Automation in Production Systems and Management
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Group Technology and Automation in Manufacturing
Lecture - 28
Part Family Formation: Tools and Techniques

We will be discussing one particular scheme or the classification and coding scheme which is referred to as Opitz classification system.

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Three types of coding, the first one is mono code, second one is the poly code and the third one is mixed coding. This Opitz classification scheme and coding system has been adopted by several organizations.

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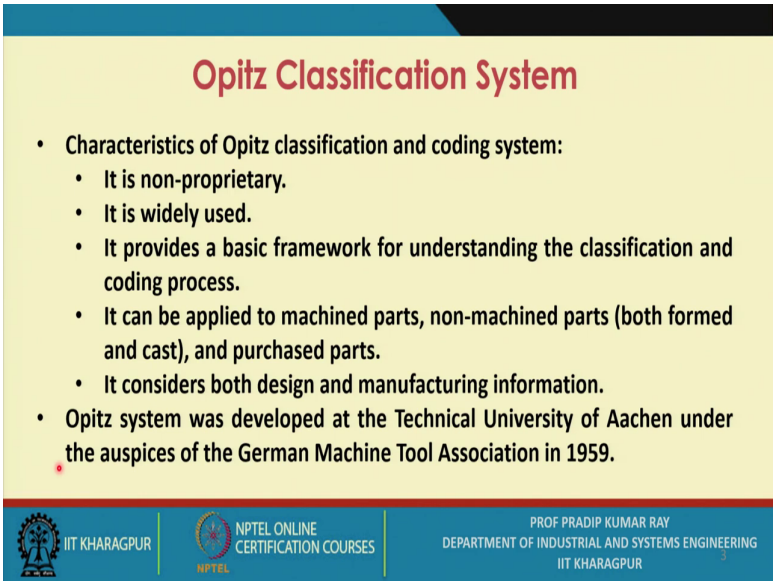

Opitz system has the following characteristics: It is non-proprietary. It is widely used. It provides a basic framework for understanding the classification and coding process. It can be applied to machined parts, non-machined parts (both formed and cast), and purchased parts. It considers both design and manufacturing information.

Instead of having say a greater number of part families if you have a smaller number of part families, your system performance will be better, and it becomes a simpler system.

The number of machine cells is less than substantially less than the number of part families. By using the mixed coding if you can reduce the number of part families, you need to deal with lesser number of machine cell and if you deal with lesser number of machine cells, the flow time will be substantially reduced.

And if the flow time is substantially reduced. You may observe that two major advantages – one is the flow time it will be less means, the inventory turnover will be more and the second one is WIP inventory work in process inventory is substantially reduced and it is expected that the flow pattern the quality of flow pattern will improve

The Opitz and classification and coding system: the first advantage is non-proprietary; you can adopt it or you do not need to get a formal permission from one particular organization.

It consider various types of features or the aspects of manufacturing system, but if you want to adopt this system, this particular classification and coding system, it become easier for you to understand and it is widely used,

It provides a basic framework for understanding the classification and coding process not only you start using this particular scheme, but you need to have thorough knowledge about the coding, or the types of coding and the classification the schemes.

The manufacturing system has been defined from not only from one perspective, but a number of perspectives.

It provides a basic framework for understanding the classification and coding process. It can be applied to machine parts where the machining is involved. Non machine parts both formed and cast products and the purchase parts. It considers both design and manufacturing information that is why it is a mixed code.

Opitz system was developed at the technical university of Aachen, is very well world-renowned university, technical university of Aachen in Germany under the auspices of the German machine tool association way back in 1959, it was introduced.

