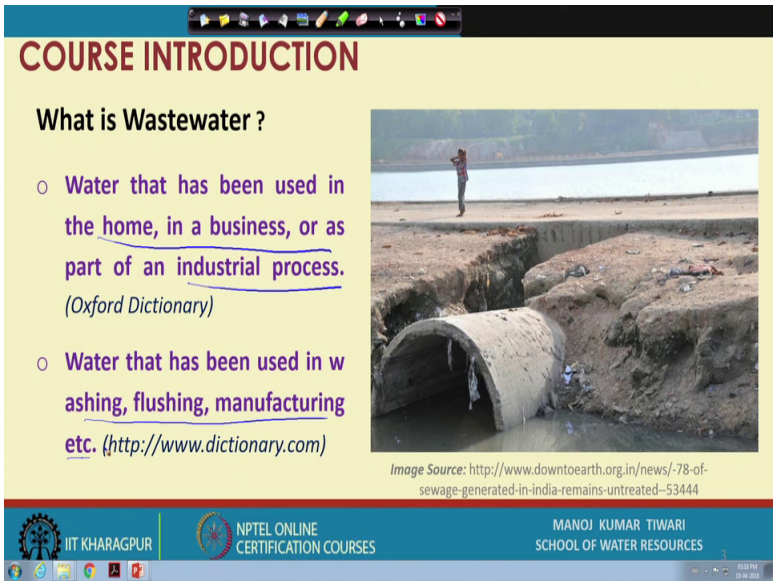
**Wastewater Treatment and Recycling**
**Prof. Manoj Kumar Tiwari**
**School of Water Resources**
**Indian Institute of Technology, Kharagpur**

**Lecture – 01**
**Course Introduction**

Hello everyone and welcome to this first session of this course Wastewater Treatment and Recycling. I am Dr. Manoj Kumar Tiwari at work at School of Water Resources and I will be guiding you through the content of this course over a period of 12 week. The course is titled as wastewater treatment and recycling and in this first session we will sort of have a introduction of this course itself. And then from the subsequent sessions from lecture 2 onwards we will talk about the specific content or the points or topics to be discuss in this course.

(Refer Slide Time: 01:09)




To start with let us first talk about the title of the course itself. So, the title of course, is wastewater treatment and recycling; so, there are 3 terms there is wastewater, there is treatment and recycling. So, let us first see what is wastewater? Now, if we go the traditional literature like our oxford dictionary suggests that the water that has been used in the home or in the business or as a part of industrial process is typically called wastewater. The dictionary dot com has a similar definition which says that water that has been used in washing, flushing, manufacturing purposes etcetera is wastewater.

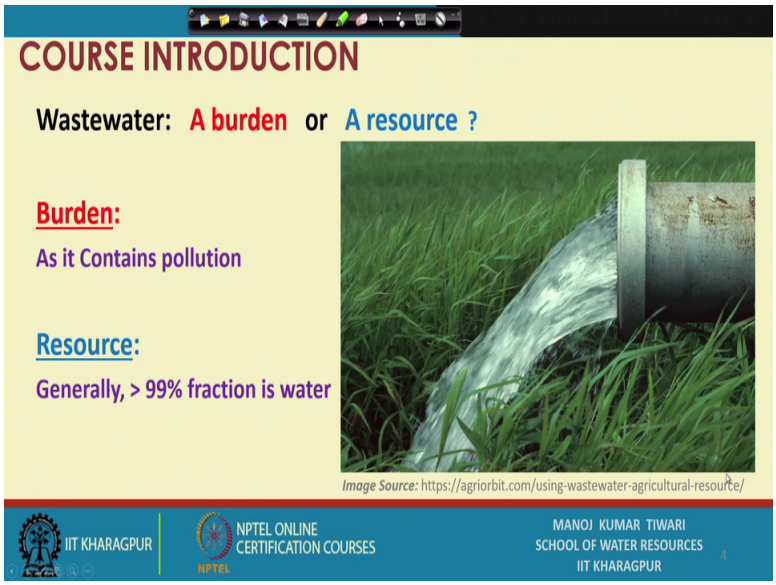
So, essentially the point is that the water which has been used once or utilized once for any sort of purpose; we consume water in our households for the purpose of cooking, drinking, bathing, cleaning so for all these different purposes of water we use. So, we open the let us say tap get the fresh water washed our clothes in that and then the water we put through or the water which in which we have washing our clothes we drain it through the, our drainage system connecting to a sewerage system or disposal anywhere in the open. So, the water which has been used for the washing purpose becomes wastewater as it is flowing in the drain. Similarly in our kitchen we generate lost lot of wastewater we cook food, so in the process basically washing vegetables, washing the various other things and in the various cooking process itself.

