Ergonomics for Beginners Industrial Design Perspective

Prof. D. Chakrabarti

Department of Design

Indian Institute of Technology, Guwahati

Module No. # 05

Behaviour and Perception

Lecture No. # 27

Human Error and Risk Perception

Welcome to this twenty seventh session of ergonomics for beginners – industrial design perspective.

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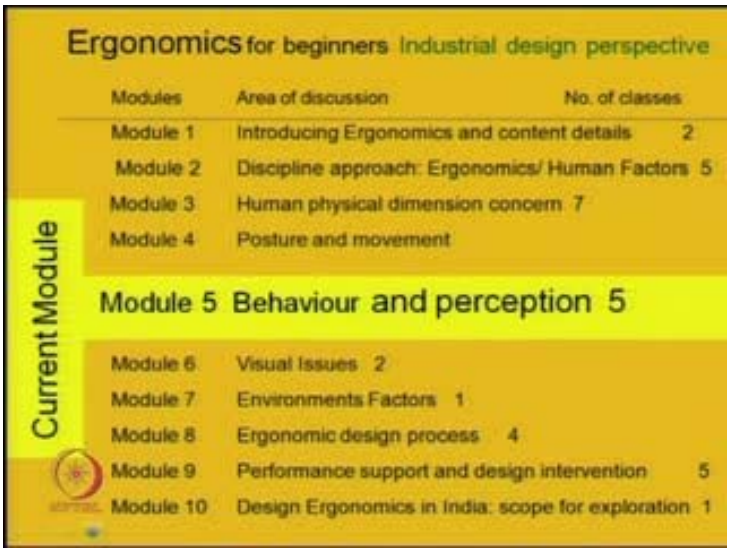

Within this module number 5 that behaviour and perception.

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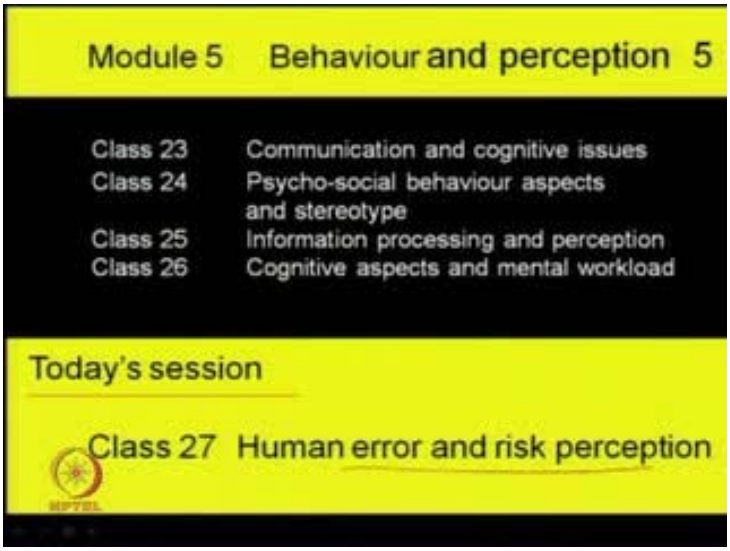

Today, the last session of this module; that is, class number 27 – human error and risk perception.

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Whatever we have discussed in last class on cognitive aspects and mental workload, there we have discussed the design features must confirm the positiveness to motivate to use and appreciate the design; in the consciousness, attention and alertness, their relationships and special attention to that; begins detection easiness of encoded

information in design that facilitates decision making; issues relevant to trust building; figure-ground segregation means how we detect an object in a larger background.

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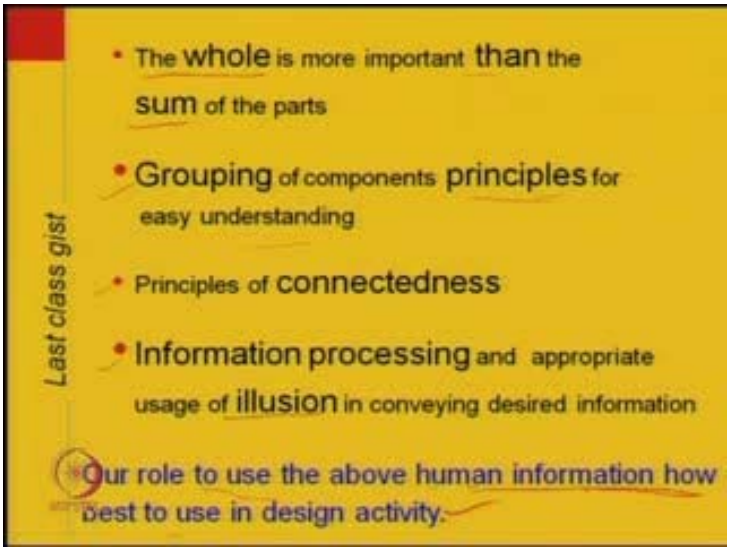

We also mentioned that the whole is more important than the sum of the parts – means design would appear with a holistic functional and trustworthy appearance. Grouping of components principles for easy understanding; principles of connectedness; information processing and appropriate usage of illusion in conveying desired information – we have discussed this. And, finally, we mentioned that our role to use the above human information how best to use in design activity. So, this is our main importance area or aspects to look into.

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With this, today's session within this cognitive ergonomics area; that is, class number 27 – human error and risk perception. Specifically, we will discuss the relevant issues in this. Relevant issues means some principles, some aspects that are necessary while considering any design idea.

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The optimisation of safety features and psychophysical space requirement and feeling, and thereby adding efficiency and reliability – this is the most important. Now, in this session, we will discuss some of the issues that is very relevant to design practice.

