Automation in Production Systems and Management
Prof. Pradip Kumar Ray
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur

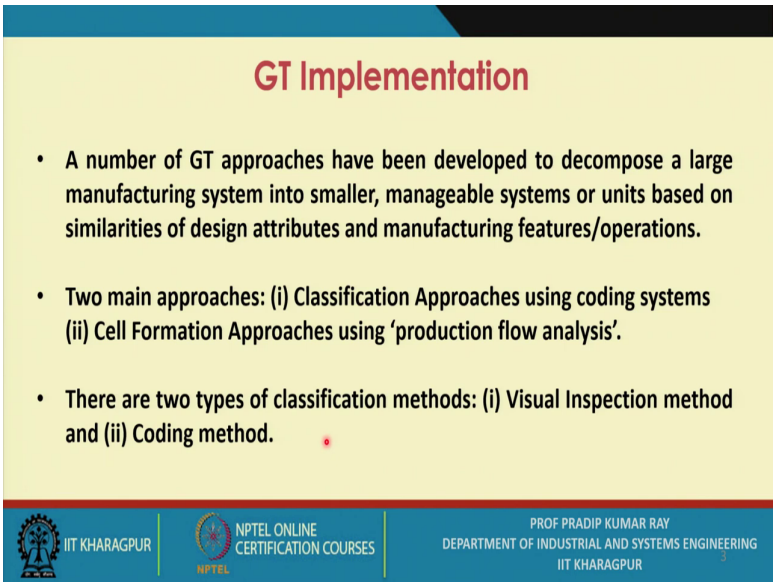
Group Technology and Automation in Manufacturing
Lecture - 27
Methods and Implementation of GT for Automation

Now we are the discussing the Group Technology principles, basic concepts I have explained in the previous lecture session.

(Refer Slide Time: 00:21)

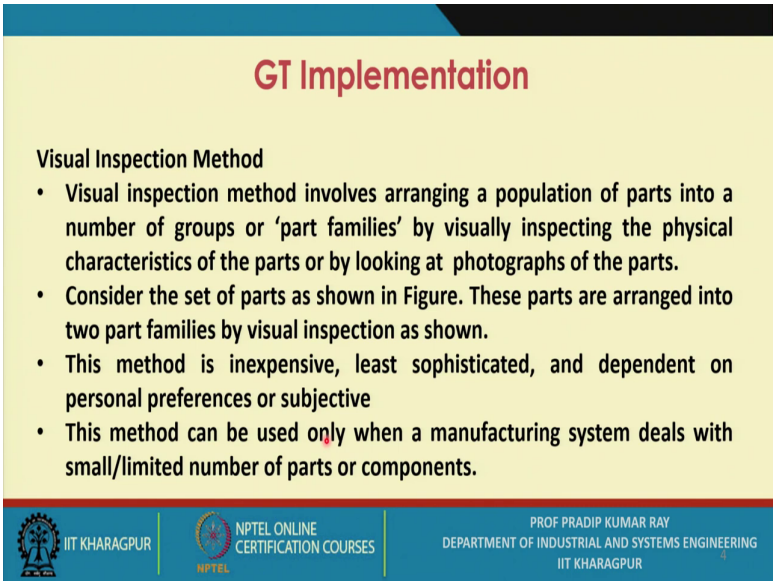
During this lecture session we will be referring to those methods and are going to implement GT principles in manufacturing.

