		UNIT-II			
10	a)	Discuss about the casting process.	L2	CO1 CO2	4 M
	b)	Differentiate Otto and Diesel cycle	L2	CO1 CO2	6 M
		OR			
11	a)	Define boiler. What are the fire tube and water tube boilers?	L2	CO1 CO2	4 M
	b)	Differentiate two stroke and four stroke engines.	L2	CO1 CO2	6 M
		UNIT-III			
12	a)	Explain about steam power plant with neat sketch.	L2	CO1 CO3	6 M
	b)	Explain the configuration of Robot.	L2	CO1 CO3	4 M
		OR			
13	a)	Sketch the diesel power plant and explain its working principle, also state its merits and demerits	L2	CO1 CO3	6 M
	b)	Discuss i) Rope drive and its applications ii) Chain drives and its applications	L2	CO1 CO3	4 M

CE

PVP 23

Code: 23ES1101

I B.Tech - I Semester – Regular/Supplementary Examinations
DECEMBER 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)	Demonstrate the scope of studying Environmental Engineering.	L2	CO1
1.b)	List the steps involved in the cement manufacturing process.	L2	CO5
1.c)	Distinguish between Azimuth Bearing and Magnetic Bearing.	L1	CO2
1.d)	Explain the uses of studying the contour map.	L2	CO2
1.e)	Write the specifications for the quality of water.	L2	CO4

			BL	CO	Max. Marks
		UNIT-I			
2	a)	Demonstrate the purpose of studying Hydraulics and Water Resources Engineering.	L3	CO1	5 M

	b)	Explain about Prefabricated Construction Techniques.	L2	CO5	5 M
		OR			
3	a)	Assess the importance of building planning and construction in Civil Engineering.	L2	CO1	5 M
	b)	Explain the mix proportions of the cement concrete.	L2	CO5	5 M
		UNIT-II			
4	a)	Discuss how to do Horizontal Measurements using surveying instruments.	L2	CO2	5 M
	b)	Draw & explain contour intervals with a sketch.	L3	CO2	5 M
		OR			
5	a)	Convert the whole circle bearing into a reduced bearing: 30°, 156°, 212°, 222°, 170°, 86°, 340°, and 262°.	L2	CO2	5 M
	b)	List out the differences between a plan and a map.	L1	CO2	5 M
		UNIT-III			
6	a)	Explain the difference between Flexible Pavements and Rigid Pavements with examples.	L2	CO3	5 M
	b)	Discuss about Rainwater harvesting.	L2	CO4	5 M
		OR			
7	a)	Discuss the need for i) a Harbor ii) a Tunnel iii) an Airport.	L2	CO3	5 M

	b)	What is Hydrology? Discuss the key concepts of Hydrology.	L2	CO4	5 M

PART – B

		BL	CO
1.f)	What are the composites?	L1	CO1
1.g)	What are the different components of IC Engine?	L1	CO1 CO2
1.h)	State the main function of boiler.	L1	CO1 CO2
1.i)	What is the meaning of "one Ton of refrigeration"?	L1	CO1 CO2
1.j)	What are the applications of belt and rope drives?	L1	CO1 CO3

			BL	CO	Max. Marks
		UNIT-I			
8	a)	Explain the role of Mechanical Engineering in Industries and society.	L2	CO1	5 M
	b)	Write a note on the different skills and knowledge required by the mechanical engineer in to work in the area of Automotive engineering.	L2	CO1	5 M
		OR			
9	a)	Differentiate Metals and Non metals based on their properties.	L2	CO1	5 M
	b)	Explain about alloys with examples. Also discuss the properties of graphene.	L2	CO1	5 M

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

BASIC CIVIL AND MECHANICAL ENGINEERING

Scheme of Valuation for PART-A

1. a) Presenting scope of environmental engineering — 1 mark
1. b) Listing steps involved in cement manufacturing process– 1 mark
1. c) Presenting differences between azimuth bearing and magnetic bearing– 1 mark
1. d) Presenting uses of studying the contour map– 1 mark
1. e) Presenting specifications for the quality of water— 1 mark

