Availability and Management of Groundwater Resources

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Lecture - 35
Measurement of Rainfall, Index of Wetness, Infiltration Rate

Welcome you all in the eighth module of the course, measurement of rainfall index of wetness and infiltration rate. So far we have discussed in greater detail about the course subject that is the ability and management of the groundwater resources. We have discussed we have started the course from the hydrological cycle we have discussed in greater detail about how the precipitation evapotranspiration runoff and groundwater runoff plays important role in the making the groundwater underneath the earth's surface.

Second lecture we have discussed about the different formation, because this groundwater remains in certain specific type of formation, a specific type of rocks underneath the earth's surface. Thereafter, we have discussed the details about the layer which plays very important role for the subsurface runoff as well as the groundwater runoff that is the Vadose zone which is in general designated as an unsaturated zone or the zone which extends from the earth surface to the upper part of the water table.

So, this we have discussed in greater detail and then when we have discussed in detail about the rock formations which are holding the water that is an aquifer then, we have discussed in greater detail about the types of aquifer that is the confined and unconfined aquifers. So, after knowing these formations in greater detail; with the 2 different classifications that is the classified and unconfined aquifer.

Then we discussed about the characteristics of the formations in terms of porosity, permeability, transmissivity and storativity that is the storage coefficient. So, this we have discussed and thereafter when water has started to remain in the rock formations then how this water moves because, permeability is nothing but it is the ability of movement of the water.

So about the law of groundwater movement we have discussed the glassy laws in greater detail and then thereafter we had approached for the surface runoff types of well and well hydraulics. After that in this module we will discuss about the precipitation which is the only recharge

source for the groundwater in the earth surface and index of wetness and infiltration rate. So, this we will discuss in greater detail in this module 8. Now I am discussing the part 1 of the module 8.

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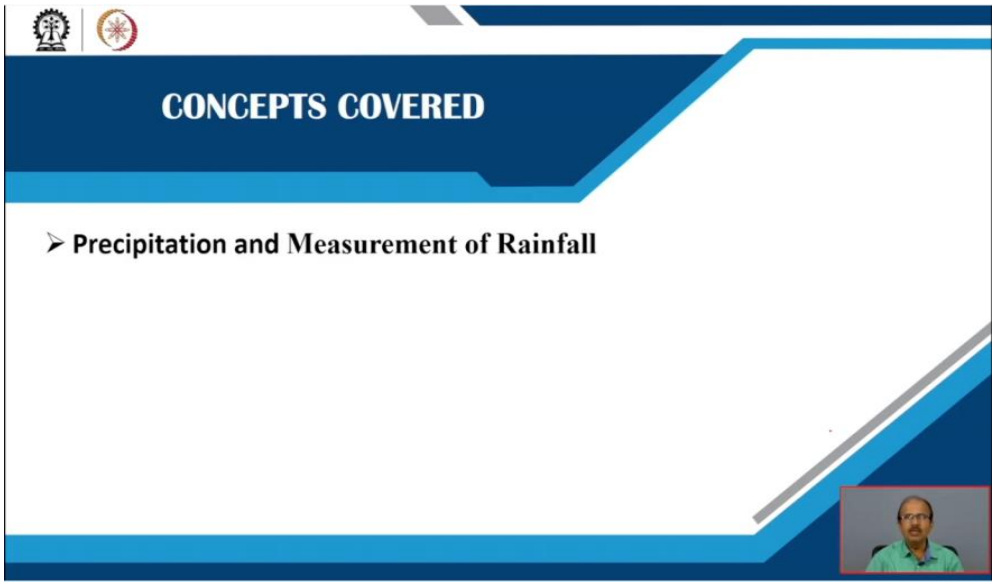

In which we will learn the concept of precipitation and the measurement of the rainfall.