(Refer Slide Time: 01:44)



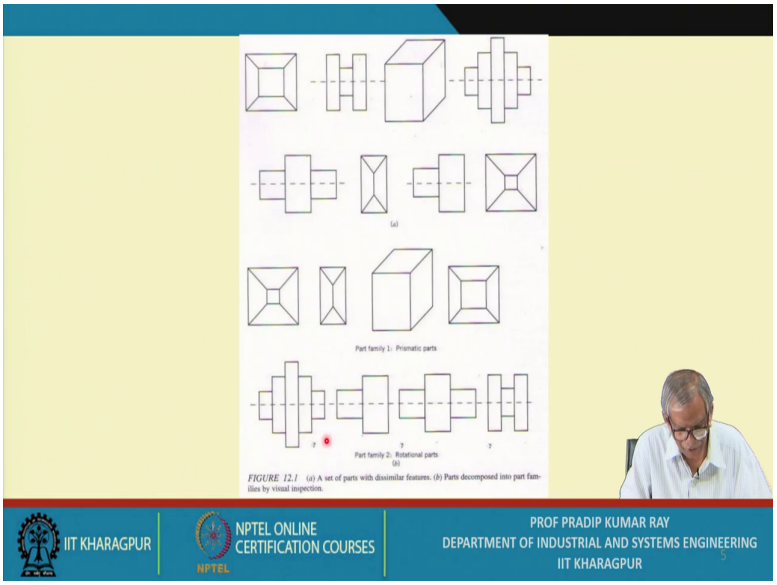
A number of GT approaches have been developed to decompose a large manufacturing system into smaller, manageable systems based on similarities of design attributes and manufacturing features. Two classes (i) classification approaches using coding systems (ii) cell formation approaches using production flow information. There are two variations of classification methods: The visual inspection method and the coding method.

(Refer Slide Time: 06:30)



Let us talk about the Visual Inspection Method. Visual inspection method involves arranging a set of parts into groups known as part families by visually inspecting the physical characteristics of the parts or their photographs. Consider the set of parts in Fig 12.1a. These parts are arranged into two families by visual inspection as shown Figure 12.1b. This method is inexpensive, least sophisticated, and dependent on personal preferences. By its nature, its utility is limited to companies having smaller number of parts.

(Refer Slide Time: 13:44)



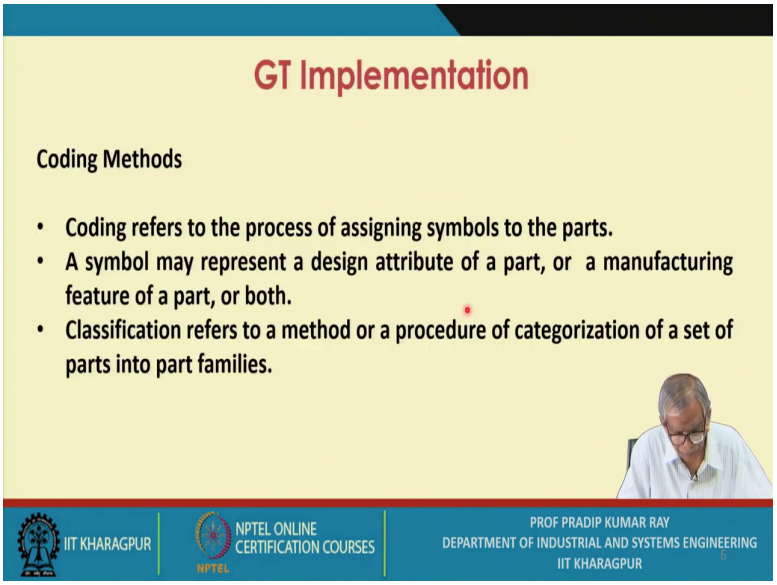
This is the first object or the part its shape is prismatic, this is prismatic.

The second one is the cylindrical, the third one is prismatic, fourth one is yes when you get this particular shape, it is also the cylindrical, then the fifth one is cylindrical, this one is prismatic the sixth one, the seventh one is cylindrical and the eighth one is prismatic that means, there are eight parts.

Now, I will form one group where I will include only the prismatic and the second group will include only the cylindrical ones.

Similarity between or among the parts as far as its shape is concerned. Other aspects maybe there could be dissimilar like or may be grouped for the groups like the dimensional envelop or maybe the raw material type, could be different or material which you use could be different.

(Refer Slide Time: 16:03)



The second approach is basically the coding method.