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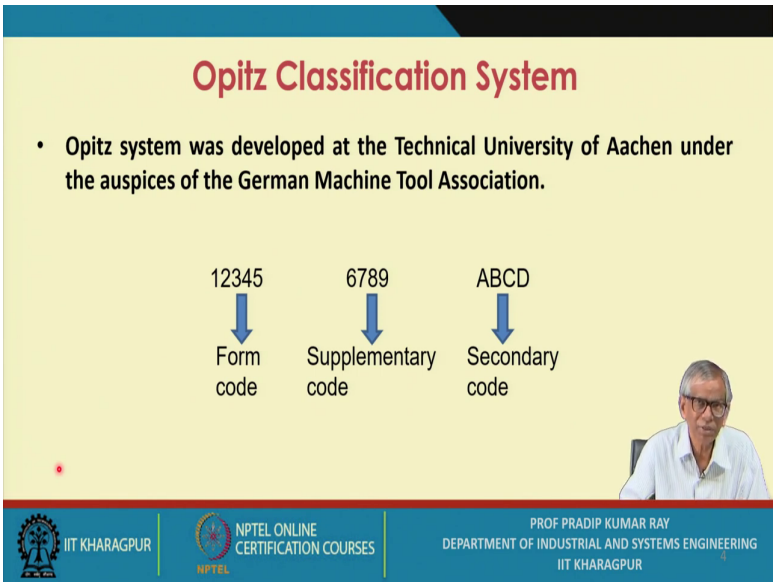

The Opitz system was developed at the Technical University of Aachen under the auspices of the German Machine Tool Association.

It is divided into form code, supplementary code and secondary code. This form code is a 5-digit code 12345; supplementary code is a 6-digit 4-digit code, 6789 and this is and both are basically numeric, Whereas, the secondary code basically related to the production related features. So, those are basically alphabetic, essentially it is an alpha numeric code.

Form code first the five digits are used to define the design characteristics, the form code could be a monocode or hierarchical code. Design related information we will include under form code.

Supplementary code includes manufacturing features related information, and in the secondary code, it is basically alphabetic one, you include production related information like volume productions, the capacity, then you can specify a particular machine tool with its specific features.

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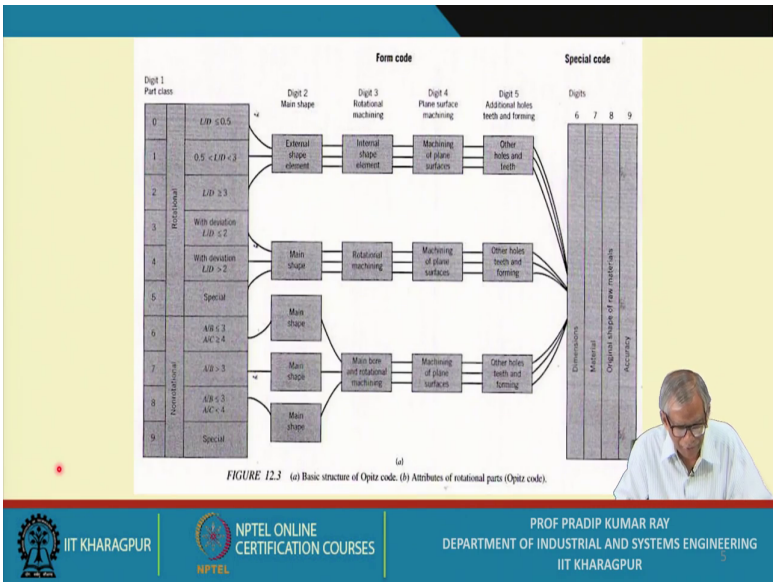

This is the basic structure. This part here, digit 1, digit 2, digit 3, digit 4, digit 5 and digit 6. The digit 5 now these are L/D, L/D means essentially if it is 0; L/D means dimensional envelope. This is basically for both of rotational parts, for the rotational part it will be L/D

and for the non-rotational prismatic part it will be , length/width or they use a notation A, B. So, this is the first part.

The next part is here digit 2 the main shape external shape, both external shape is defined as well as the internal shape. They have further classified this is the main shape and this is for the rotational machining, this is for the main bore trivial machining, the machining part has also been properly classified.

Then next one is basically plane surface machining. This is a rotational machining, this is the plane surface machining, this is additional holes, teeth and turning.