So, whatsoever water is generating out of the uses in the kitchen is actually a kitchen wastewater that way, the wastewater which is generated out of the cloth washing activities or laundry activities is laundry wastewater ok. The water which is generating when we are taking the bath or taking the shower and doing the whatsoever processes cleaning and all that through the bathroom and all these things so that is your bathroom wastewater in a way. So, there are different types of uses and whenever we consume water in some sort we generate the wastewater.

It is not limited to household only, the wastewater comes from various other sources there are industries which utilize water for their various industrial processes; let us say you take example of textile industry. So, in the process of textile manufacturing they need water at various stages they add lot of chemicals in that they add lot of additives in the water in the process and when their process is completes so let us say washing or whatsoever process they are utilizing it for the water which is generated is wastewater.

It could be generated from business areas as well in the institutions we are using water say in a laboratory, so for the purpose of cleaning the glass wares or some any sort of laboratory processes. So, there we are generating wastewater. So, it can be generated from any sort of business areas homes industrial processes. And the water which we have consume is eventually comes out in our drainage system or sewerage system and is referred typically as wastewater. So, the wastewater if we see essentially is majority of the content of wastewater is actually water.

(Refer Slide Time: 05:19)




So, there is a big question that often rises that wastewater should be considered as a burden or as a resource, burden many like it is burden for many people or in many sense because it contains pollution and it cannot be used directly for most of the practical purposes. So, since something which is unusable which cannot be used like nobody would like to take water from the drain and put it in their shower or use it in their kitchen or used it for laundry purpose.

So, the water which has been used generally people do not prefer to use that water ok, it can be used for agriculture or horticulture purpose few places it is used also, but again there is a risk associated with that using even it for agriculture purpose directly. So, since the water is in general is not usable in its original state. So, it becomes a burden because something which is not usable you have to find a place to dispose it ok. Now, it contains a lot of pollutants in it, it contains pollution and in the presence of those various contaminants disposing it to a natural system have its own demerits. There are environmental issues associated with that we know that the pollution in our major waterways, surface channels, rivers Ganga Yamuna all that is primarily because of the wastewater disposal.

So, when we cannot use it we have if in its original state and if we have to dispose it, it really becomes a big burden where to dispose it in a sustainable manner so that it does not cause harm to environment or our natural system or natural resources. At the same

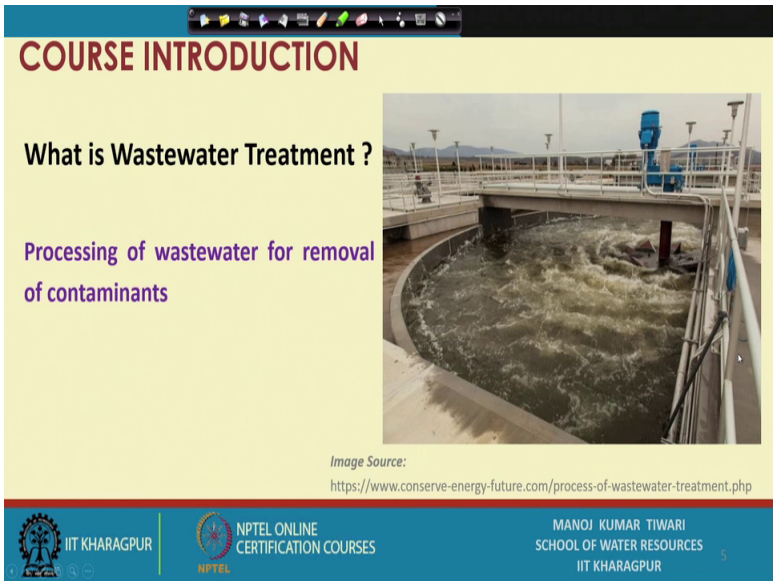
time this water essentially or the wastewater what is actually there are some pollutants, there are some contaminants available in it, but they are in a very little quantity ok. So, when we talk about various parameters of the wastewater you see that COD, BOD has to be for say 10 50 milligram per litre, 100 milligram per litre or iron 1 milligram or let say 2 milligram per litre, 3 milligram per litre.