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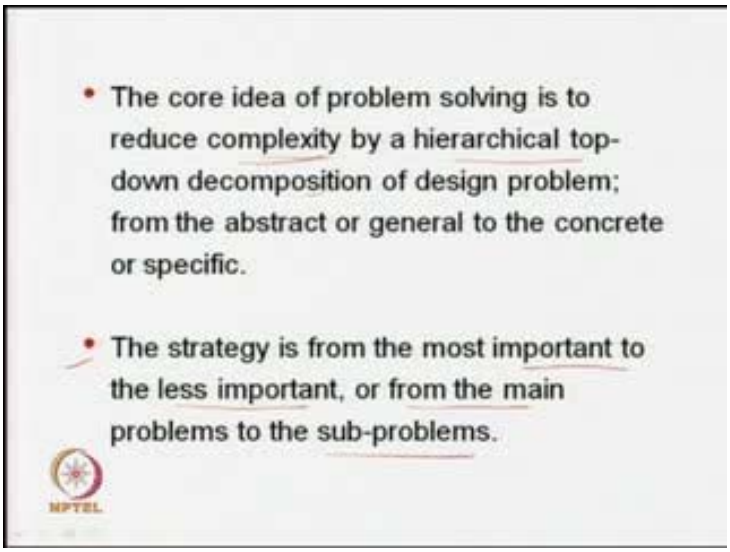

Now, the core idea of problem solving is to reduce complexity by a hierarchical top-down decomposition of design problem from the abstract or general to the concrete or specific. The strategy is from the most important to the less important or from the main problems to the sub-problems; that we need to follow.

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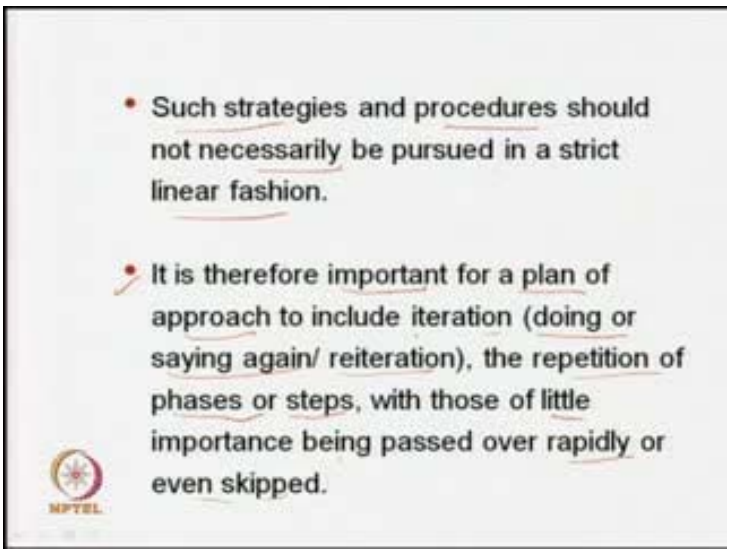

Such strategies and procedures should not necessarily be pursued in a strict linear fashion. That also must be remembered when we decide on some design elements and their linkages. It is therefore, important for a plan of approach to include iteration, that is,

doing or saying again/ reiteration, the repetition of phases or steps, with those of little importance being passed over rapidly or even skipped.

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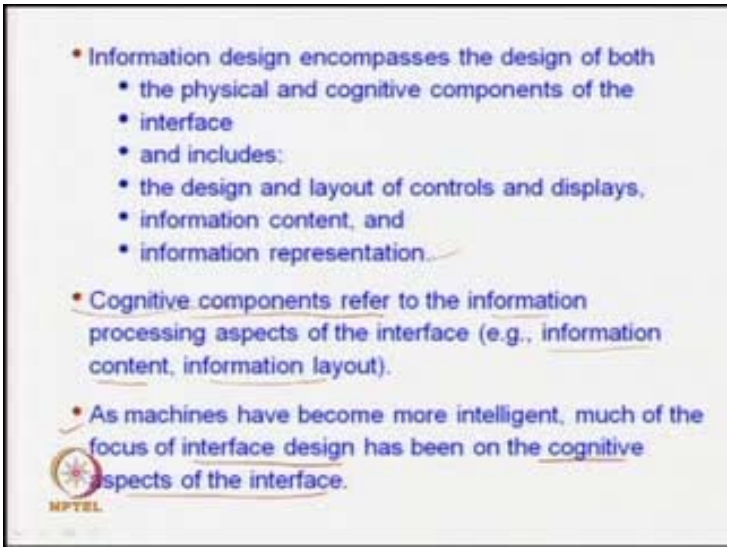

Now, if we consider all these aspects, then how the information design encompasses? The information design encompasses the design of both, that is, the physical and cognitive components of the interface. And, it includes the design and layout of controls and displays, information content, and information representation.

Now the cognitive components refer to the information processing aspects of the interface; as for example, it can be said that information content and information layout. As machines have become more intelligent, much of the focus of interface design has been on the cognitive aspects of the interface – means the operator or the user, whatever input they are giving to that equipment or the machine how machine acts on that intelligently and gives a feedback to the person? And, that cycle if it continues in a harmonious way, then the task will be performed nicely and the interface between the human capabilities and the machine forms a good match.

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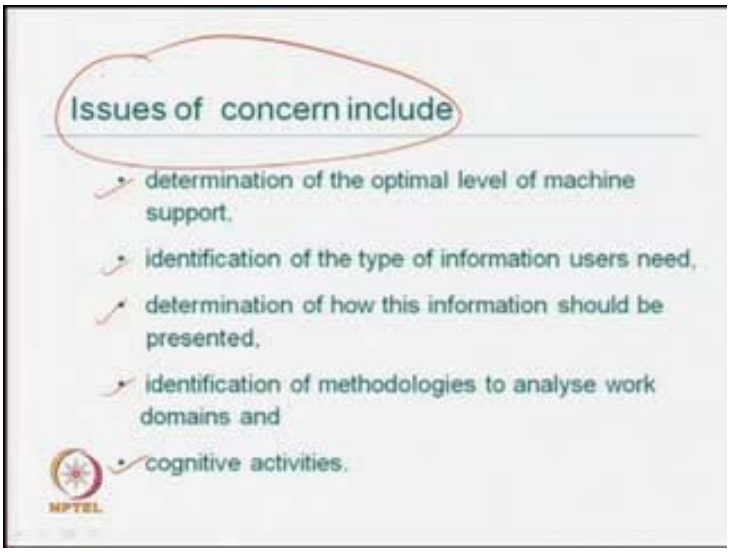

Issues of concern – in this aspect, there are some issues that concern these. It includes that determination of the optimal level of machine support – how much in a task machine should give support? Identification of the type of information users need to operate upon that – how much information users need? Determination of how this information should be presented, so that it is easier to understand. Identification of methodologies to analyse work domains and the cognitive activities. So, these are the issues that really concern a design decision.