2.a) Explanation of the hydraulics and water resources engineering -5Marks
2.b) Explanation of pre-fabricated construction techniques in detail. -5Marks

3.a) Explanation of the building planning and construction in civil engineering-5Marks
3.b) Explain the mix proportions of the cement concrete-5marks

4.a) Explanation of horizontal measurements using surveying instruments – 5marks
4. b) Explanation of contour intervals with sketch — 5marks

5. a) Calculation of WCB to RB – 5marks
5. b) Listing out differences between a plan and a map – 5marks

6. a) Explanation of differences between flexible pavements and rigid pavements – 5marks
6.b) Explanation of rainwater harvesting – 5marks

7. a) Explanation need of Harbor, Tunnel and an Airport – 5marks
7.b) Explanation of concepts of hydrology – 5marks

I B.Tech- I Semester - Regular Examinations - December 2024

BASIC CIVIL AND MECHANICAL ENGINEERING

Key for PART-A

1. a) **Scope of hydraulics and water resources engineering:**
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.

1. b) **Steps involved in manufacturing of cement:**

- Cement is obtained by burning at a very high temperature a mixture of calcareous and argillaceous materials. The calcined product is known as clinker. A small quantity of gypsum is added to the clinker and is pulverised into very fine powder known as cement.

1. c) **Azimuth bearing:** The line passing through geographic north, south and the point on earth is called true meridian at that point and the angle made by a line passing through that point is called true bearing or azimuth bearing

Magnetic bearing: The direction shown by a freely suspended and properly balanced magnetic needle is called magnetic meridian and the horizontal angle made by a line with this meridian is known as magnetic bearing.

1. d) **Note: <u>Any TWO uses listed below can be given 1 mark</u>**

Uses of contour map:

1. A civil engineer studies the contours and finds out the nature of the ground to identify suitable site for the project works to be taken up.

2. By drawing the section in the plan, it is possible to find out profile of the ground along that line. It helps in finding out depth of cutting and filling, where formation level of road/railway is decided.

3. Inter-visibility of any two points can be found by drawing profile of the ground along that line.

4. The routes of the railway, road, canal or sewer lines can be decided so as to minimize and balance earthworks.

5. Catchment area and hence quantity of water flow at any point of river can be found. This study is very important in locating bunds, dams and also to find out flood levels.

6. From the contours, it is possible to determine the capacity of a reservoir.

1. e) **Note: Any TWO specifications listed below can be given 1 mark**

Specifications for the quality of water:

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

2. a) **Purpose of studying Hydraulics and water resources engineering:**

i) Fluid Mechanics, Hydraulics and Hydraulic Machines: Fluid mechanics deals with the properties and behaviour of fluids at rest or in motion. The principles of fluid mechanics can be applied to daily life as in the case of the flight of planes, the movement of fish in water, and the circulation of blood in the veins.

1. The design of hydraulic structures, such as dams and regulators, require the force exerted by water and the behaviour of water under pressure.
2. Machines which utilize the hydraulic energy are called hydraulic machines. For example, turbines use potential energy of water to generate power. Pumps are devices which utilize mechanical energy to lift water.
3. The efficient working of the above machines depends upon the fluid behaviour whichis dealt with in this discipline.

ii) 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.