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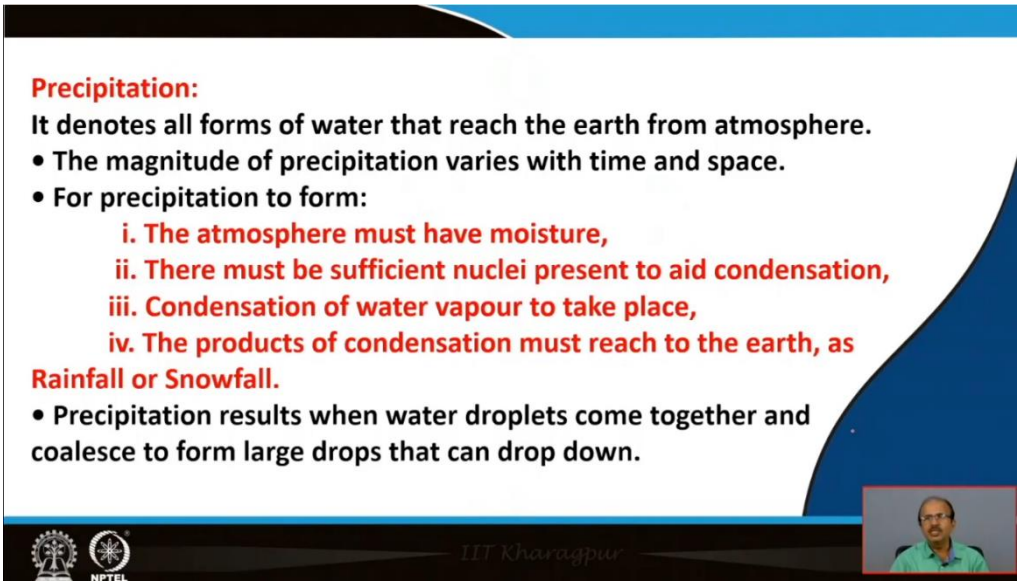

So, what we have discussed from very beginning in the high logical cycle also we have discussed, that precipitated water is only infiltrated and percolated and raised to the formations that is in aquifer. So, now we will know about the precipitation, What is precipitation? It denotes all forms of water that reach from the earth reach the earth from the atmosphere.

So, this is generally termed as a precipitation the magnitude of precipitation definitely varies with time and space. For precipitation to form, there should be some conditions and the conditions are that the atmosphere must have moisture. There must be sufficient nuclei present to aid condensation and the condensation of water vapour to take place, this is very important.

The products of condensation must reach to the earth in the form of rainfall or snowfall. So, these conditions are important for precipitation to form and precipitation results when water droplets come together and coalesce to form large drops that can drop down. So, in this way we are getting the precipitation rainfall on the earth's surface.

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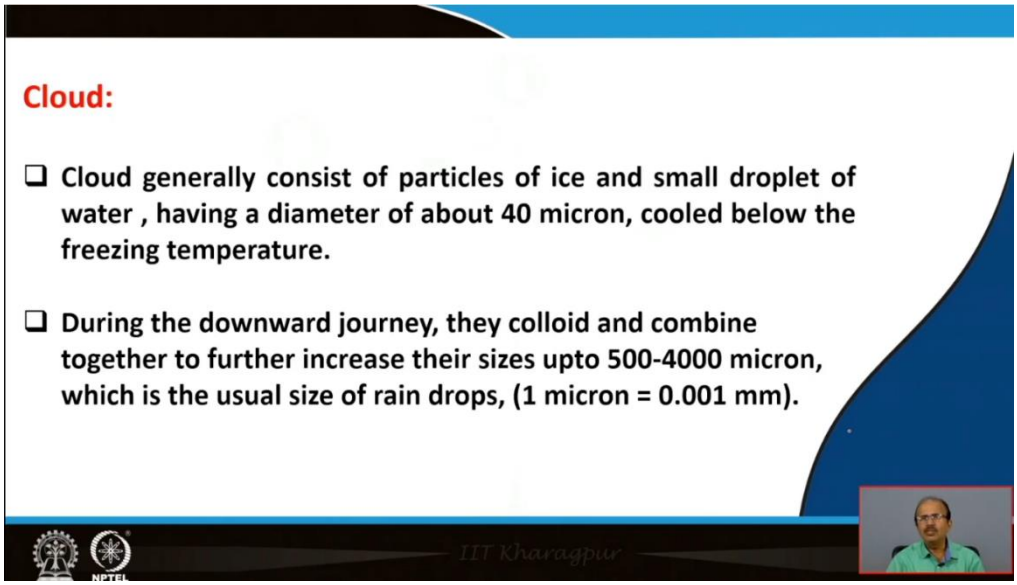