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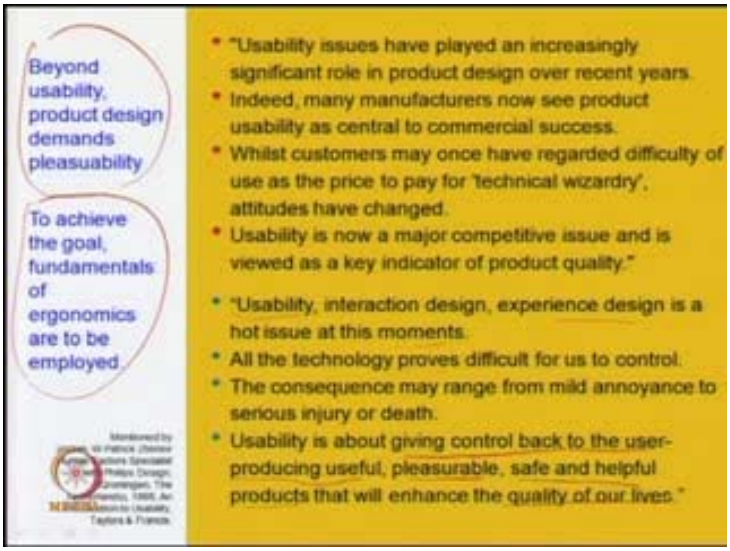

Now, it is said that today's design practice – beyond usability, product design demands pleasurability. And also, to achieve this goal, fundamentals of ergonomics are to be employed. Now, what are the fundamentals and what are the links with usability aspects? Let us see this. The usability issues have played an increasingly significant role in product design over recent years. Indeed, many manufacturers now see product usability as central to commercial successes. Whilst customers may once have regarded difficulty of use as the price to pay for technical wizardry, attitudes have changed. Usability is now a major competitive issue and is viewed as a key indicator of product quality. Again, it can be said that usability, interaction design, experience design is a hot issue at this moment. All the technology proves difficult for us to control. The consequence may range from mild annoyance to serious injury or even death. Usability aspect is about giving control back to the user producing useful, pleasurable, safe and helpful products that will enhance the quality of our lives. So, these are the basic assumptions of usability.

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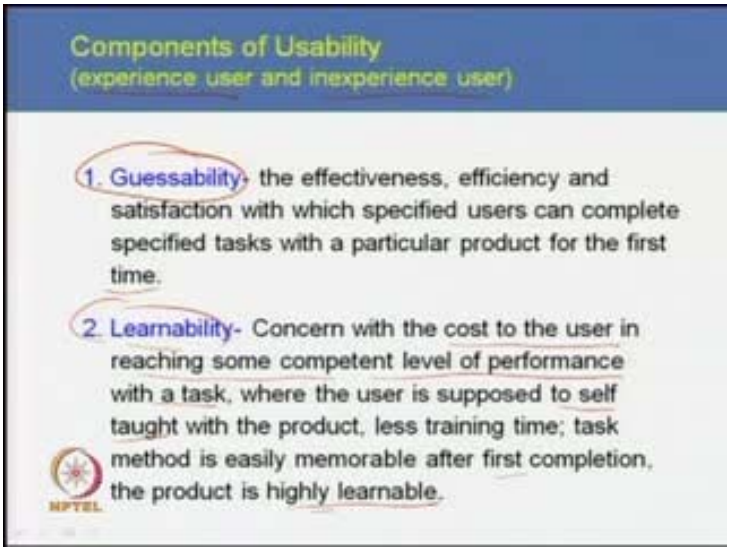

Now, what are the components of usability? When you talk about usability, the components are – that is, that experience user and inexperience user. So, when a product is encountered by an experience user and an inexperience user, the interaction is not the same. So, there are some specific terms, which are used while discussing these aspects. These are likely guessability. Guessability is that the effectiveness, efficiency and satisfaction with which specified users can complete specified tasks with a particular product for the first time. This is the guessability.

Now, what is learnability? Learnability issues are that learnability concern with the cost of the user in reaching some competent level of performance with a task, where the user is supposed to be self-taught with the product, less training time; the task method is easily memorable after first completion; the product is highly learnable. It is considered. So, guessability and learnability are some issues that we need to keep in our mind.

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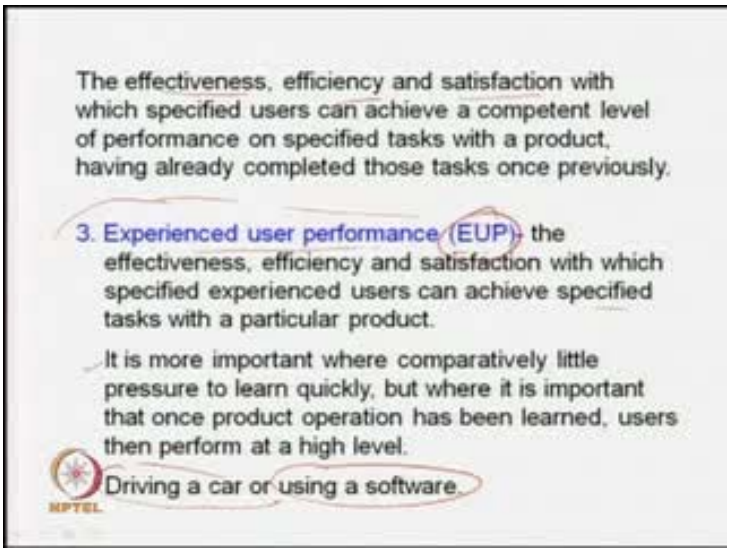

The effectiveness, efficiency and satisfaction with which specified users can achieve a competent level of performance on specified tasks with a product, having already completed those tasks once previously.