The coding methods or the coding schemes have grouped under types of parts and under three categories the first one is the mono code or hierarchical code. The next one is poly code or there many other names given like chain code. And in certain cases, you apply both the schemes and you call it the mixed mode.

And while the mixed mode coding or the mixed coding are used, there are many standardized systems. one particular standards with this coding scheme are basically referred to as the classification scheme. Coding scheme are grouped under three categories and in majority of the cases you go for coding.

Whether it is the materials management or production management or the production operations, the operations or productions in the context of materials management you need to be given a particular part given a particular material.

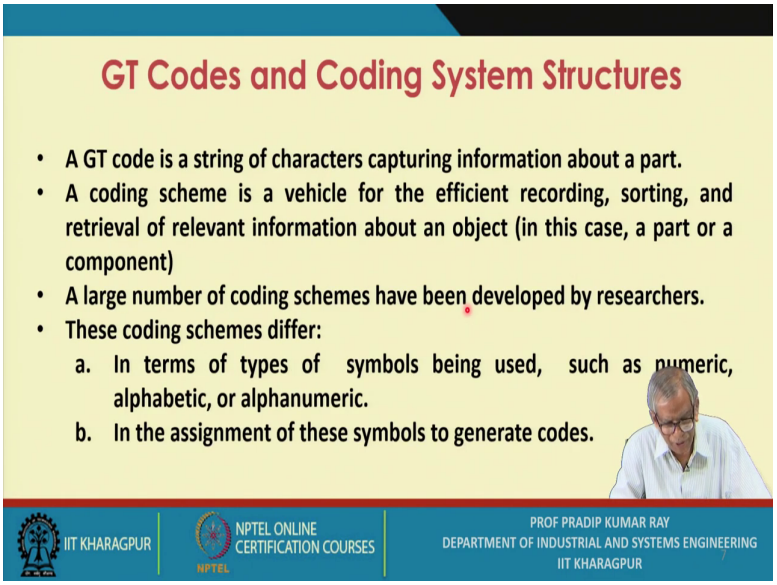
The coding scheme when they are all coded, then each part becomes a unique one by its code. If you opt for the coding scheme, there is no duplications.

In investment, wastage will be less and with this coding scheme you can classify the components. So, that is why it is called classification scheme.

One particular scheme is referred to as the Opitz classification system, Opitz classification system is basically a German system many years back almost 60 years ago was proposed, coding refers to the process of assigning symbols.

A symbol may represent a design attribute of a part or a manufacturing feature of a part or both. Classification refers to method or procedure of categorization of set of parts into part families through by using coding scheme.

(Refer Slide Time: 20:36)



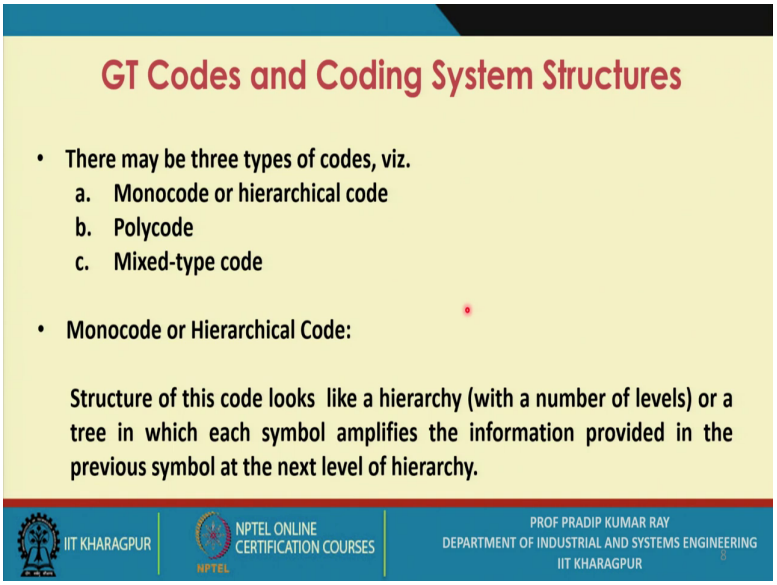
As the reference point is group technology, that is why sometimes in this particular context, the code is referred to as the GT code, a GT code is a string of characters capturing information about a part capturing information about a part, so a coding scheme this is another definition. A coding scheme is a vehicle for the efficient recording, sorting and retrieval of relevant information about an object.