Absolutely at the minute level are the micro level. The kinds of manufacturing system they are dealing with, varieties of parts they produce varieties thousands of parts you need to produce is a typical automobile plant. Or aircraft manufacturing, many kinds of the military aircraft when you design, it is the bill of material it may consist of say 50 to 60000s of parts, 1 unit and varieties of parts like metallic, non-metallic vary various kinds of shapes and sizes.

A greater number of the shops or a greater number of manufacturing system means a greater number of parts. So, if you adopt this particular system you may find that the initially m sorts of attributes are not required, but later on you go for it.

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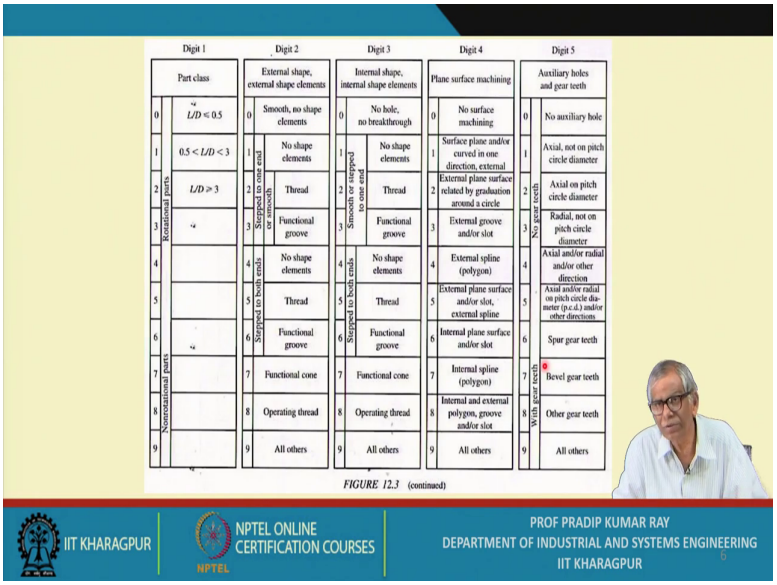

FIGURE 12.3 (continued)

Initially you start with say one or few objects or the parts and later on you try to add greater number of parts and objects. This is 5 digits. This all details are here now part class external shape elements, these are consolidated, digit 3 internal shape digit 4 is plane surface machining, and the digit 5 is auxiliary holes and gear teeth.

Further classification is there.

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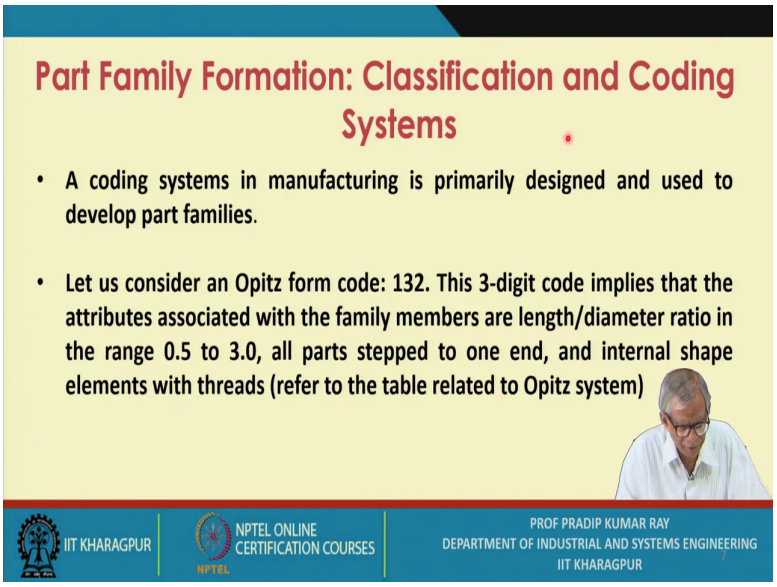

The basic objective is to part family formation. In the part family formation, these classification and coding system is to be used. A coding system in manufacturing is primarily designed and used to develop part families.