Now, the third point is that the experienced user performance, that is, EUP (experienced users performance) – the effectiveness, efficiency and satisfaction with which specified experienced users can achieve specified tasks with a particular product. It is more important where comparatively little pressure to learn quickly, but where it is important that once product operation has been learned, users then perform at a higher level. So, these issues are the experienced user performance level. As for example, it can be said that driving a car or using a software; driving a car day by day or when your used frequency is increased, gradually, your learning gets perfection. So, similarly, while using a software also. What are the issues, what are the aspects that give you these facilities; with regular use, how we can reduce this relearning time?

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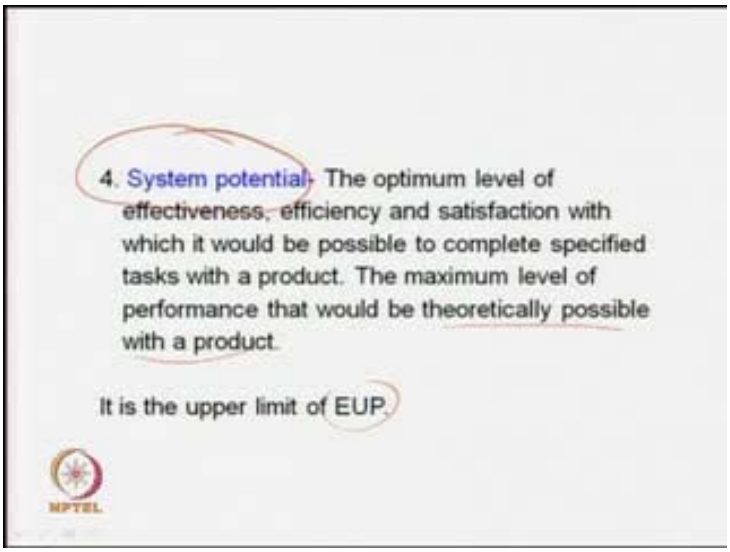

Number 4 is the system potential. What the system potential means? The optimum level of effectiveness, efficiency and satisfaction with which it would be possible to complete specified tasks with a product or a system; the maximum level of performance that would be theoretically possible with a product. This is the system potential. It is the upper limit of EUP, that is, experienced user performance.

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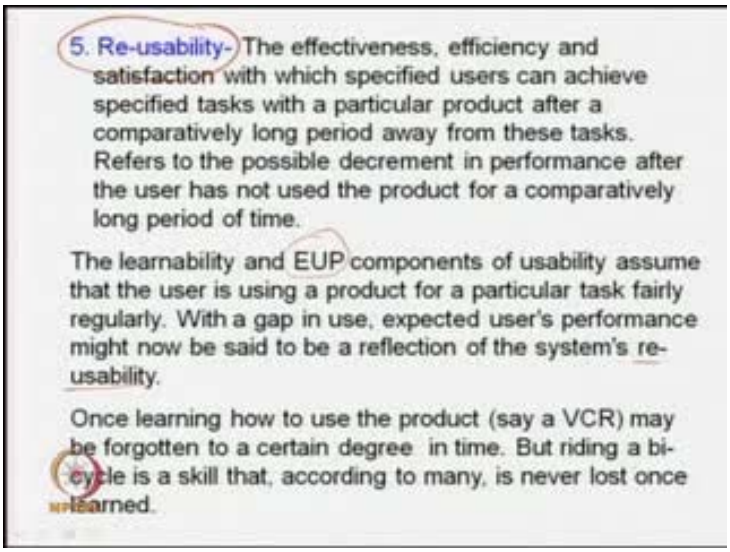

Now, what is re-usability? Re-usability is that the effectiveness, efficiency and satisfaction with which specified users can achieve specified tasks with a particular

product after a comparatively long period away from these tasks. It refers to the possible decrement in performance after the user has not used the product for a comparatively long period of time. What would be the design features that can give me cues, so that after a long time not using that product, still I can relearn how to use that thing? So, what are the specific elements that can give me these facilities? If we can apply it properly, then the design would be highly accepted; means once I learnt it, after certain period of not using, again, I can use it with full confidence.

The learnability and experienced user performance components of usability assume that the user is using a product for a particular task fairly regularly. With a gap in use, expected user's performance might now be said to be a reflection of the system's re-usability. Once learning, how to use the product say as for example, a VCR? All the switches, indicators and etcetera may be forgotten to a certain degree in time. But, riding a bicycle is a skill that according to many, is never lost once learned. So, some of the issues that physical we learnt that people may retain for longer time. But, where the some learning itself is difficult to retain that learning in mind is also difficult. So, how we can nicely use these aspects in design, so that this relearning would be easier? Then only, the product will be highly accepted; it will be pleasurable then to use it.