Now, this is when you go for the process planning or automated process planning, there will be recording. The data there will be sorting of data and there will be retrieval of data. At what extent these three activities you can do one after another automatically, this is how coding will help you, that is why it is referred to as the vehicle or a large number of coding schemes have been developed by researchers.

And there are review paper on this coding schemes, you will come to know that what is how they are classified now. These coding schemes differ in terms of types of symbols being used. So, the symbols could be numeric, it could be alphabetic or alpha numeric, previously it is to be the alphabetic in general, then alphabetic change to numeric, 100 percent numeric.

Not only for GT coding as a general as a method used for many purposes. Originally it was alphabetic, then you move to numeric and today it has become alpha numeric. There are reasons behind it, there are scientific reasons, in majority of the cases you go for alpha numeric code in the assignment of the symbols to generate course.

(Refer Slide Time: 23:40)



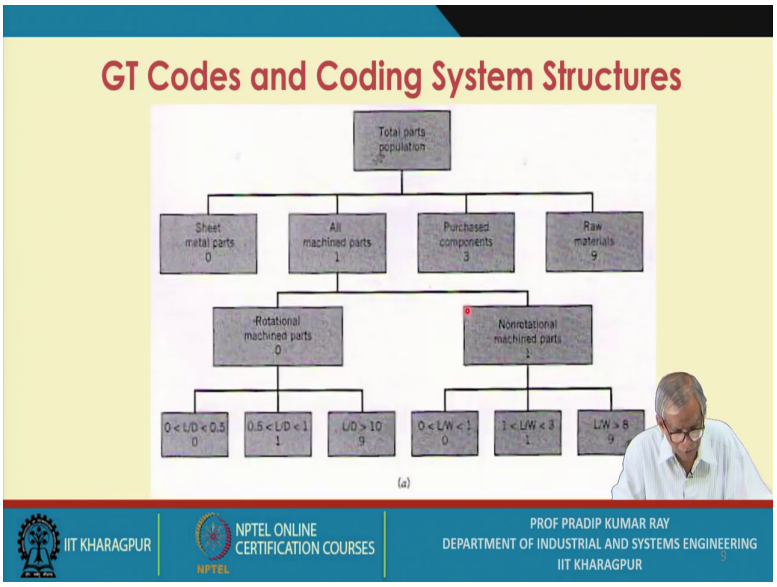
Like the poly code there are the mono code or hierarchical code.

The amount of information you may store with poly code, there may be substantial difference in the mixed type code. These are three types of code the companies have been using for many years mono code or hierarchical code, if you refer to design attributes, poly code can be used only when you refer to the manufacturing features but if your priority is to define the similarity among parts the design attributes, you can refer to the mono code or hierarchical code.

Both are widely used and there are many standard systems you have and they are all mixed type code. That means, once you use this mixed type code, you can define the similarity with respect to the design attributes as well as manufacturing features.

Structure of this code looks like a hierarchy and this hierarchy means number of levels or a tree. Sometimes this is referred to as a tree in which each symbol amplifies the information.