Generally, we know about the cloud, that cloud generally consists of particles of ice and small droplet of water. It consists of ice and small droplet of water having diameter of about 40 micron, which cooled below and the freezing temperature. So, what happens when the cloud downward journey starts, they collide and combine together to further increase their sizes up to 500 to 4000 micron which is the usual size of the raindrops, where one micron is called 2.001 mm. So, from the cloud we are getting the rainwater we all know this thing.

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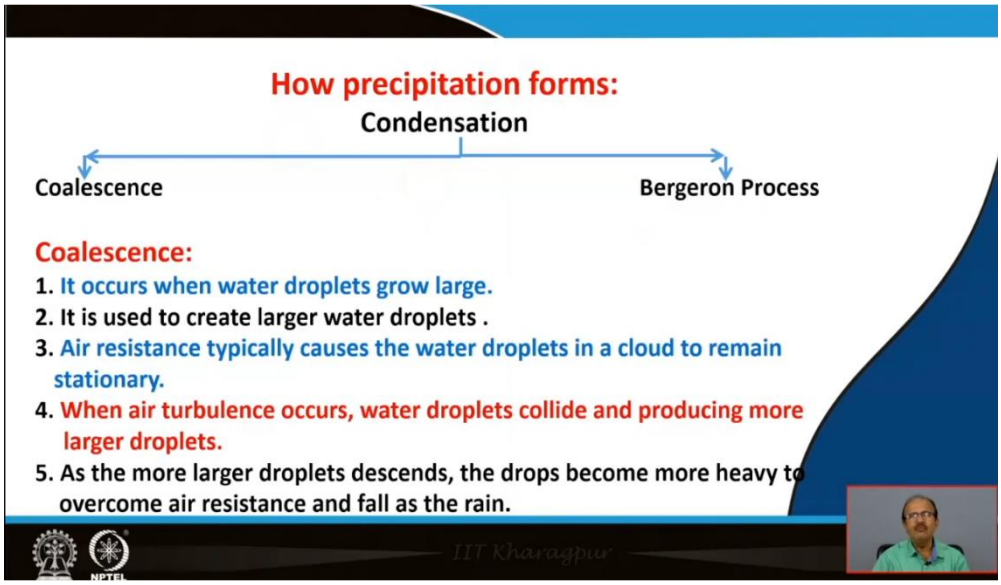

Now, the point is how precipitation is forming? So we have started from the condensation because that is important. This condensation is of 2 types coalitions and Bergeron process. The 2 different processes runs then only we are getting the rainfall or snowfall on the earth surface in the coalescence process what is happening, it occurs when water droplets grow large then, it is used to create larger water droplets and here air resistance typically causes the water droplets in a cloud to remain stationary.

So, this air resistance plays important role it keep the clouds in the stationary position. It keeps the water droplets in a cloud in stationary positions and where air turbulence occurs because, in the atmosphere air turbulence is the regular phenomena. Air turbulence occurs water droplets collide and producing more larger droplets. So, then it is producing more larger droplets;

And as the more larger droplet descends the drops become more heavy to overcome the air resistance and ultimately what is happening it falls as a vein on the earth surface. So, this is about the coalescence process second is the Bergeron process.