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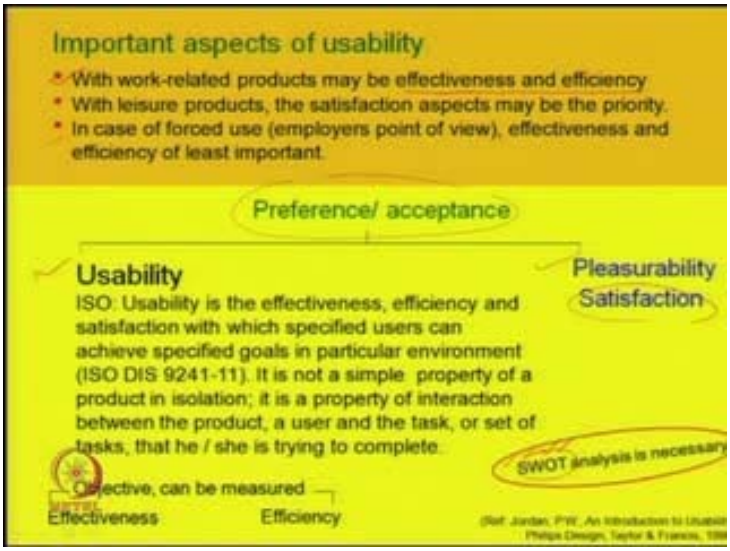

Now, the important aspects of usability; now, usability also differs if it is a work-related product or a leisure-related product. Like with work-related products, it may be

effectiveness and efficiency. With leisure products, the satisfaction aspects may be the priority. In case of forced use with compulsion like employers point of view, effectiveness and efficiency of least important – means there is compulsion you have to use work on that context; you have to use that design. So, there the system effectiveness and efficiency is least important, because the view point is from employers. But, as an employee point of view or users point of view, if it is a work-related product, effectiveness and efficiency should get priority.

Now, the preference and acceptance of a design – it depends on usability and pleasurability, that is, the satisfaction issues. Now, if we see the usability as a definition kind of thing or as an explanation, we can say by ISO, the usability is the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environment. The document is ISO DIS 9241-11. It is not a simple property of a product in isolation; it is a property of interaction between the product, a user and the task, or set of tasks that he or she is trying to complete. The main objective of the usability can be measured as effectiveness and efficiency. That we will discuss in the next slides. Now, while doing these things, that SWOT analysis is also necessary; that is, if there is a product, while taking any concept of that, the strength, weakness, opportunity and threat – these issues are to be analysed on that thing and then make a design decision.

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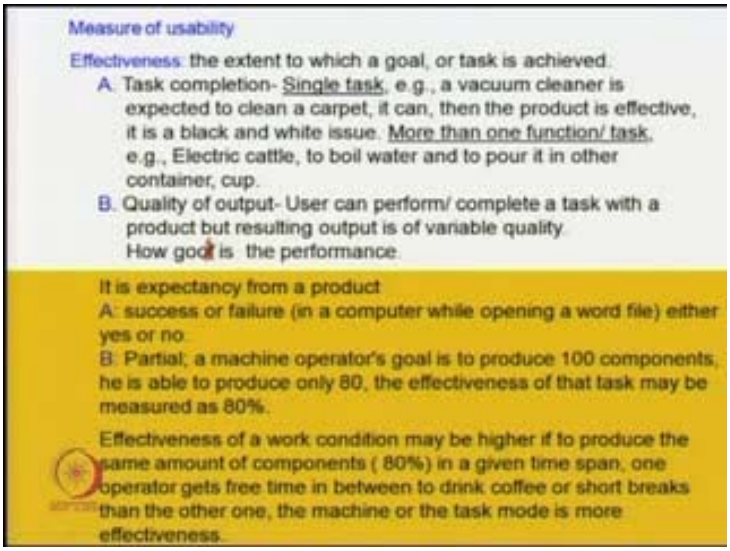

Now, when we are talking the measure of usability, that is, the effectiveness and efficiency, now, let us see what the effectiveness is. The effectiveness is the extent to which a goal or task is achieved. This is the effectiveness. Now, if we see A, the task completion point of view, the single task as for example, a vacuum cleaner is expected to clean a carpet it can, then the product is effective. It is a black and white issue. More than one function or task, as for example, electric kettle to boil water and to pour it in other container and cup. So, this is a task completion type of effectiveness single task in more than one task per function.

Now, B – the quality of output – user can perform or complete a task with a product, but resulting output is of variable quality. How good is the performance? It is expectancy from a product A – the success or failure type in a computer while opening a word file, either you can open it or it can fail it; either yes or no. That type of effectiveness. B, that is, partial – a machine operator's goal is to produce 100 components. He is able to produce only 80 pieces. The effectiveness of that task may be measured as 80 percent. Effectiveness of a work condition may be higher if to produce the same amount of components, that is, 80 percent of the productions in a given time span, one operator gets free time in between to drink coffee or short breaks than the other operator, the machine or the task mode is more effectiveness – means effectiveness of a machine; it depends on the skill of its operator also.

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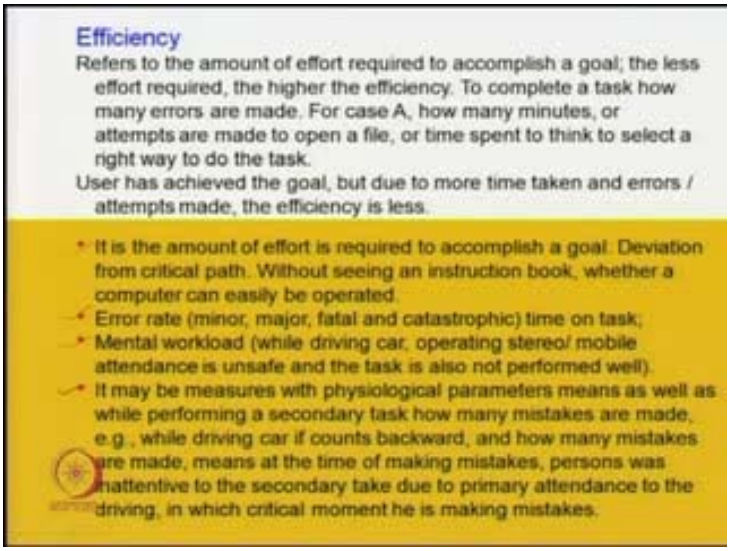

Now, the efficiency – efficiency refers to the amount of effort required to accomplish a goal; the less effort required, the higher is the efficiency. To complete a task, how many errors are made? For case A, how many minutes or attempts are made to open a file in a computer or time spent to think to select a right way to do the task? User has achieved the goal, but due to more time taken and errors and attempts made, the efficiency is less. So, these are the issues of usability.