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 had 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.a) Importance of building planning and construction in Civil Engineering :-

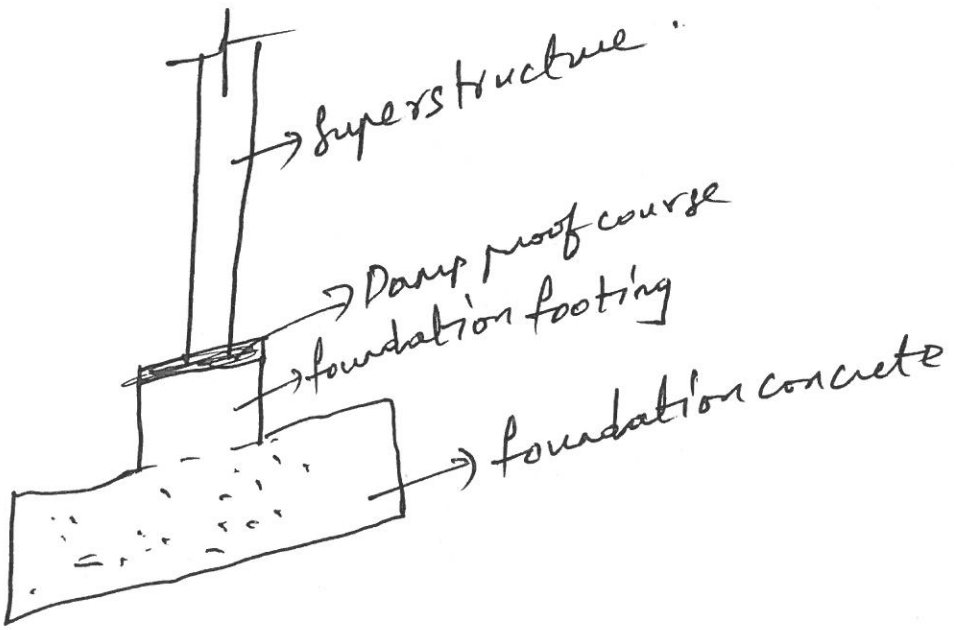
→ A plan is the graphical representation, to some scale, of the feature (i.e., building in our case) on the surface of the earth as projected on a horizontal plane which is represented by plane of the paper on which the plan is drawn.

→ The building construction has been the responsibility of civil engineer. The main considerations in building planning and construction are all as follows:

(i) Climate and its effect.
(ii) People and their requirements.
(iii) Materials for construction and method of construction.
(iv) Bye-laws and Regulations of sanctioning authority.

→ A building has two basic parts: (i) substructure and (ii) superstructure. A building has following components: 1) foundations, 2) Masonry units: walls & columns, 3) floor structures, 4) roof structures, 5) Doors, windows and other openings, 6) Vertical transportation structures such as stairs, lifts, ramps etc., 8) Building finishes.

→ A figure consisting of structural components in a building can be drawn as follows.



3. b)

Note: <u>Any THREE properties and TWO uses listed below can be given 5 marks</u>

Mix proportions of the cement concrete:

Cement concrete is a mixture of cement, sand, crushed rock and water which when placed in the skeleton of forms and allowed to cure, becomes hard such as stone. Concrete has attained the status of a major building material in all branches of modern construction and hence it is necessary to know the properties and uses of concrete.

- <u>Properties of Concrete</u>

1. It has a high compressive strength and its strength depends on the proportion in which cement, sand, stones and water are mixed.
2. It is free from corrosion and there is no appreciable effect of atmosphericagents on it.
3. It hardens with age and the process of hardening continues for a long timeafter the concrete has attained sufficient strength.
4. As it is weak in tension, steel reinforcement is placed in it to take up thetensile stresses. This is termed as 'Reinforced Cement Concrete'.
5. It shrinks in the initial stage due to loss of water through forms. Theshrinkage of cement concrete occurs as it hardens.
6. It has a tendency to be porous. This is due to the presence of voids whichare formed during and after its placing.
7. It forms a hard surface, capable of resisting abrasion.