So, most of these impurities or most of the contaminants even the sediments, salts how much it is 500 milligram per litre TDS, 1000 milligram per litre TDS let us say even so, these quantities are in a few milligrams or at max a few grams per litre ok. So, we are talking about 1 litre water in 1 litre water the impurities of the scale of impurities is barely of few milligram or at max let us say couple 2, 3 grams; if you collect take consider it in a collective way ok. If you combine or some all the form of pollution or impurities it may maximum reach to a level of few grams per litre.

So, majority of the fraction in that wastewater is actually the water pure H2O which has a lot of beneficial uses. Now, we are considering it as a burden because of those pollutants available in it which are just barely a few grams ok, few milligrams or few grams and rest of the mass of the wastewater is actually water and we know what crises or how much application of water is there and in what the age we are living in. How much water stress we are facing and disposing or considering something as a burden which contains almost 99 percent or even greater than 99 percent water is a is sort of gives us an idea that there is something which is not right and we should look it from a different perspective.

So, in that sense the wastewater can be considered as a resource also as is being done now, many people many places are considering wastewater nowadays as a resource and therefore, trying to reclaim water out of that wastewater and reuse it for some beneficial purposes. So, this course primarily is about to discuss this aspect only that how, what is the level of pollution and how we can sort of reclaim the useful component in the wastewater, most useful component for us in our perspective is water actually.

(Refer Slide Time: 10:52)




So, how we can reclaim the water out of that wastewater and reuse it for some potentially beneficial purpose. Now, if we see, we talk about what is the wastewater the other terms in the in this course is essentially the treatment because its course is wastewater treatment and recycling. So, what is wastewater treatment? The wastewater treatment is the processing of wastewater for the removal of these contaminants, as we were discussing just now that wastewater can be considered as a burden or as a resource.

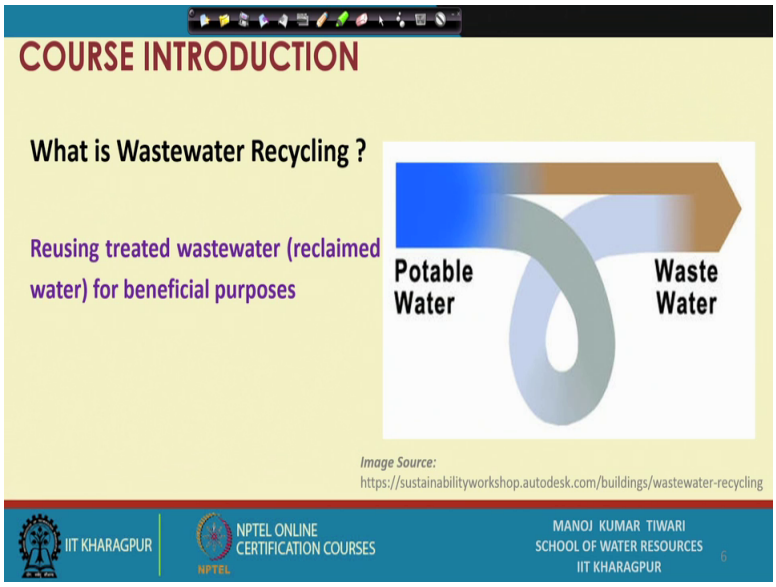
So, it is burden because of this pollutants only and if we process this wastewater in such a way that these pollutants can be removed from water or can be at least minimized so, that the water can be used for some beneficial purpose. That or even for disposal let us say because we do not want to dispose the wastewater in its original state or natural resources because that will lead lot of environmental consequences.

And in order to avoid that even if we are disposing wastewater, we must ensure that the pollutant levels in the wastewater have been substantially reduced so that the environmental effect of that disposal is reduced. So, either for disposal or for any reuse purpose or recycling purpose it becomes essential to remove the pollutants from the wastewater and using engineering technologies or engineering approaches for removal of these contaminants or removal of these pollutants from wastewater is called wastewater treatment.