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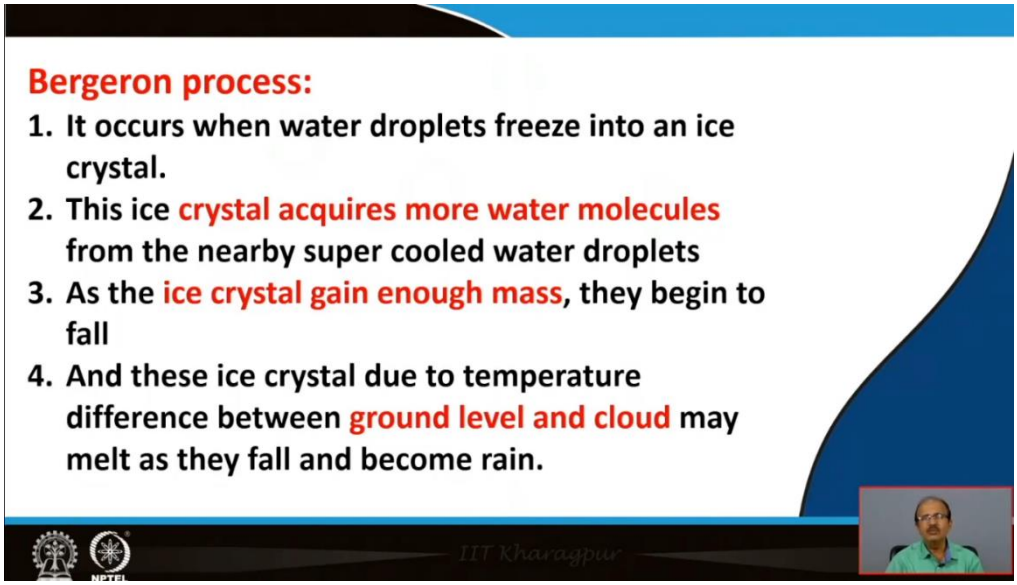

In the Bergeron process, it occurs when water droplets freeze into an ice crystal. So, here the water droplets is freezing into an ice crystal, this ice crystal is acquiring more water molecules from the nearby supercooled water droplets. So, it is acquiring more water molecules from the nearby supercooled water droplets and as the ice crystal gain enough mass because, gradually it will gain mass, so they begin to fall and this ice crystal due to temperature difference between ground level.

And cloud may melt and they fall and this result is in the form of rain. So, the two different process Coalescence and Bergeron process plays very important role in the formation of rainfall or snowfall on the earth's surface.

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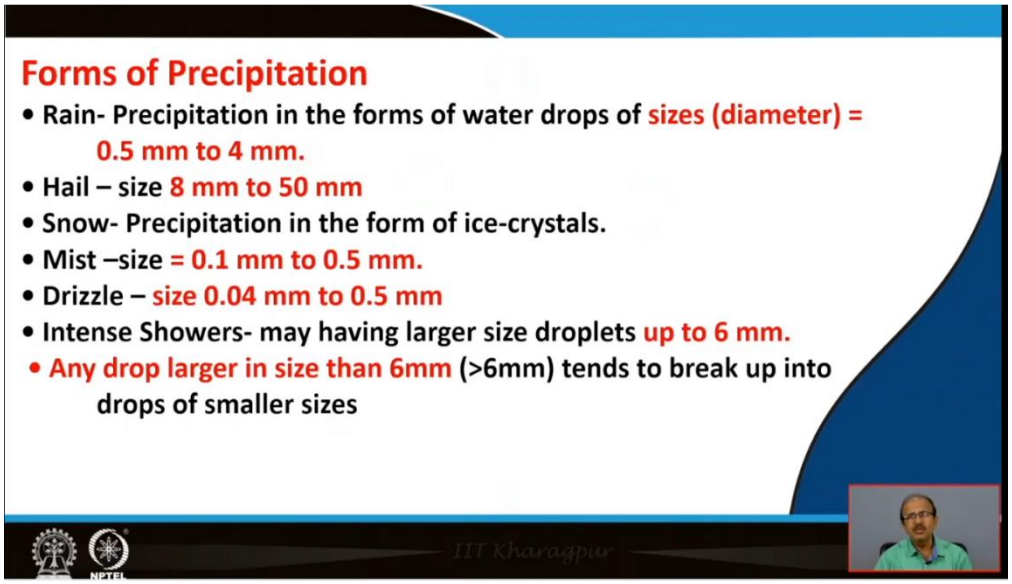

Now, there are different forms of precipitation also rain, when we are telling it rain it means the precipitation remains in the form of water drop, precipitation in the form of water drops of the sizes diameter 0.5 mm to 4 mm, if the size remains 0.5 mm to 4 mm then definitely it will rain. When it is 8 mm to 50 mm then it is called as hail and snow precipitation in the form of ice crystal is called as snow.

