equally spaced contour indicates uniform slope.
5. Irregular contours indicate uneven surface.
6. Approximately concentric closed contours with decreasing values towards centre indicate a pond.
7. Approximately concentric closed contours with increasing values towards centre indicate hills.
8. Contour lines with U-shape with convexity towards lower ground indicate ridge (Fig.1)

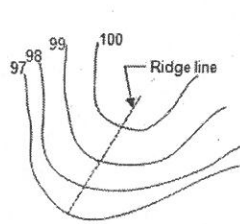


Fig. 1

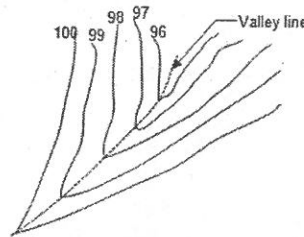


Fig. 2

9. Contour lines with V-shaped with convexity towards higher ground indicate valley (Fig.2).
10. Contour lines generally do not meet or intersect each other.
11. If contour lines are meeting in some portion, it shows existence of a vertical cliff (Fig.3).
12. If contour lines cross each other, it shows existence of overhanging cliffs or a cave (Fig. 5).

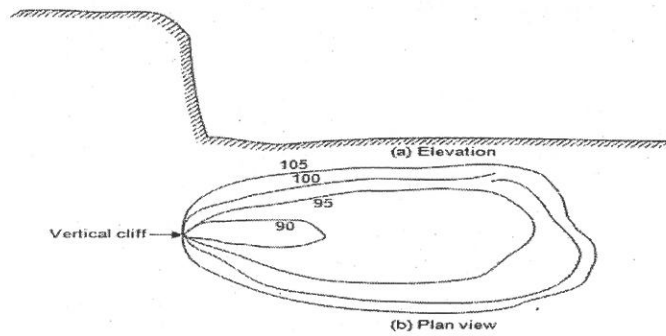


Fig. 3

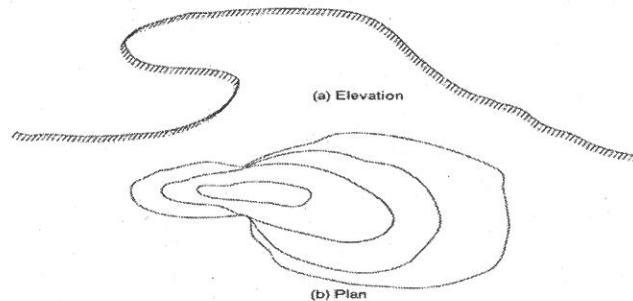


Fig. 4

4. b) Prismatic compass:

Compass is an instrument which can be used to measure the direction of a survey line with respect to magnetic north-south. The magnetic north-south direction which is the reference direction is called meridian (reference direction) and the angle between the line and the meridian is called bearing. Use of compass for measuring direction of line simplifies the surveying to a great extent.

The types of compass that are used commonly are: (i) prismatic compass; and (ii) surveyor compass. The essential parts of both types are: magnetic needle, graduated circle, line of sight, and box to house them.

Figure 1 shows the cross-section of a typical prismatic compass. The graduations are from zero to 360° in clockwise direction when read from top. The direction of north is treated as zero degrees, east as 90°, south as 180° and west as 270°. However, while taking the readings observations are at the other end of line of sight. Hence, the readings are shifted by 180° and graduations are marked as shown in figure 2. The graduations are marked inverted because they are read through a prism.