So, we treat this wastewater, we process this wastewater in such a fashion or through such a system where the various types of contaminants that are present in the wastewater and there are variety of types of contaminant present in the wastewater. We will discuss that in detail when we go into the section of characteristic of the wastewater in the course, but to begin with. So, we essentially want the removal of majority of the harmful contaminants or harmful contents that are present in the wastewater and we achieve this thing through the wastewater treatment.

So, wastewater treatment is essentially the processing of wastewater through a system or through some engineering or technological interventions so, as the contaminants can be removed or sort of reduced from the wastewater. And we can look for the subsequent step, whether we want to further reuse recycle this or dispose it off.

(Refer Slide Time: 14:01)




The other term in the course was recycling, wastewater treatment and recycling. So, we did talk about what is wastewater, we did discuss what is the wastewater treatment of course, the further details will be discussed subsequently in the lectures. But we did have an idea of what is the treatment, now what is the wastewater recycling? So, recycling wastewater, recycling is the pretty common term, but recycling normally we use let us say recycling glass bottles, recycling newspaper, recycling tin cans so, in those sense of waste recycling is a pretty common thing. We recycle the papers, we recycle the we

bottles and various other things plastic many a times. So, all those things are generally recycled, here we are referring to the recycling of the water or rather wastewater.

So, how we achieve wastewater recycling, well we just discuss that there is something which is wastewater treatment which can process the wastewater for removal of contaminants from it and once the contaminant is removed. See in our earlier discussion we did see that wastewater generally contains some contaminant and a large junk of water. Now, if you remove those contaminants from that of using certain treatment process whatever is remaining is mostly the water without too much of contamination or with minimum contamination or it is better if it is with no contamination. So, that water is has actually been reclaimed from a wastewater because your wastewater traditionally was having significant amount of contamination in it.

If you remove those contaminants so, we are able to reclaim water from that wastewater and reusing this reclaimed water or treated wastewater for certain beneficial purpose is generally referred as wastewater recycling. So, wastewater recycling essentially is reusing the treated wastewater, there are two three terms, different terms so there is something which is reuse, reclamation and recycling. Reuse is if we can reuse something with let you in wastewater sense let us say so the wastewater which is being generated if we are using it say for irrigation purpose or horticulture purpose without any treatment or with very little treatment.

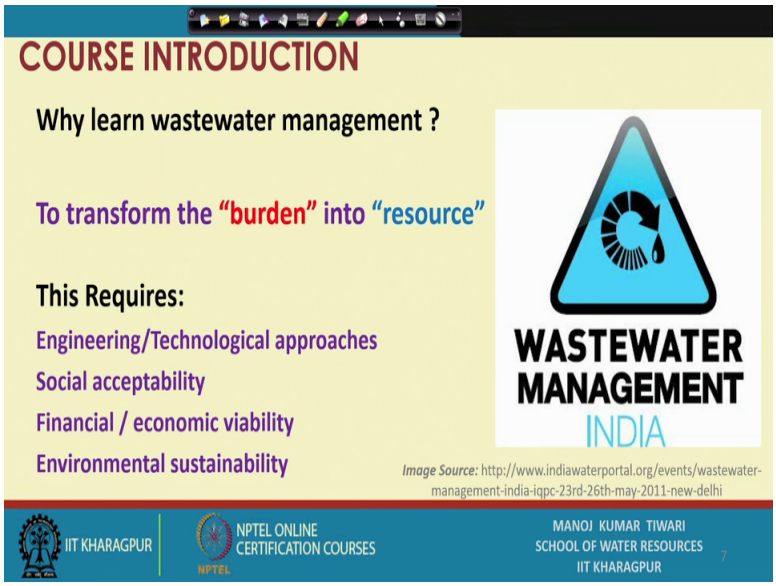
So, we are not changing the state of wastewater too much ok, we are just using this wastewater which has come through our drain for let us say irrigating a field. So, in such a scenario this wastewater is essentially being reused, water which has come which has been used once because wastewater, what is wastewater? Wastewater is the water which has been used. So, the water wastewater which has been used once is being used for some other application, it may have been used for let us say washing purpose earlier or bathing purpose or in the for its application in the kitchen. And if we channelize that water put that to a irrigation field so it is again being used for a beneficial purpose which is irrigation.

