Module - III

Fundamental of soil and its classification

1) Define soil.

→ The term soil in soil engineering is defined as an unconsolidated material, composed of solid particles, produced by the disintegration of rocks. The void space between the particles may contain air, water or both. The soil particles may contain organic matter.

2) What do u mean by soil mechanics?

→ The ~~th~~ term soil mechanics was coined by "Dr. Karl Terzaghi" in 1925, who is also known as the father of soil mechanics.

→ According to Terzaghi, 'Soil mechanics is the application of the laws of mechanics and hydraulics to engineering problems dealing with sediments and ~~other~~ formed by the mechanical and chemical disintegration of rock.

→ Soil mechanics is therefore, a branch of mechanics which deals with the action of forces on soil and with the flow of water in soil.

3) Classify different type of soil.

→ The more common classification systems are,

(i) Preliminary classification ~~by~~
(ii) Geological classification
(iii) Classification by structure
(iv) Grain size classification
(v) Unified soil classification
(vi) Indian standard soil classification.

(i) Preliminary classification

→ In this approach, soils are described by designations such as boulder, gravel, sand, silt, clay, rock flour, peat, china clay, bentonite, black cotton soil.

→ Boulder, gravel and sand belong to the category of coarse-grained soils, distinguished primarily, by the particle size, they do not exhibit the property of cohesion and so may be said to be cohesionless soil.

→ Silt refers to a soil with particle sizes finer than sand. If it is inorganic in nature, it is called 'rock flour'. It exhibit some degree of plasticity and compressibility.

→ clay posesses high plasticity over a fairly range of moisture content. They may be called lean clay or fat clays. Three major clay minerals are Kaolinite, Illite and montmorillonite. China clay is a pure white clay,

2) Geological Classification :-

→ Soils may be classified on the basis of their geological origin. The origin of a soil may refer either to its constituents or to the agencies responsible for its present state.

→ Based on constituents, soil may be classified as,

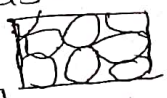
(i) Inorganic soil
(ii) Organic soil { Plant life / Animal life }

→ Based on the agencies responsible for their present state, soils may be classified as,

(i) Residual Soils
(ii) Transported soils
- (a) Alluvial or sedimentary soils (transported by water)
- (b) Aeoline Soil (transported by air)
- (c) Glacial soil (transported by glaciers)
- (d) Lacustrine soils (deposited in lakes)
- (e) Marine soils (deposited in seas)

3) Classification by Structure :-

Depending upon the average grain size and the cond's under which soils are formed and deposited in their natural state They may be catagorized on the basis of their str,

(i) soils of single grained str 
(ii) soils of honeycomb str 
(iii) soils of flocculent str 

4) Grain size and textural classification :-

→ In grain size classification, soils are ~~designated~~ classified according to the grain size or particle size.

→ Terms such as gravel, sand, silt and clay are used to indicate certain ranges of grain sizes.

→ Various classifications are,

(i) US Bureau of soils and public roads administration system of classification.

2 mm		0.5	0.25	0.10	0.05		0.005
gravel	fine gravel	coarse	Medium	fine	very fine	silt	clay
		Sand					

(ii) International classification

2	1	0.5	0.2	0.06	0.02	0.006		0.002	0.006	0.002
Very Coarse	Coarse	medium	fine	Very fine	Coarse	fine	silt	Coarse	fine	very fine
								clay		

Unified Soil Classification System

→ It was originally developed by A. Casagrande and adopted by the U.S. Crops of Engineers in 1942. as "airfield Classification".

→ It was later revised for universal use and redesignated as the unified soil classification in 1957.

→ In this system, soils are classified into ~~three~~ 2 broad categories.

(i) coarse grained soils with upto 50% passing through 75μ sieve

(ii) Fine grained soils with more than 50% " "

→ Each soil component is assigned a symbol as,

Gravel :- G	Silt :- M	Organic :- C
Sand :- S	Clay :- C	Peat :- Pt

6. Indian Standard Soil Classification System :-

Soils shall be broadly divided into three divisions.