Let us consider an Opitz form code 132. This 3-digit code implies that the attributes associated with the family members, a length by diameter ratio or the dimensional envelope in the range 0.5 to 3, all parts stepped in one end and the internal shape elements with threats; both internal elements as well external elements you need to consider, related to the Opitz system.

we can refer back to this one 132, 132 – 1, then this is 1, Then you have 3; this one and next one is 2, first one is 0 to 9, maximum the number of the classes in each the design feature are grouped under 10 categories.

As of now you are just using up to the second one 3 types, but you never know when the product makes the gets changed. you may find that initially for the first 5 year you have been working after 2 and the next 2 years you have to include some new parts with the different designs and there and they fit tough a particular dimensional envelop if it is under 3 under 4.

In course of time what is expected as the product mix changes so, is an increasing product mix, within say 10 years or within 5 years you cover the entire space, like here the external shape is concerned. There are 10 digits and all the digits you have been using, as far as external shape is concerned there are lots of varieties.

Whereas, for the part clause, as far as the dimensional envelope is concerned there is not much variety. By looking at this you can conclude when you design, this is through empirical research only they have done, whether this particular scheme fits to your part mix or not.

Similarly, the internal shape all you could define, say if it is 7, it is a functional cone and this is operating thread, this way you have to classify.

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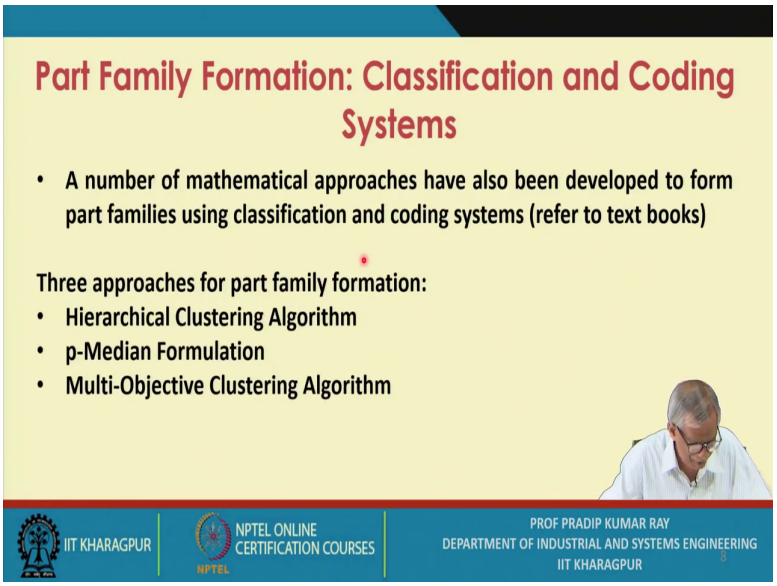

Now we will be referring to certain mathematical model or mathematical approaches.

A number of mathematical approaches have also been developed to form part families using classification and coding schemes. Please refer to the textbooks.

The three approaches for part family formation – one is hierarchical clustering algorithm; hierarchical clustering algorithm, the second one that is called p-Median formulation and third is multi objective clustering algorithm.

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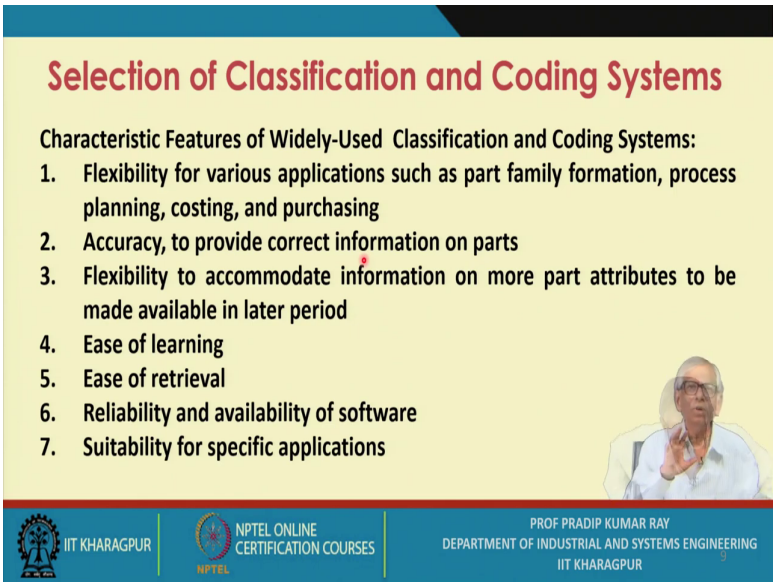