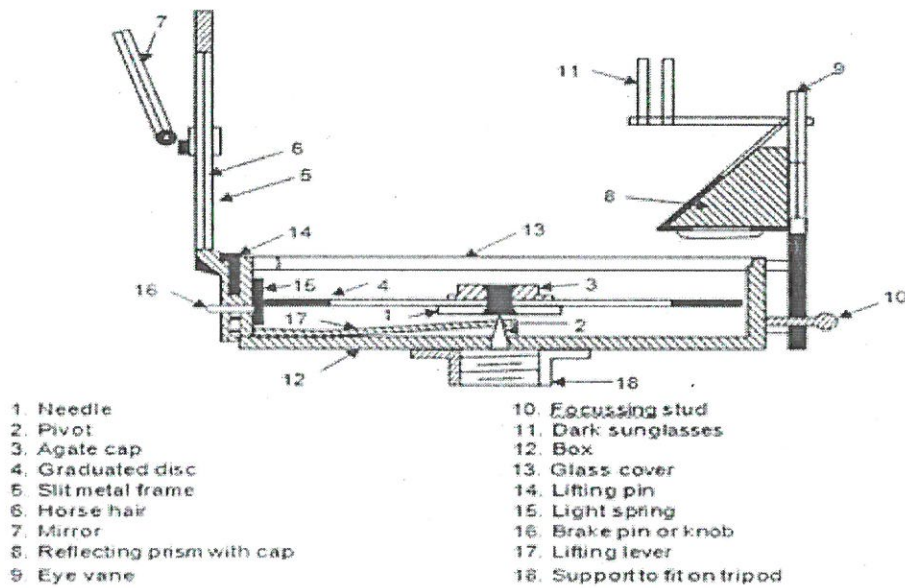


Fig. 1

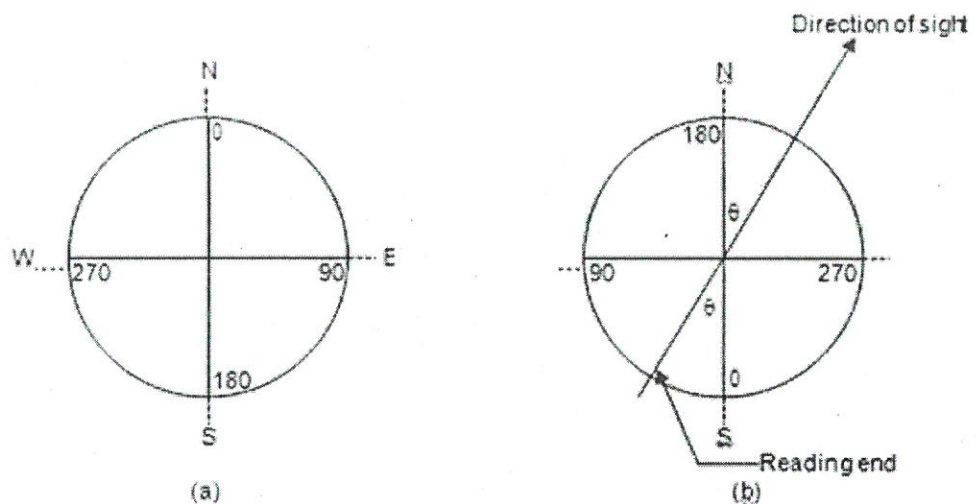


Fig. 2

5. a) Calculation of Reduced Levels using Rise and Fall Method:

<i>Back Sight (m)</i>	<i>Intermediate Sight (m)</i>	<i>Fore Sight (m)</i>	<i>Rise (m)</i>	<i>Fall (m)</i>	<i>Reduced Level (m)</i>	<i>Remarks</i>
0.485					100	Bench mark
	1.210			0.725	99.275	
	1.635			0.425	98.85	
	3.395			1.76	97.09	
0.650		3.775		0.38	96.71	Change of Instrument
	1.400			0.75	95.96	
	1.795			0.395	95.565	
	2.575			0.78	94.785	
	3.375			0.8	93.985	
1.735		3.895		0.52	93.465	Change of Instrument
	0.635		1.1		94.565	
		1.605		0.97	93.595	
$\sum \text{Back sight} - \sum \text{Fore sight} =$ $2.870 - 9.275 = -6.405$			$\sum \text{Rise} - \sum \text{Fall} =$ $1.1 - 7.505 = -6.405$		Last Reduced Level – First Reduced Level = $93.595 - 100 = -6.405$	

5.b) Note: Any TWO methods explained below can be given 4 marks

METHODS OF LEVELLING:

The following methods are used to determine the difference in elevation of various points:

- | | |
|----------------------------|----------------------------|
| (i) Barometric levelling | (ii) Hypsometric levelling |
| (iii) Direct levelling and | (iv) Indirect levelling. |

Barometric Levelling

This method depends on the principle that atmospheric pressure depends upon the elevation of place. Barometer is used to measure the atmospheric pressure and hence elevation is computed. However it is not accurate method since the atmospheric pressure depends upon season and temperature also. It may be used in exploratory surveys.

Hypsometric Levelling

This is based on the principle that boiling point of water decreases with the elevation of the place. Hence the elevation difference between two points may be found by noting the difference in boiling point of water in the two places. This method is also useful only for exploratory survey.

Direct Levelling

It is common form of levelling in all engineering projects. In this method horizontal sight is taken on a graduated staff and the difference in the elevation of line of sight and ground at which staff is held are found. Knowing the height of line of sight from the instrument station the difference in the elevations of instrument station and the ground on which staff is held can be found.

Indirect Methods

In this method instruments are used to measure the vertical angles. Distance between the instrument and staff is measured by various methods. Then using trigonometric relations, the difference in elevation can be computed.