Mist 0.1 mm to 0.5 mm is called as mist whereas real size is 0.04 mm to 0.5 mm. Intense showers when may having larger size droplets up to 6 mm size and any drop larger in size than 6 mm tends to break up into drops of smaller sizes. So, in this way the precipitation is termed in according to size by the different names. Rain when it is 0.5 mm to 4 mm droplet size. So, then hail size 8 mm to 50 mm, snow when it is in the form of ice crystals, mist when it is from 0.1 mm to 0.5 mm, drizzle size is 0.04 mm to 0.5 mm.

Intense showers up to 6 mm and greater than 6 mm when the drop lets remains it usually breaks up into small sizes. So, this is about the form of precipitation. So we have learnt about the precipitation which forms because of the 2 different process coalescence and Bergeron process and this different forms of the precipitation occur in the nature.

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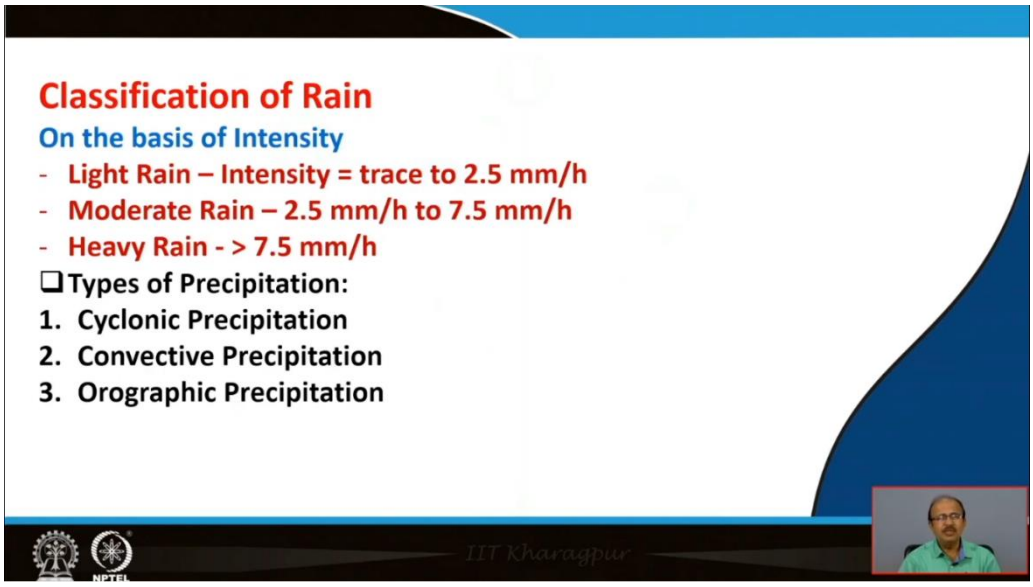

Then, the classification of rain is very important, because on the basis of intensity of rain the rain has been divided into different categories, say for light rain intensity remains stress to 2.5 mm per hour. So, if it is intensity is from trace to 2.5 mm per hour it is the example of light rain, if the intensity is 2.5 mm per hour to 7.5 mm per hour the example is the moderate rain and if it is greater than 7.5 mm per hour then definitely it is the heavy rain.

So, this is according to the intensity of the rain which we usually experienced also during rainy season. Now, this precipitation is basically of 3 important types the cyclonic precipitation the first one then the convective precipitation second one and third is the orographic precipitation. So, we will see what are the different types the different types are cyclonic convective and orographic now in detail.