Efficiency is the amount of effort, is required to accomplish a goal; deviation from critical path. Without seeing an instruction book, whether a computer can easily be operated? What features we need to keep there, so that with earlier experience or with intuition or with some specific trial and errors it can be performed? Then, the error rate – minor, major, fatal and catastrophic; the error rate, that is, time on task; then, mental workload – like while driving a car operating a stereo or a mobile attendance is unsafe and the task is also not performed well. That type of mental workload. It may be measures with physiological parameters means as well as while performing a secondary task how many mistakes are made. As for example, while driving a car, if counts backward, and how many mistakes are made – means at the time of making mistakes, persons were inattentive to the secondary take due to primary attendance to the driving, in which critical moment he is making mistakes. So, these issues are the efficiency of a design or a system.

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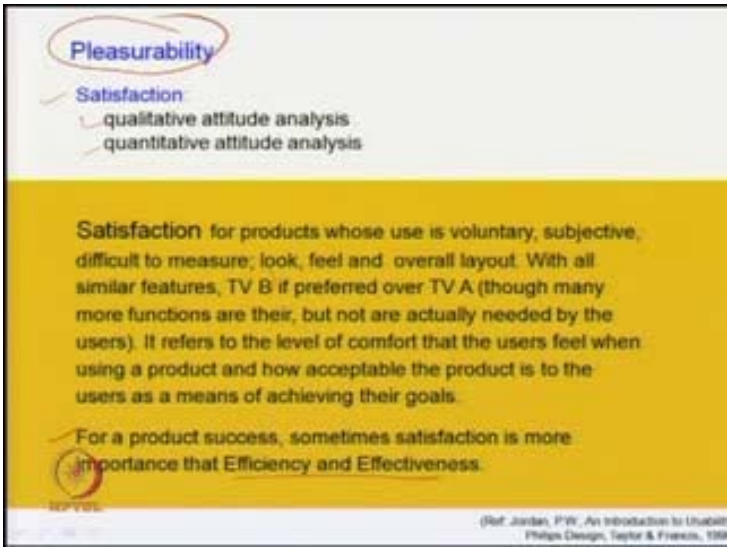

Now, the pleasurability – the pleasurability aspect that is based on satisfaction; and, that satisfaction is qualitative attitude analysis and quantitative attitude analysis. Now, the satisfaction for a product whose use is voluntary, subjective, difficult to measure; look, feel and overall layout – these are the satisfaction issues. With all similar features, as for example, it can be said a television set B if preferred over another television A though many more features are there in A than B, but not are actually needed by the users; then, which one people normally prefer? In that case, with unnecessary features that people do not require or use, then people may not need those. In that case, the television B will be preferred over television A. It refers to the level of comfort that the users feel when using a product and how acceptable the product is to the users as a means of achieving their goals. For a product success, sometimes satisfaction is more important than efficiency and effectiveness, because now, the design is not only for work purpose or leisure purpose; we cannot separate like that way. Now, the design is a pleasurable issue; it should perform that work-related things as well as comfort that a person requires in leisure time.

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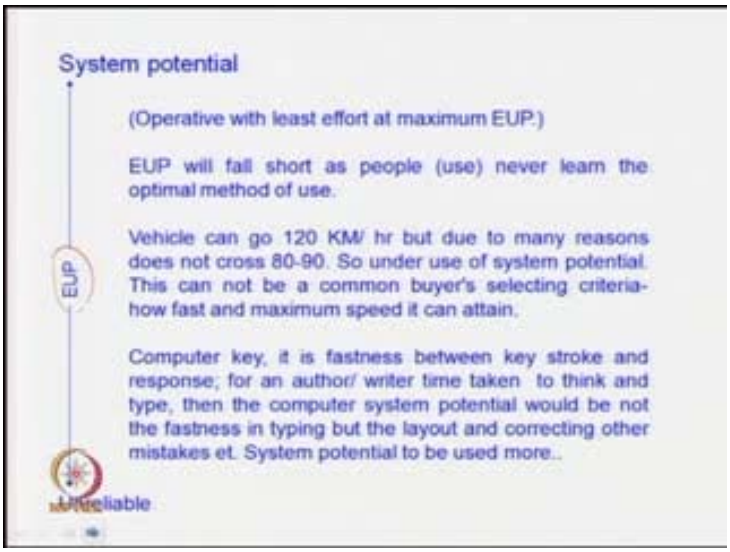

Now the system potential and then experienced user performance, and then unreliability; that issues. In this, we can say that the system potential is operative with least effort at maximum EUP. Experienced user performance (EUP) will fall short as people, the user never learn the optimal method of use. As for example, vehicle can go 120 kilometer per hour, but due to many reasons does not cross 80-90 kilometer per hour speed limit. So,

under use of system potential in this case, this cannot be a common buyer's selecting criteria – how fast and maximum speed it can attain. If a vehicle comes with very higher speed, but normally, you do not require that. So, that higher speed limit is not a selling point for that car; here some other issues are coming. So, the system potential – how much we are using or capable of using; that is the issue. Like computer key, it is fastness between key stroke and the response. For an author or a writer, time taken to think and type, then the computer system potential would not be the fastness in typing, but the layout and correcting other mistakes, etcetera; that is, the system potential to be used more.

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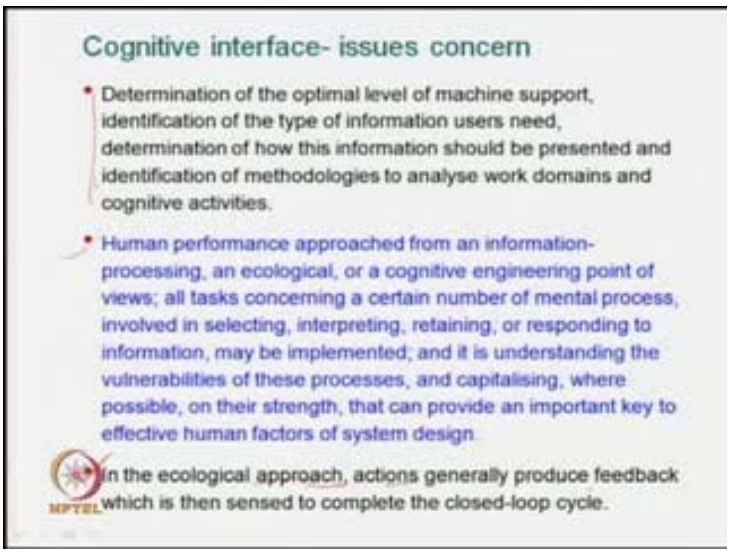

Now, cognitive interface – issues concern – the determination of the optimal level of machine support; identification of the type of information users need; determination of how this information should be presented; and, identification of methodologies to analyse work domains and cognitive activities.