6. a) **Necessity of transportation:** For rapid economic, industrial and cultural growth of any country, a good system of transportation is very essential. Transportation system comprises good network of roads, railways, well-developed waterways and airways. Airways and waterways although help to some extent in transportation within the country, these are the primary modes of transport between countries. Railways, and highways, also to some extent, help in transport between countries, but their main concern is within the country itself. An industrialist has to transport the raw materials and then market finished products. This can be done so efficiently only through a good system of transportation. A farmer can market products to the nearby market economically only through a good system of roads. As blood transportation through body arteries is essential for the well-being of the human being, a similar good system of transportation has actually become a measure of country's economic and social development.

6. b) **Hydrology** is the scientific study of the movement and distribution of water on Earth and other planets, including the water cycle, water resources, and drainage basin sustainability.

The water or hydrological cycle:

The water or hydrological cycle is a continuous natural process that helps in the exchange of water between the atmosphere, the land, the sea, living plants and animals. The water cycle, also known as the hydrological cycle, describes the continuous movement of water on, above and below the surface of the earth. Since the water cycle is truly a 'cycle', there is no beginning or end. Water can change states among liquid, vapour and ice at various places in the water cycle.

The sun, which drives the water cycle, heats the water in the oceans. Water evaporates as vapour into the air. Ice and snow can sublime directly into water vapour. Rising air currents take the vapour up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move clouds around the earth; cloud particles collide, grow and fall out of the sky as precipitation. Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snow-packs can thaw and melt, and the melted water flows over the land as snowmelt. Most precipitation falls back into the oceans or onto the land, where the precipitation flows over the ground as surface runoff. A portion of runoff enters the rivers in valleys in the landscape, with stream flow moving water towards the oceans. The runoff and groundwater are stored as freshwater in lakes. Not all runoff flows into rivers. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers, which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface water bodies (and the ocean) as groundwater discharge. Some groundwater finds openings in the land surface and comes out as freshwater springs. Over time, the water returns to the ocean, where the water cycle started.

7. a) A **tunnel** can be defined as an underground passage for the transport of passengers, goods, water, sewage, oil, gas, etc. The construction of a tunnel is normally carried out without causing much disturbance to the ground surface. The necessity of constructing a tunnel may arise because of one of the following considerations.

- A tunnel may be required to eliminate the need for a long and circuitous route for reaching the other side of a hill, as it would considerably reduce the length of the railway line and may also prove to be economical.
- It may be economical to provide a tunnel instead of a cutting, particularly in a rocky terrain. Depending upon various factors, a rough calculation would indicate that for a small stretch of land the cost of constructing a tunnel is equal to the cost of a cutting in a rocky terrain.
- In hills with soft rocks, a tunnel is cheaper than a cutting.
- In metropolitan towns and other large cities, tunnels are constructed to accommodate underground railway systems in order to provide a rapid and unobstructed means of transport.
- A tunnel constructed under a river bed may sometimes prove to be more economical and convenient than a bridge.
- In the case of aerial warfare transportation through tunnels provides better safety and security to rail users compared to a bridge or deep cutting.
- The maintenance cost of a tunnel is considerably lower than that of a bridge or deep cutting.

Airport Engineering has the following characteristics:

1. **Unbroken Journey:** Air transport provides unbroken journey over land and sea. It is the fastest and quickest means of transport.
2. **Rapidity:** Air transport had the highest speed among all the modes of transport.
3. **Expensive:** Air transport is the most expensive means of transport. There is huge investment in purchasing aero planes and constructing of aerodromes.
4. **Special Preparations:** Air transport requires special preparations like wheelers links, meteorological stations, flood lights, searchlights etc.
5. The main components of airport are Runway, Terminal Building, Apron, Taxiway, Aircraft Stand, Hanger, Control Tower and Parking

7. b) Quality of water:

The aim of water treatment is to produce and maintain water that is hygienically safe, aesthetically attractive and palatable in an economic manner. The method of treatment to be employed depends on the nature of raw water and standard of water quality. The unit operations in water treatment are given below:

1. Aeration
2. Coagulation
3. Flocculation
4. Sedimentation
5. Filtration
6. Softening
7. Disinfection
8. De-mineralisation
9. De-fluoridation

Specifications of Drinking Water Quality Standards as per IS 10500:

S. No.	Parameters	Acceptable	Maximum allowable
1.	Turbidity (JTU)	5	10
2.	TDS (mg/L)	500	2000
3.	pH	6.5-8.5	6.5-8.5
4.	Total hardness as CaCO ₃ (mg/L)	300	600
5.	Calcium as Ca ²⁺ (mg/L)	75	200
6.	Iron as Fe (mg/L)	0.3	1.0
7.	Manganese as Mn (mg/L)	0.1	0.3
8.	Nitrate NO ₃ ⁻ (mg/L)	45	100
9.	Chlorides as Cl ⁻ (mg/L)	250	1000
10.	Fluorides as F ⁻ (mg/L)	1.0	1.5
11.	Sulphates (mg/L)	200	400