- <u>Uses of Concrete</u>

1. Concrete can be made impermeable by using hydrophobic cement. This is used for the construction of RCC flat-roof slabs.
2. Coloured concrete is used for ornamental finishes in buildings, park lanes,separating lines of road surfaces, underground pedestrian crossings, etc.
3. Light weight concrete is used in multi-storeyed constructions.
4. No-fines concrete is one in which sand is eliminated. This can be used for *cast-in- situ* external load bearing walls of single and multi-storey houses,retaining walls, damp-proofing material, etc.
5. Concrete is mainly used in floors, roof slabs, columns, beams, lintels, foundations and in precast constructions.
6. It is used in massive structures, such as dams and bridges.
7. Concrete is used in the construction of roads, runways, playgrounds, water tanks and chimneys.
8. It is used in the construction of sleepers in railways.
9. Prestressed concrete is a relatively new type of concrete which is used inmany constructions particularly in the construction of bridges.
10. Concrete trusses are also used in factory constructions.
11. Concrete is used in the construction of bunkers, silos, etc.
12. It finds a place in the construction of nuclear reactors because of its highshielding capacity for the radioactivity.
13. Thin economical shell construction is possible with the use of concrete.

4. a)

Horizontal linear measurements:

The principle of chain surveying is to divide the area into a number of triangles of suitable sides. A network of triangles is preferred here as triangle is the simple plane geometrical figure which can be plotted with the lengths of its sides alone. Chain surveying is the simplest kind of surveying.

The following instruments are required for measurements with chain and tape: Arrows, Pegs, Ranging rods, Offset rods, Plumb bobs and Line ranger

Horizontal angular measurements:

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.

In magnetic 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 1. The graduations are marked inverted because they are read through a prism.

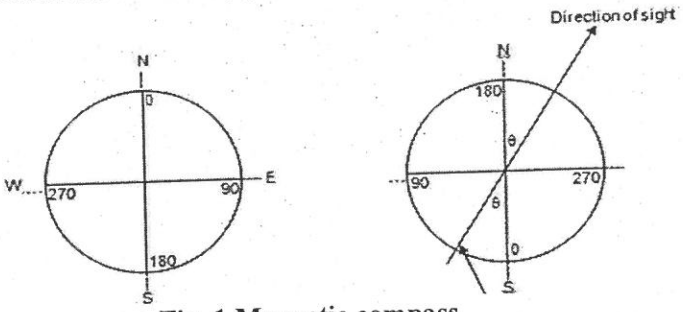


Fig. 1 Magnetic compass

In Surveyors compass graduation disc is fixed to the box and magnetic needle is free to rotate above it. There is no prism provided at viewing end, but has a narrow slit. After fixing the line of sight, the reading is directly taken from the top of the glass cover. Hence, graduations are written directly (not inverted). In this compass graduations are from zero to 90°, zero being to north or south and 90° being to east and west. An angle of 20° to north direction to the east is written as N 20° E, and an angle of 40° to east from south is written as S 40° E. Always first direction indicated is north or south and the last letter indicates east or west direction. In this system graduated circle rotates with line of sight and magnetic needle is always towards north. The reading is taken at the tip of needle. Hence, on the compass east and west are marked interchanged as shown in figure 2.

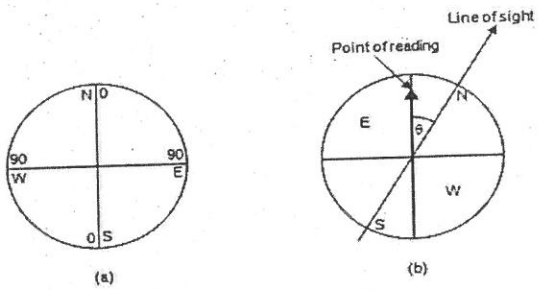


Fig. 2 Surveyors compass

4. b) A contour line may be defined as an imaginary line passing through points of equal elevation. A contour interval is the vertical distance between two adjacent contour lines on a map.

Characteristics of contour lines:

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)

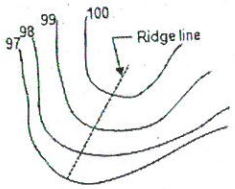


Fig. 1

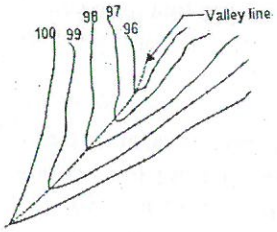


Fig. 2

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).