Another issue is that human performance approached from an information-processing, an ecological or a cognitive engineering point of views. All tasks concerning a certain number of mental process involved in selecting, interpreting, retaining, or responding to information may be implemented; and, it is understanding the vulnerabilities of these processes and capitalizing, where possible on their strength that can provide an important

key to effective human factors of system design. In the ecological approach, actions generally produce feedback, which is then sensed to complete the closed-loop cycle.

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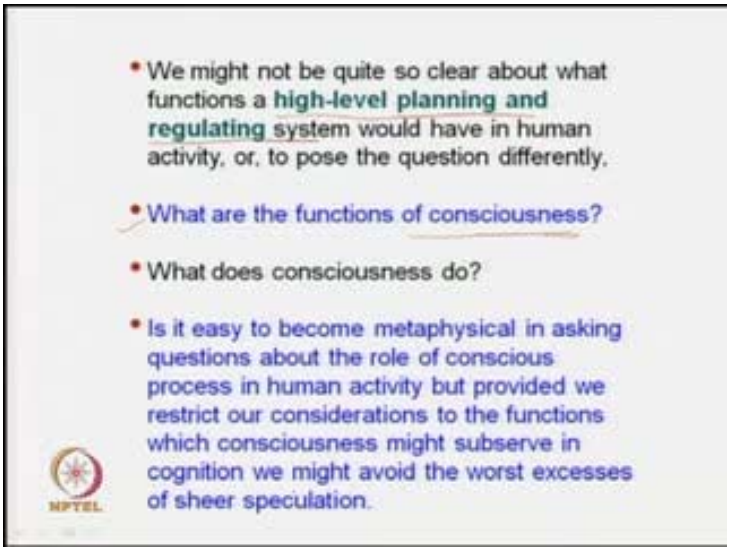

We might not be quite so clear about what functions a high-level planning and regulating system would have in human activity or to pose the question differently. What are the functions of consciousness? That we need to answer; we need to think. What does consciousness do? It is easy to become metaphysical in asking questions about the role of conscious process in human activity, but provided we restrict our considerations to the functions which consciousness might subserve; in cognition, we might avoid the worst excesses of sheer speculation.

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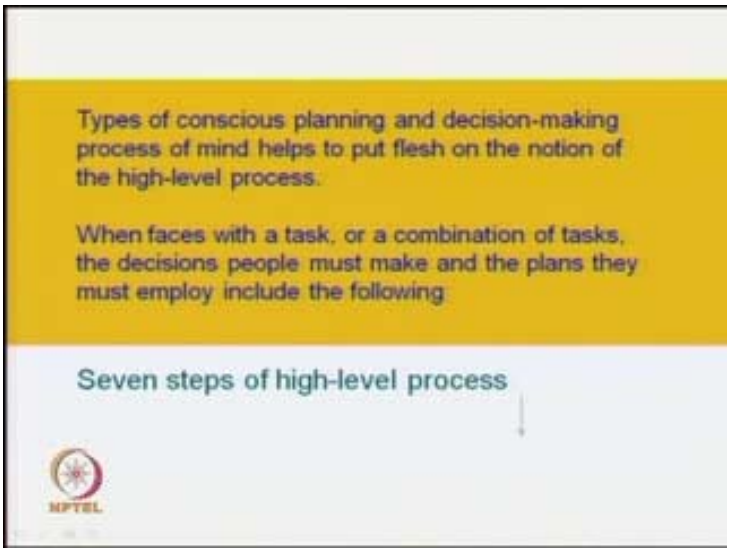

Types of conscious planning and decision-making process of mind helps us to put flesh on the notion of the high-level process. When faces with a task, or a combination of tasks, the decisions people must make and the plans they must employ include the following seven steps. And, these are seven steps of high-level processes.

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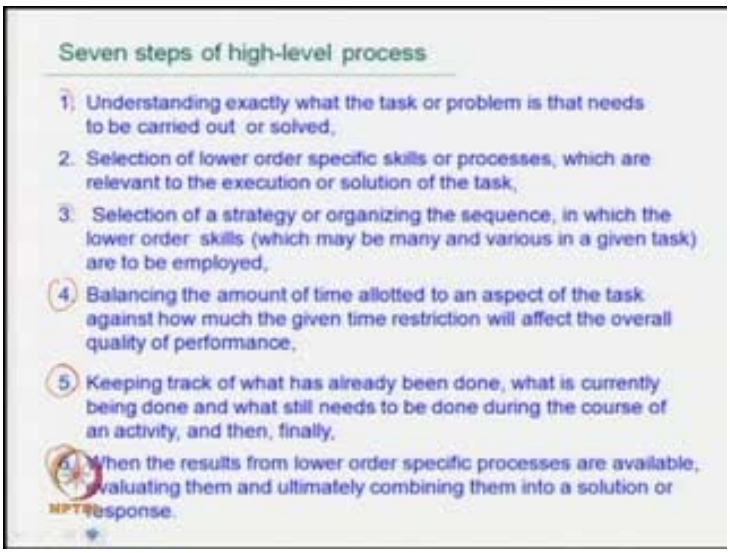

Now, the seven-level processes; here thing is that number 1 – understanding exactly what the task or problem is that needs to be carried out or solved. Number 2 – selection of lower order specific skills or processes, which are relevant to the execution or solution

to the task. Number 3 – selection of a strategy or organizing the sequence, in which the lower order skills, which may be many and various in a given task, are to be employed. Number 4 – balancing the amount of time allotted to an aspect of the task against how much the given time restriction will affect the overall quality of performance. Number 5 – keeping track of what has already been done, what is currently being done and what still needs to be done during the course of an activity. And then, finally, number 6 – when the results from lower order specific processes are available, evaluating them and ultimately combining them into a solution or response.