(Refer Slide Time: 26:46)



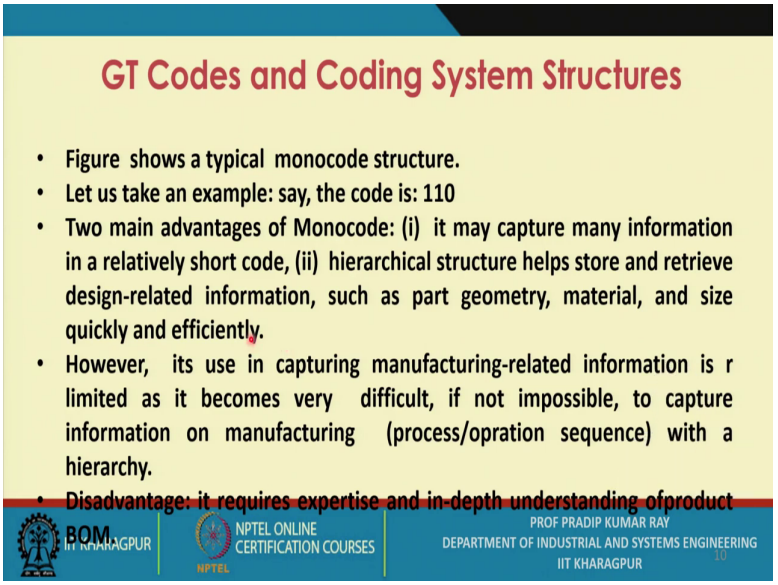
There is an example like the total parts part populations, this to be classified it could be sheet metal parts, the machine parts, purchase components.

So, you can you may have, so the ten types and this is 0 and the tenth one is 9. So, numeric code you use then in the next level say for each the machine parts. The machine part could be either rotational one or cylindrical one or say non-rotational or the prismatic one.

So, the non-rotational rotational, your symbol is 0 and non-rotational is 1. and then the rotational one. Now you consider another important attribute that is called dimensional envelop. That means, here it is the rotational component , l by d ratio.

So, if it is between 0 and 0.5 say you code is 0 and if it is between 0.5 and 0.1 and 1, then it is 1. If it is between greater than say 10 you say it is 9, in between you have other groups also. So, it is similarly for the non-rotational.

(Refer Slide Time: 28:23)

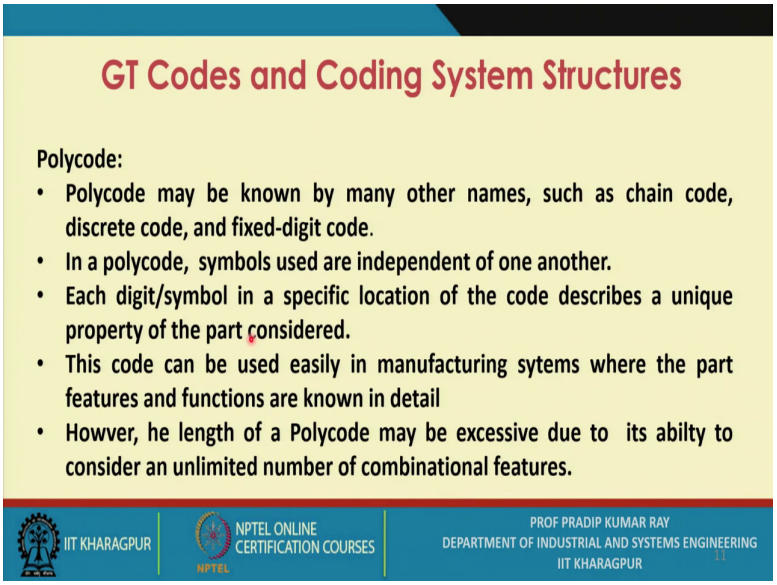


So, the figure shows a typical mono code structure. Figure 12.2a depicts the monocode generation scheme.

Consider a code of 110 in Figure 12.2a. Major advantage of hierarchical code (i) is that it captures a great deal of information in a relatively short code. (ii) The hierarchical nature of the code makes it useful for storage and retrieval of design-related information such as part geometry, material, and size. (iii) The applicability of these codes in manufacturing is rather limited as it is difficult to capture information on manufacturing sequences in a hierarchical manner.

Disadvantage of this type of code (i) is that it requires expertise to conceive such a coding system for a part spectrum.