Some of the important classification and coding system attributes: Flexibility for various applications such as part family formation, process planning, costing, and purchasing. Accuracy, to provide correct information on parts. Expendability, to accommodate information on more part attributes deemed important later on. Ease of learning. Ease of retrieval. Reliability and availability of software. Suitability for specific applications.

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The benefits of group technology are mentioned as follow:

Engineering Design, Layout Planning, Specification of equipment, tools, jigs, and fixtures, Manufacturing: Process Planning, Manufacturing: Production Control, Manufacturing: Quality Control, Purchasing, Customer Service.

Engineering design is the first one, when you look at those drawings you may find that you have manufacturing experience.

When you refer to such coding or part family formation, you will have a very good idea about what kind of relationships you have between design and manufacturing, to what extend the design is creating problem for manufacturing.

The quality of engineering design will improve, and no design is perfect, there is always the scope for improvement.

The 2nd one is the layout planning. Ultimately by application of the group technology principles you have to convert your manufacturing system from the existing one where existing could be the pure product layout or pure functional layout or the process lay out.

You will get the advantages of both. you must know what are the positive features. These are two pure layouts, when you combine them, both are made available with the minimum number of disadvantages or the demerits.

It will help you in creating a layout of fitting to say cellular manufacturing system, and later on you will find that this cellular manufacturing system you want to create you go one step ahead in developing the flexible manufacturing system or flexible production system.

Specification of equipment tools jigs and fixtures because when you try to classify, you refer to the process plan, later on when we discuss the process plan you will come to know ins and outs of all this otherwise know you cannot propose a comprehensive process plan.

Manufacturing process planning or Manufacturing production control first is the planning, next is the production and production means definitely fabrication plus the stage wise inspection. Why you go for stage wise inspection? Because, that ensures the controlling of the production system.

The production control, manufacturing quality control will help for purchasing, coding scheme is required. Manufacturing standard product is very complex.

When you make the product a standard one, there are many advantages.

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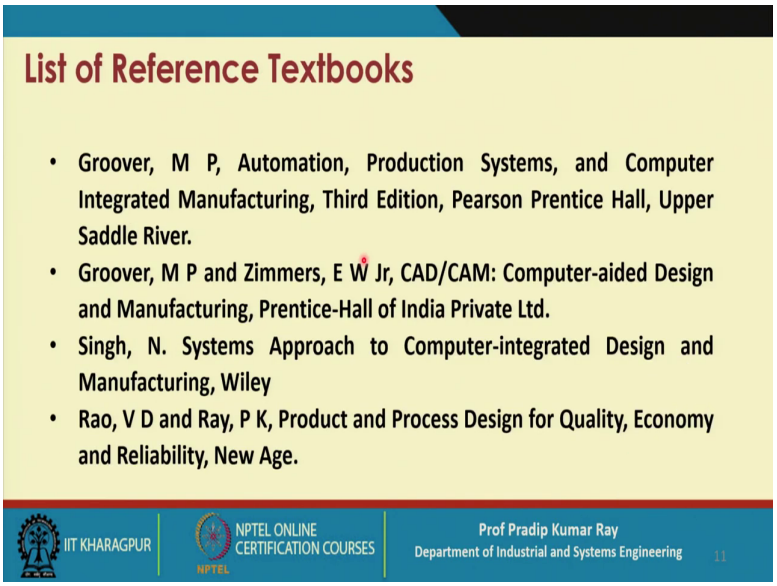

And, in the next the lecture sessions, we are a going to discuss a number of the part family formation technique.