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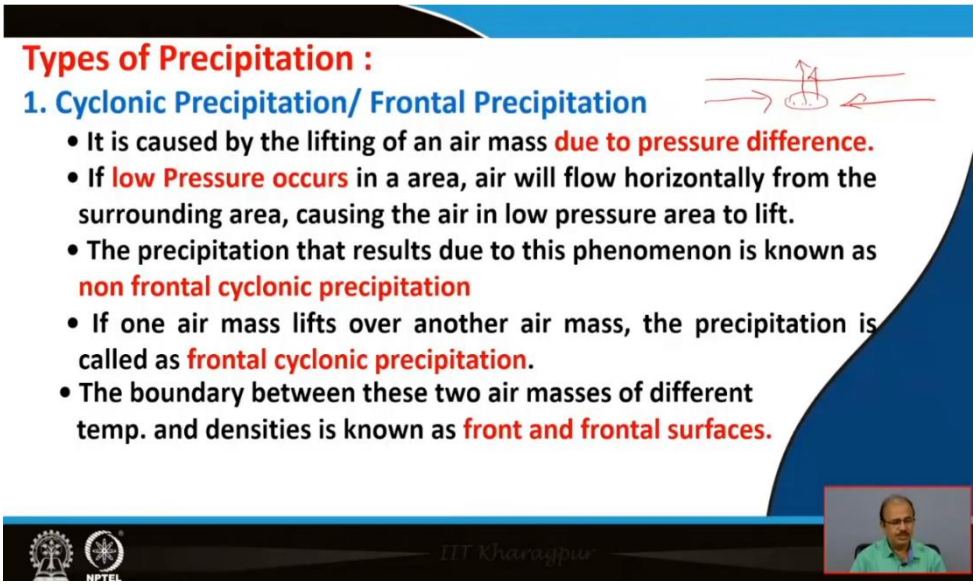

Let us see cyclonic precipitation also called as frontal precipitation. So, it is caused by lifting of an air mass due to the pressure difference, due to the pressure difference so what is happening in the case of cyclonic precipitation the lifting of air mass takes place. So, why? Because of the pressure difference. So if low pressure occurs in any area what will happen air will flow horizontally from the surrounding area. So, just the air will flow from the surrounding area the low pressure surrounding area then what will happen?

Air will flow horizontally from the surrounding area causing the air in low pressure area to lift, because this area has become low pressure area. So, here whatever amount of air is there it will try to go up lift, so if low pressure occurs in area air will flow horizontally from the surrounding area and it will allow to move the air of the low pressure area to the upward direction. Now, the precipitation that results due to this phenomenon is known as non-frontal cyclonic for precipitation.

If the precipitation is occurring because of this phenomena then it is known as non-frontal cyclonic precipitation, but if one ear mass lifts over another air mass the precipitation is called

the frontal cyclonic precipitation. So, this is very important the boundary between these 2 air masses of different temperature and density is generally known as the front or the frontal surface, so it is known as front or frontal surface.

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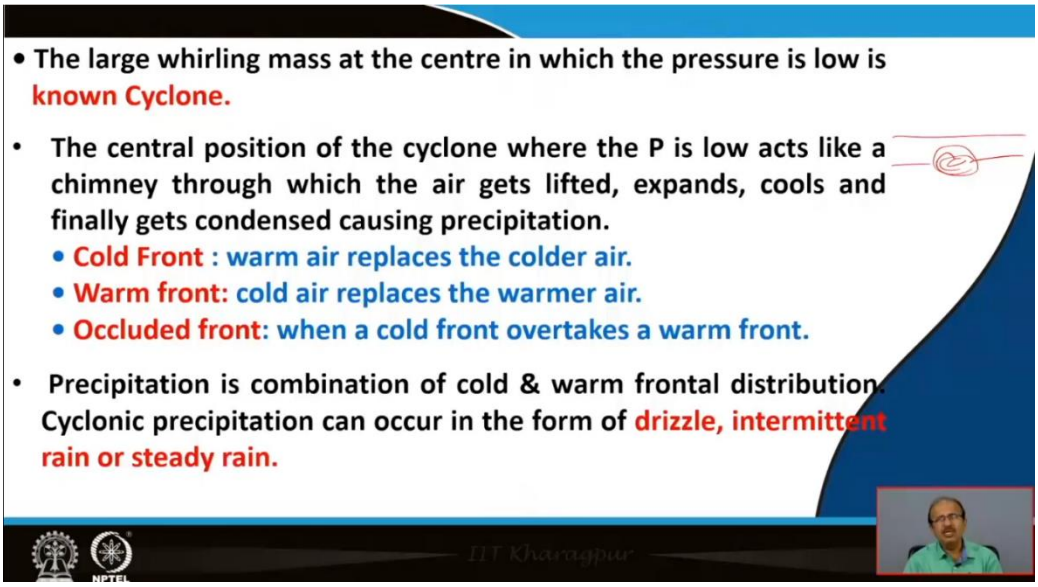