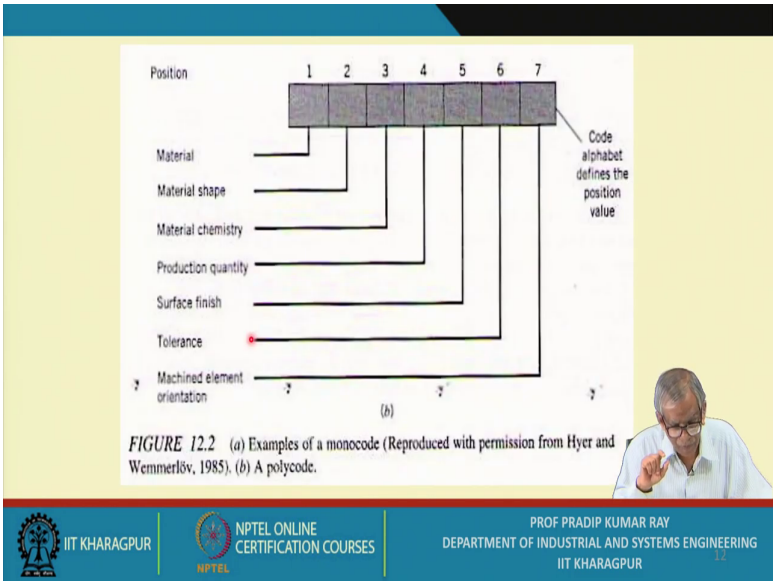
(Refer Slide Time: 29:57)



However, it is used in capturing manufacturing related information is limited, because manufacturing related information cannot be converted or cannot be placed or cannot be documented in a hierarchical form. So, rarely it can be done, that is why you use poly code.

The poly code may be known by many other names such as the chain code, discrete code or fixed digit code, each digit or symbol in a specific location of the code describes the unique property of the part consider.

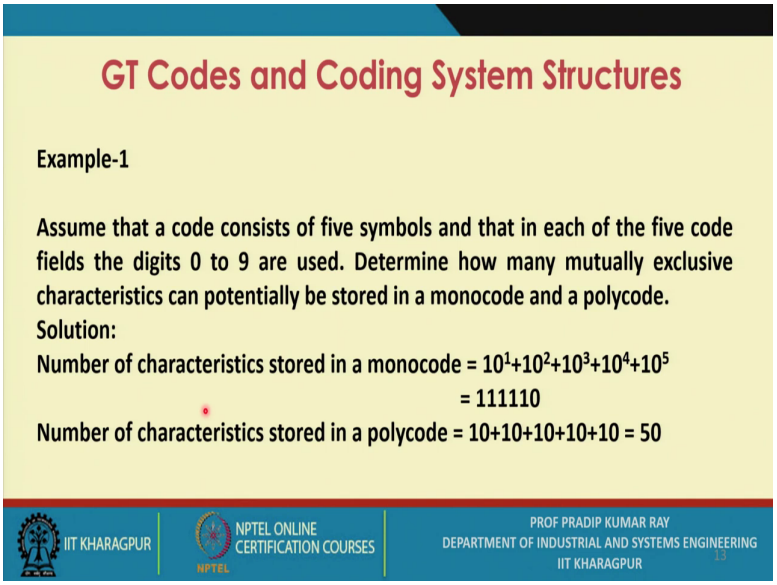
(Refer Slide Time: 30:30)



And what you assume that all these features or the manufacturing, are independent with one another parallelly. Here is one example, this is a poly code, 1 2 3 4 5 6 7. So, the first one is referring to the material, second one this is just an example given in your text book material shape. Material chemistry production quantity and while you use this code, you assume that all these characteristic features are independent with one another.