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So, there is a hierarchy of levels of control; that is, the conditioning like Pavlovian conditioning, conditioned stimulus and unconditioned stimulus. So, I think we know the Pavlovian conditions – that if a performance is done in a specific time or it is associated with a specific function or specific thing, when it reappears in advance, then the need to perform the task it appears. That is the Pavlovian conditions.

Now, the universal law of learning – seeing, judging and retaining; automatic stimuli response links need to consider. Like for an example, influence of alcohol, etcetera, on learning, shadowing, hallucination, etcetera – means when we are learning the things. Memory decay is the main cause of forgetting. Normally, it is said that while people forget things when age grows, the physiological reason it may be that some grey cells are

dying; and so, something is missing; some portion is missing. Another that is, memory decay.

Then, the attitude to learn the things – the harmony, homogeneousness and heterogeneousness; those things. So, some things presented homogeneously; we may feel it in one way. If there is any problem or deflection, then it draws our attention. If it is heterogeneous, all are different; then, how to make equality with them? And finally, the family resemblance – this family resemblance gives a specific input. So, these are the hierarchy of levels of controls. Just for one example, we can say here a person here is sitting on an indefinite protest fast; but, before that, a person is selling some good food. So, the smell and etcetera is disturbing him probably. So, it is said that cannot you find some other place to sell your delicious preparation my dear man; means the context, the need and the presentation should have some link for a certain purpose. If these things are achieved in a design, it will be successful.

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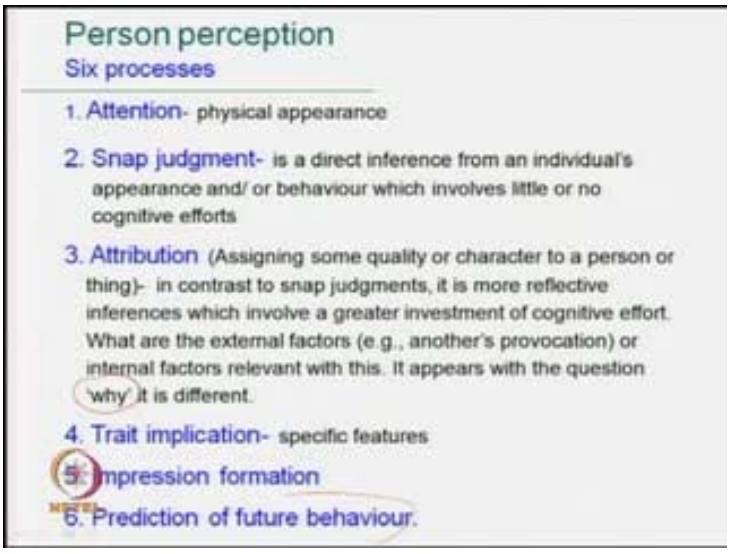

Now, the person perception – here the six processes are there. Six processes will be the attention, that is, physical appearance. Second is the snap judgment – is a direct inference from an individual's appearance and/or behaviour which involves little or no cognitive efforts. Number 3 – the attribution like assigning some qualities or character to a person or thing in contrast to snap judgments; it is more reflective inferences, which involve a greater investment of cognitive effort. What are the external factors – as for example,

another's provocation or internal factors relevant with this. It appears with the question why it is different.

The trait implication – that is the specific features; impression formation and prediction of future behaviour or to attain next level. So, with this, whatever we discussed till now, these are some issues and concerns of cognitive issue aspects that if we apply in a design, it will be successful. So, we have to understand these things. So, when we are making a design for a certain group, what are their cognitive levels, whether my design will succeed there; or, the need and my design; whatever I am trying to put as messages in that design features, whether those people can recognize and can act upon that? All these things are necessary to understand and practice. So, these things…

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Now, with this, our role is to use the above human information how best to use in design activity.

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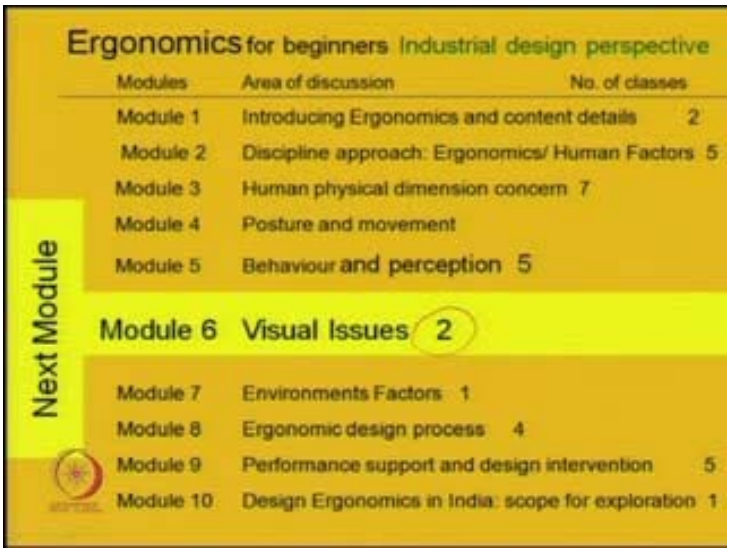

So, with this, we are concluding today's session. Today's session we are concluding; and, the module number 5 – the behaviour and perception. Some direct design application issues – we will discuss in the next sessions. So, in the coming day, the next module is module number 6, that is, visual issues in ergonomic design practice; with two classes, we will cover these aspects. So, till then, thank you very much. So, we will meet next time.

Thank you.