Now, the large bowling mass at the center in which the pressure is low is known as cyclone. So, where the large mass was there and here the whirling action is taking place, so this is called as cyclone the central position of the cyclone where the pressure is low acts like a chimney through which the air gets lifted expands cool and finally gets condensed causing precipitation. So, cold front is called when warm air replaces the colder air warm front is called when cold when the cold air replaces the warmer air.

And occluded front is called when a cold front overtakes a warm front, so this precipitation is a combination of cold and warm frontal distribution. Cyclonic precipitation can occur in the form of drizzle intermittent rain or steady rain. So, we have seen the cyclonic precipitation during the monsoon season in the form of drizzle or intermittent rain or seedling rain contain continuous slowly rain you will get in the during the cyclonic precipitation type of precipitation.

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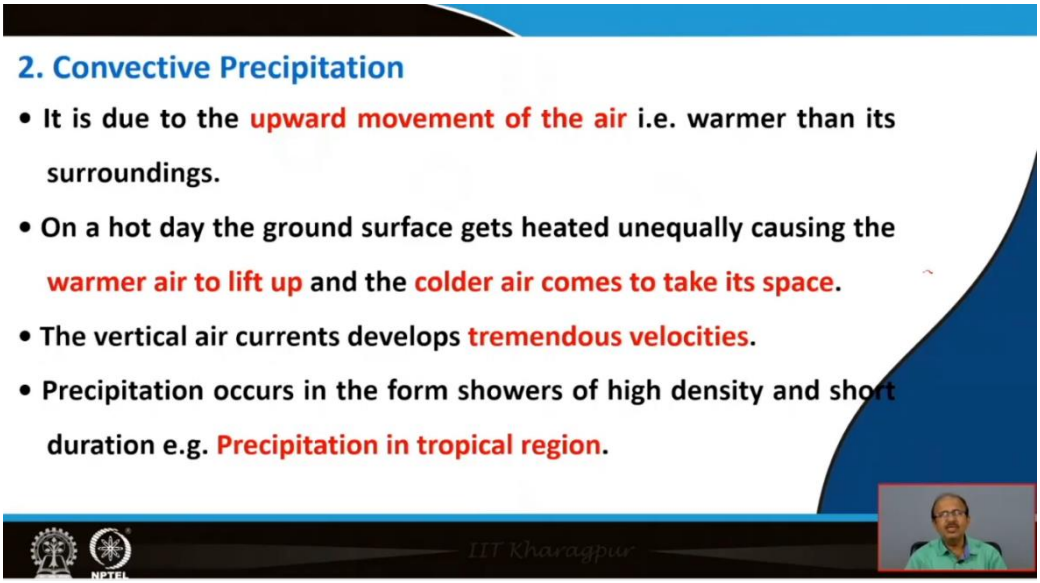

Now, second is the convective precipitation it is because of the upward movement of the air that is warmer than it is surroundings on a hot day the ground surface gets heated unequally causing the warmer air to lift up, so usually happens warm air moves up and the colder air from the surrounding comes to take place. So, the vertical air current develops tremendous velocities. This tremendous velocity, so it is developed in developing tremendous velocity precipitation occurs in the form of showers of high density and slowed of short duration.

So, when the convective precipitation takes place, it gives showers rain of high density and short duration, example is your precipitation in the tropical region. In tropical region generally we are getting the convective type of precipitation.