So, the production capacity is this surface finish the next digit, the tolerance is this 6th one and the machined element, orientation machine element orientation like NC Technology we have already discussed, the orientation of the part is very important, the rotational axis we refer to, this is an example of the poly code

(Refer Slide Time: 31:43)

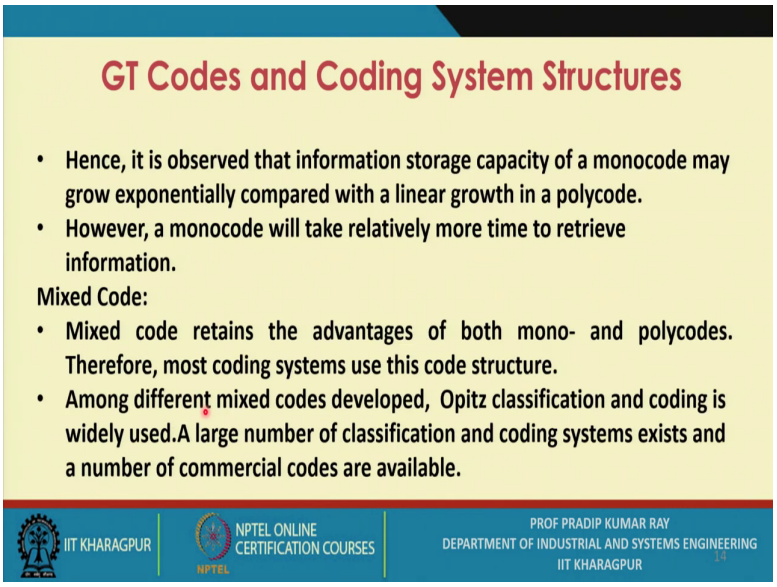


Let me give this simple example. Assume that a code consists of five symbols and that in each of the five code fields the digits 0 to 9 are used. Determine how many mutually exclusive characteristics can potentially be stored in the monocode and the Polycode.

Solution: Number of characteristics stored in a monocode = $10^1+10^2+10^3+10^4+10^5$ = 111110

Number of characteristics stored in a Polycode = 10+10+10+10+10 = 50

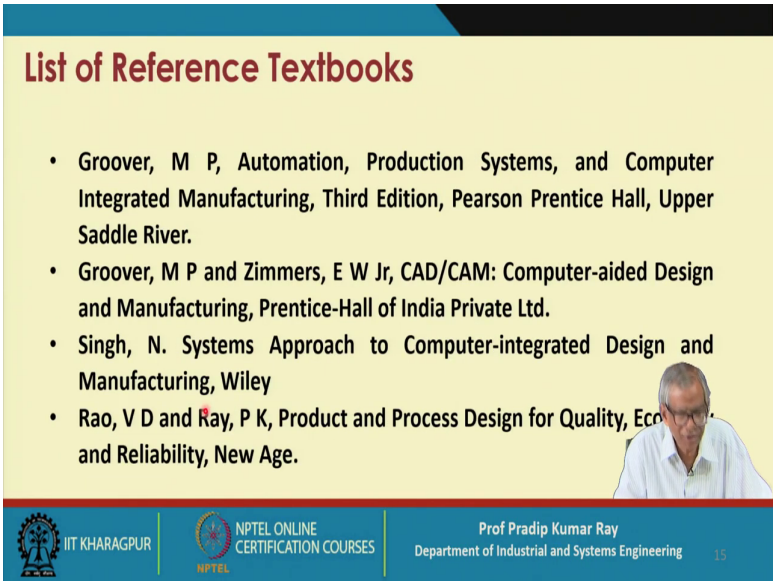
(Refer Slide Time: 32:46)



The information storage capacity of monocodes grow exponentially compared with the linear growth in the polycodes. However, monocode will take relatively more time to retrieve information.

Mixed code retains the advantages of both mono- and polycodes. Therefore, most coding systems use this code structure. For example, the Opitz classification system. A large number of classification and coding systems exists and a number of commercial codes are available.

(Refer Slide Time: 33:24)



So, this we will discuss in our next lecture sesssions,