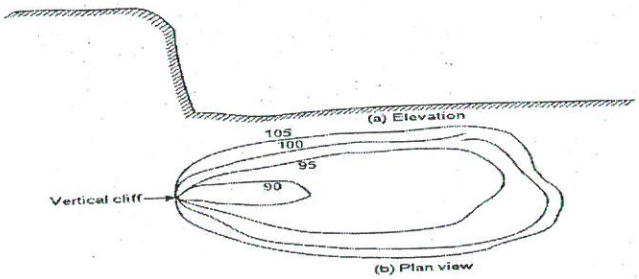


Fig. 3

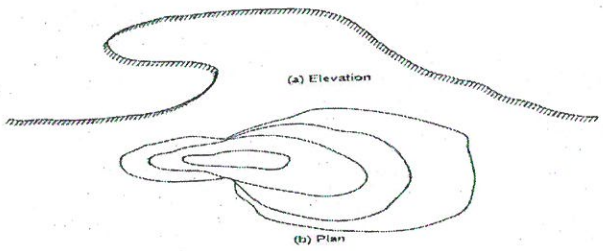


Fig. 4

5. a) **Whole circle bearing (WCB) into Reduced bearing(RB):**

Given WCB	*Converted RB*
30^0	$N30^0E$
156^0	$S24^0E$
212^0	$S32^0W$
222^0	$S42^0W$
170^0	$S10^0E$
86^0	$N86^0E$
340^0	$N20^0W$
262^0	$S82^0W$

5. b) **Differences between plan and a map:**

In civil engineering, the main difference between a map and a plan is that a map depicts geographical features over a wide area, while a plan is a sketch that shows a projected development or building in detail. A plan is considered to have a larger scale than a map if it has a scale of larger than 1 cm for 100 m (1 : 10 000). A map is considered to have a scale equal to or smaller than 1 cm for 100 m (1 : 10 000).

Plan:

A plan is a sketch that shows a projected building or development, and specifies the dimensions and measurements for implementation. Plans are mainly used for technical purposes, such as architecture, engineering, or planning. Plans are used to represent things that cannot be shown on a map, such as the length and breadth of a room

Map:

A map is a drawing that shows geographical features, such as roads, buildings, locations, bodies of water, and other natural and man-made features, over a large area of land and sea. Maps can be drawn to represent real, space, or imagined areas, without regard to scale.

6. a) **Note: Any TEN differences can be given 5 marks**

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.

6.b) **Rain water harvesting:**

The saline water from the sea gets evaporated due to the heat from the sun, forms clouds and falls as rain as freshwater. A significant part of this rainwater drains out into oceans and drains. If we are able to harness this effectively, it can be an important source which can be used for various applications. So, in short, rainwater harvesting is the process of storing rainwater for reusing rather than allowing it to run off. However, it is vital to understand the steps of rainwater harvesting before that.

Types of rainwater harvesting:

Rooftop rainwater harvesting: The system of catching rainwater right where it falls. In rooftop harvesting, the roof becomes the catchment area and the rainwater is collected on the roof of the house or building. It can either be stored in a tank or diverted to an artificial recharge system. This method is less expensive, and if implemented correctly, helps in augmenting the groundwater level of the area.

Surface rainwater harvesting: In urban areas, rainwater flows away as surface runoff. This runoff can be caught and used for recharging aquifers by adopting appropriate methods.

Advantages of rainwater harvesting:

- Promotes adequacy of underground water
- Mitigates the effect of drought
- Improves groundwater table thereby saving energy to lift water
- Storing water underground is good for the environment
- It is cost-effective
- It helps conserve water

7. a) A **Harbor** is partly enclosed area which provides safe and suitable accommodation for supplies, refueling, repair, loading and unloading cargo. A port is a harbour where marine terminal facilities are provided. A port is a place which regularly provides accommodation for the transfer of cargo and passengers to and from the ships.
Port = Harbour + Storage Facility + Communication Facility + Other Terminal Facility.
From above, it can be stated that a port includes a harbour i.e. every port is a harbour.