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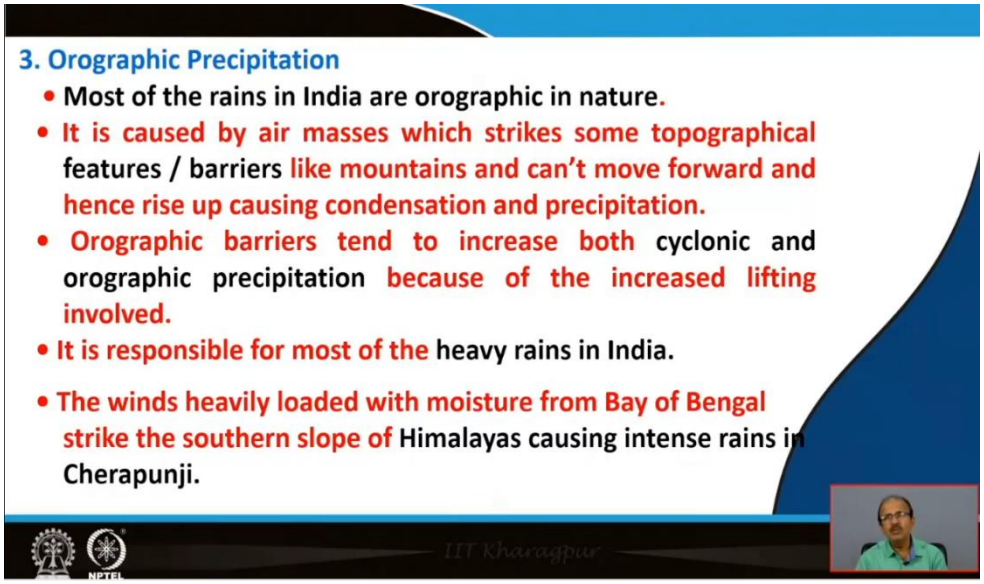

So, now third is the orographic type of precipitation. So here what we; have seen that most of the rains in India. In India we are having the Indian subcontinent in which the top part is the extra peninsula region, middle part is the Indogenic plain region and the bottom part that is the your southern portion is your the Peninsula region. So, we are having the mountainous region in the northern part of our Indian subcontinent and also in your Western and Eastern part we are getting some sort of fields.

So, what is happening in India mostly the precipitation is because of the orographic type of precipitation, whatever precipitation we are getting in Indian subcontinent it is because of the orographic type of precipitation. You know that monsoon starts from the your south west it extends towards the southeast and then it moves all over the country. So, most of the rains in India are orographic in nature.

Here, in the orographic type of precipitation it is crossing because of the air mass which strikes some topographical features. So, what are the topographical features or barriers? That is only the mountains, small hills. So, the mountains and hills it cannot move forward because of this it is not moving forward and hence rising up causing condensation and precipitation.

So, first it moves up and then condense and then precipitation take place. So, because of this we are getting most of the rains in India orographic barriers tend to increase both cyclonic and orographic type of precipitation. So, through the orographic pattern we can get the cyclonic as well as the orographic precipitation and it is responsible for most of the heavy rains in India whatever amount of heavy rain or intensity of heavy rain, we are getting in India that is because of the orographic precipitation.

The winds heavily loaded with moisture from Bay of Bengal. So, generally the wind is heavily loaded with moisture from this side from Bay of Bengal strike the southern slope of the Himalayas causing intense rains in the Cherapunji. You have heard that in the Cherapunji the maximum rainfall region where we get the maximum average annual rainfall in this place which is in Northeast.

So, generally what we have seen that the precipitation is because of the lifting of air masses, it is just moving up the formation of clouds take place and then by the movement of the clouds generally, we are getting the rainfall and snowfall at the earth's surface. So, this is all about the

about the just the basic about the precipitation. We call precipitation generally it is of three types convective cyclonic and orographic precipitation; different forms remain precipitation forms we are having in the form of mist, drizzle, snow, rain.

So, different forms depend on the diameter size drops diameter size in mm. So, on this basis we can just have the idea because this precipitation is the only source which provides us the groundwater in the earth's surface. So, we should know about it formation also. What we have discussed here is that that this precipitated water will first of all just intercepted by tall trees, tall buildings then it will satisfy the different storages structure which lies on the earth's surface;

And from there then, few amount of the rainfall that will infiltrate further percolate and then moves towards gravity and remains in the formations which are having the characteristics of storing the water that is the formations are having the porosity and permeability ability to contain or to store the water and then we are getting the groundwater underneath the surface. So, in the first part of this module 8 we have just and then discussed about the precipitation and it is form. So, thank you very much to all.