So, this kind of applications is generally referred as reuse, reclamation is a process through which we reclaim water out of wastewater by removing the contaminants through the wastewater treatment. So, that is reclamation; so reclaimed water is the water

which we have reclaimed out of wastewater and recycling is conceptually the use of reclaimed water. So, the water once which we have treated we want to use that for subsequent purpose it could be the similar purpose also, application the water coming out of household application if we treat it, purify it and put it again for the similar household application. So, that is what is recycling or it can be used for different application also so we take the water we treat it, purify it and then put it for say industrial uses ok.

The household sewage treated household sewage or reclaimed household, reclaimed water from the household sewage if it is putting it, putting it we are putting it in some say industrial application so, that is recycling of wastewater or if we are augmenting or water supply with that water that is the recycling of wastewater. So, that is essentially recycling and these are the three different terminologies in that sense.

(Refer Slide Time: 19:15)




Now, why we should learn wastewater management ok, that is the question that one should have before venturing into this course, because this course talks about the wastewater treatment and recycling which is essentially the wastewater management in generally scale. So, what is the need of discussing or knowing all these things gaining knowledge onto the wastewater management well, the whole idea of this course is to provide knowledge, information on the approaches or concepts on the transforming the burden into the resource. So, wastewater which we perceive as a burden because of the contaminants in it through this proper management of wastewater we can consider or we

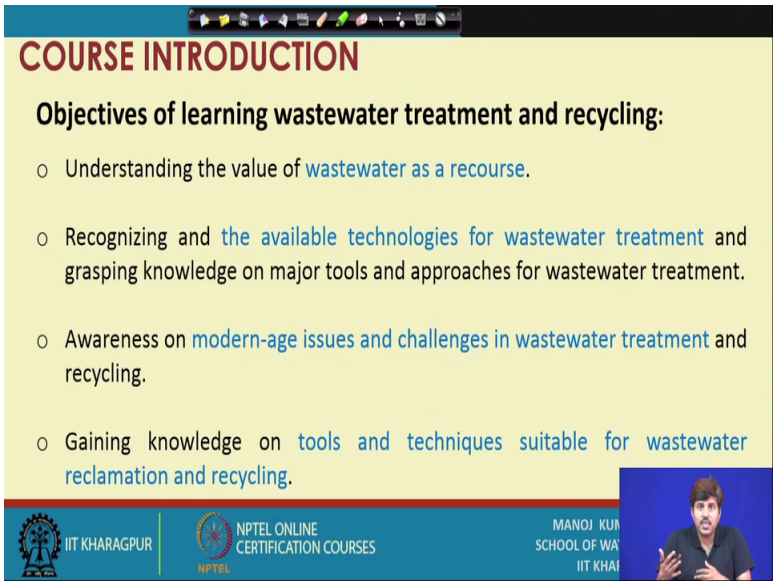
rather we should consider that as a resource and that is what is the prime objective of this course in a way.

Now, how we can transform this burden into the resource will be through appropriate treatment, reuse, reclamation and recycling processes right. And kind of knowledge needed for this will be engineering and technological approaches because reclamation of the wastewater or the treatment of wastewater will eventually need engineering interventions or technological approaches. So, the different processes for wastewater treatment engineered process for wastewater treatment so one should have the knowledge of that that is one aspect which is needed.

It also needed social acceptability because if we want to use water or the reclaimed water as a resource the society should be willing to accept it, as we were just seeing that the water can be recycled or can be recycled for the household application also, but people should be willing to accept it. So, that social acceptability is also important aspect we will discuss that in detail in the subsequent sessions, then there has to be financial and economic viability of these recycling approaches ok. It is not that in order to in order to sort of extract the water out of the wastewater or the reclaim water out of the wastewater we spent so, much that the cost of the water that we get is enormously high and then it becomes financially unsustainable or unviable project.

So, we should see or we should observe that the process or the approach which is being adopted are financially and economically viable and we should think of environmental sustainability as well. So, all these different knowledge's are required and that is why it is should be considered as a interdisciplinary subject ok.