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 s 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:

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

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- Special Preparations: Air transport requires special preparations like wheelers links, meteorological stations, flood lights, searchlights etc.
- The main components of airport are Runway, Terminal Building, Apron, Taxiway, Aircraft Stand, Hanger, Control Tower and Parking

7. 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 sublimate 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.

The hydrologic cycle can be presented through figure 1:

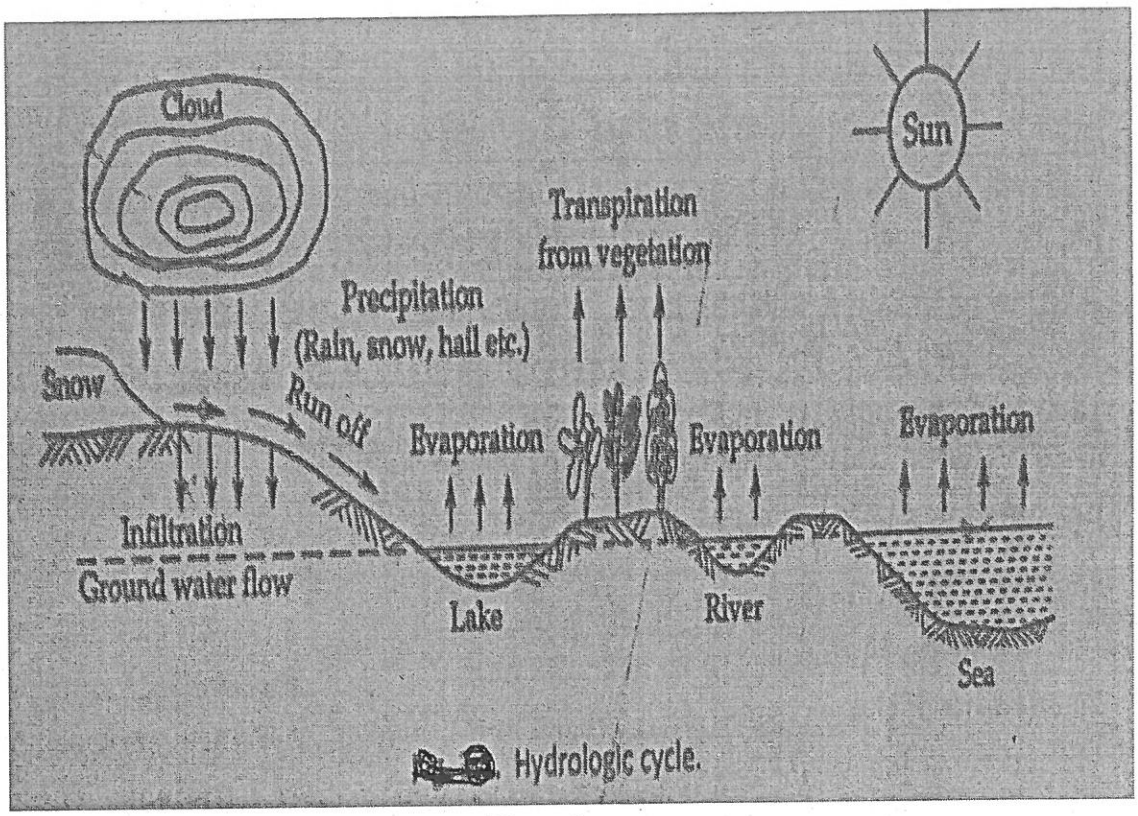
Cloud
Sun
Transpiration
from vegetation
Precipitation
(Rain, snow, hail etc.)
Snow
Run off
Evaporation
Evaporation
Evaporation
Infiltration
Ground water flow
Lake
River
Sea
Hydrologic cycle.

Figure 1