(i) Coarse :- More than 50% of total weight is larger than 75μ

(ii) Fine :- " " " " " is smaller " "

(iii) Highly organic soils :- ~~More than 50%~~ These soil contain large % of fibrous organic matter such as peat, and particles of decomposed vegetation.

Q) What do u mean by irrigation engineering?

→ Irrigation is defined as the process of artificial supply of water to soil ~~by~~ for raising crops.

→ It is a science of planning ~~of~~ and designing an efficient, low cost, economic irrigation system tailored to fit natural conditions.

→ It is the engineering of controlling the various natural sources of water by constructing dams and reservoirs, canals and headworks, and finally distributing the water to the agricultural field.

→ Irrigation engineering includes the study and design of works in connection with river control, drainage of water logged areas and generation of hydroelectric power.

Q) Why we need irrigation ?

⇒ The intensity of rainfall is practically uncertain and beyond the control of human power and it may not be well distributed throughout the crop season.

⇒ So, irrigation becomes absolutely necessary to fulfil the water requirement of crops.

⇒ The following are the factors which govern the necessity of irrigation.

(a) Insufficient of Rainfall :- When seasonal rainfall is less than the minimum requirement for the satisfactory growth of crops, the irrigation system is essential.

(b) Uneven distribution of rainfall :- When the rainfall is not evenly distributed during the crop period or through out the culturable area, the irrigation is extremely ~~nee~~ necessary.

(c) Improvement of perenial crops :- Some perenial crops like sugarcane cotton etc. require water through out the major part of the year. But the rainfall may fulfill the water requirement in rainy season only. So for the remaining part of the year, irrigation becomes nesessary.

(d) Development of agriculture in Desert area :- In desert area where the rainfall is very scanty, irrigation is required for the development of agriculture.

Q) What are the benefits related to Irrigation ?

⇒ The following are the important benefits of irrigation.

(a) Yield of Crops :- In the period of low rainfall or draught, the yield of crop may be increased by the irrigation system.

(b) Protection of famine :- The food production of a ~~cont~~ country can be improved by ensuring the growth of crops by availing the irrigation facilities.

(c) Improvement of cash crops :- Irrigation helps to improve the cultivation of cash crops like vegetable, fruits, tobacco etc.

(d) Water supply :- The irrigation canals may be the source of water supply for domestic and industrial purposes.

(e) Development of fishery :- The reservoir and the canals can be utilised for the development of fishery projects.

Q) Write a short note on hydraulic structures.

→ A hydraulic structure is a structure submerged or partially submerged in any body of water, which disrupts the natural flow of water.

→ They can be used to divert, disrupt or completely stop the flow.

→ Example of hydraulic str's are (i) canals
(ii) Siphons
(iii) Weirs
(iv) dams

(i) Canals :- Canals are ~~man made~~ waterways channels, artificial water ways for water conveyance, or to service water transport vehicles.

→ It helps in the irrigation system by controlling the river water.

→ There are two type of canal.
(a) Waterways (b) aqueducts

→ Waterways :- These ways connect two or more water bodies

→ Aqueducts :- These are used exclusively to transport water for drinking, agriculture and hydroelectric power.

(ii) Siphons :- These are used in irrigation to transfer water over a barrier (such as the bank of a raised irrigation canal), using the siphon principle.

→ The main benefit of siphon tubes is that they relatively inexpensive, and do not required any engineering to put into place

(iii) Weirs :- An impervious barrier which is constructed across a river to raise the water level on the up stream side is known as weir. Here the water level is raised up to the required height and the surplus water is allowed to flow over the weir. Generally it is constructed across a inundation river.

(iv) Dam :- The high impervious barrier constructed across a river valley to form a deep storage reservoir is known as dam. The surplus water is not allowed to flow over the dam, but it flows through the spillways provided at some designed level.