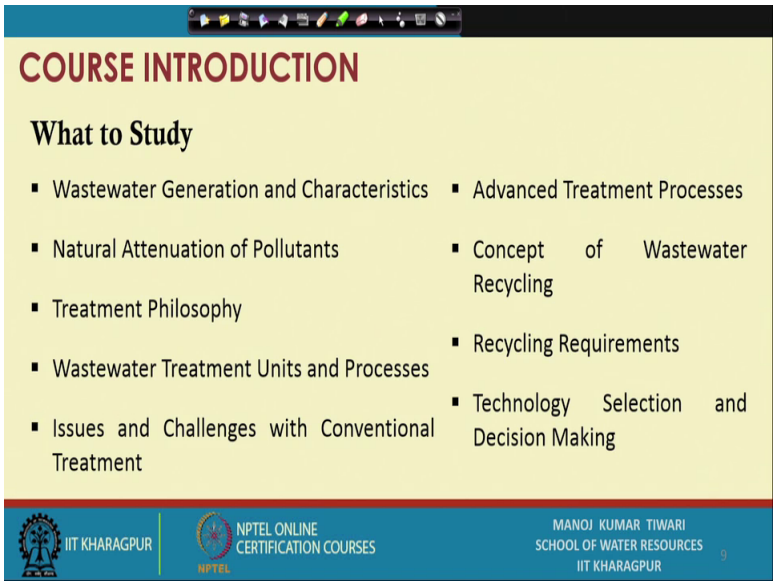
(Refer Slide Time: 22:30)




And if we see what are the various objectives of this course: what do we want to learn or what the attendees of this course will gain out of sort of spending the next 12 weeks time with us is will try to develop that understanding on the value of the wastewater as a resource. The idea is to recognize the various available technologies for wastewater treatment, the conventional process that are being used and some advanced processes which can be used for wastewater reclamation or wastewater treatment.

So, gaining the knowledge onto this major tools and approaches for wastewater treatment is one of the core objectives. Then there has to be awareness has to be developed on the modern age issues and challenges in the wastewater treatment and of course, on recycling and the overall gaining knowledge onto the tools and technologies suitable for wastewater, reclamation and recycling.

(Refer Slide Time: 23:51)




So, these are the primary objectives learning objectives of this course and what is going to be covered in this course although the information is available on the course webpage. However, just to quickly brief you we will talk about the wastewater generation and its characteristics in the subsequent sessions, we will talk about the natural attenuation of pollutants. So, when the pollutants are released in the nature there is some self attenuating ability of nature itself with to deal with these pollutants.

So, how that natural attenuation of the pollutants works then what are the general treatment philosophies for wastewater what are the specific treatment units and processes. We will also talk about the issues and challenges with the conventional process treatment process which are being used because, we see that wastewater treatment say for say has been being done since several decades now. But still even in those cities which have the wastewater treatment facilities the outcome is not meeting to the sort of desired conditions.

So, what are the major issues and challenges we will also be discussed, then we will also cover the various advanced treatment process so, which are often overlooked in the conventional treatment systems and that results in the variety of issues and challenges with the quality of the water that comes out of those treatment systems. So, how to deal with that, what are the available advanced treatment systems for that, we will talk about the concept of recycling what are the various recycling requirement in terms of

regulatory requirement or in terms of technological availabilities ok, what is the scope of the recycling wastewater.

So, the scope and demand in this sector and we will conclude this course basically with a idea on how to select appropriate technologies because once we are into the course you will realize that there are variety of systems or variety of treatment processes are available. And a general treatment system will not use all of these so few specific processes or the best technology should be adopted.

Now, the best technology also may vary condition to condition; so what is the characteristic of the input waste or what is the fund available, what is the space available? So, based on all these various criteria's how we can select the appropriate technology and how we can sort of conduct decision making out of this. So, out of the wastewater treatment; water reclamation out of the wastewater and wastewater recycling.

So, we will conclude on that lines for towards the end of this course. So, this all will be covered in the next 12 week including this of course, and subsequently we will move from the basic introductory part about the characteristic generation towards the treatment aspects, recycling, requirements, approaches, scope and demands and a decision making kind of framework.

So, this is this was about the course which we are going to discuss through the next 12 weeks. And so, we conclude this session here only and in subsequent sessions one by one we will take up all these specific content of the course and we will have elaborated discussions on those sections.

Thank you.