Ergonomics for beginners Industrial design Perspective

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Module No. # 02

Discipline approach: Ergonomics / Human Factors

Lecture No. # 05

Mutual Task Comfort: Two way dialogue, communication model

So, welcome to this fifth session of ergonomics for beginners, industrial design perspective. Now, out of these 10 modules, this is under module 2, that is, Discipline approach ergonomics and Human factors, there under total 5 classes, today is the class fifth. Here, the session in this module is, mutual task comfort, that is, two way dialogue and communication model.

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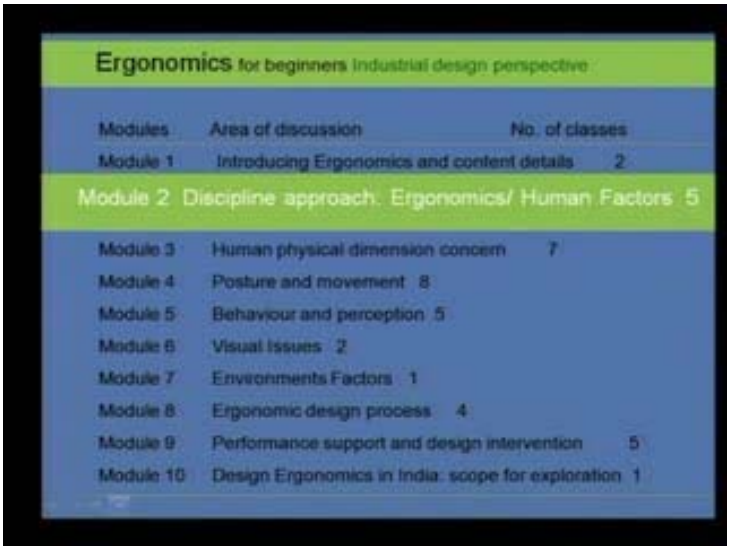

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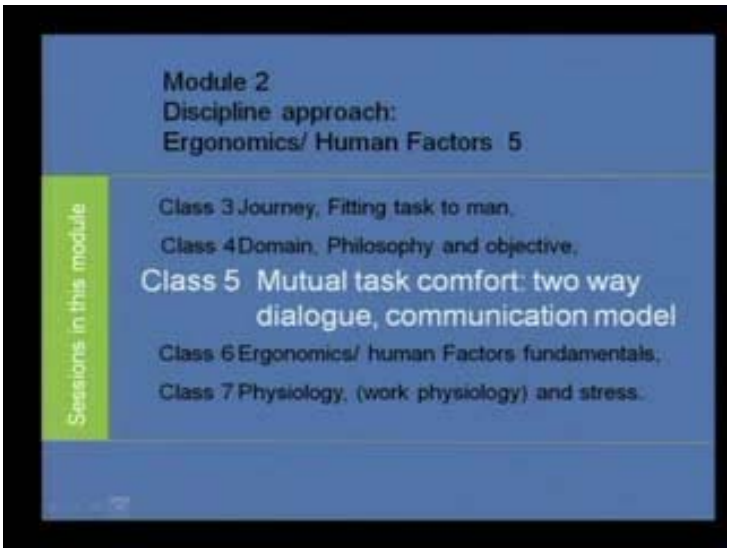

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Now, with this, the last class gist to recall what we have discussed in earlier class that ergonomics based development and marketing policies are well adopted in design, production process, safety and occupational health, and management issues that we have discussed. And ergonomics philosophy, it is based on two specific aspects, that is, fitting task to man, and the considerations accordingly, and better design for people and objectives to increase productivity, safety, and comfort for effective use.

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And also, we have discussed that ergonomic domains; human interfaces developed through hardware ergonomics, environmental ergonomics, cognitive ergonomics and macro ergonomics - that is with organizational issues. So, ergonomics domain and interface technology, here we can say that hardware ergonomics is for human machine interface, that is, physical match mostly. Environmental ergonomics is human environment interface; cognitive ergonomics, that is, human perception interface; macro ergonomics, that is, human organization interface that we have discussed in last class.

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Now, current session will be on mutual task comfort that two way dialogue communication model, with this will have few specific topics, that is, domains contribute to design development, Man- Machine systems shows control cycle of Sense- Decide- Act and feel Feedback, this system we will discuss today. Man- Machine system is a close cycle system, we will discuss through this communication model, product and System- User and context interface, and domains of specialization as per International Ergonomics Association specifications.

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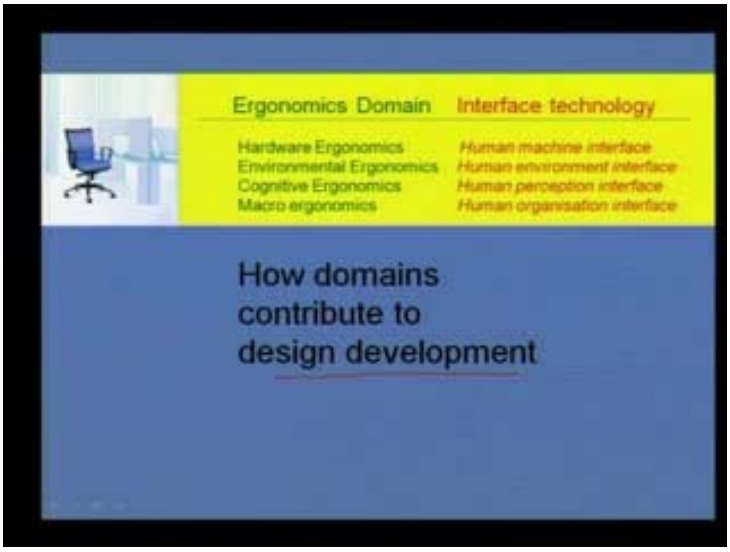

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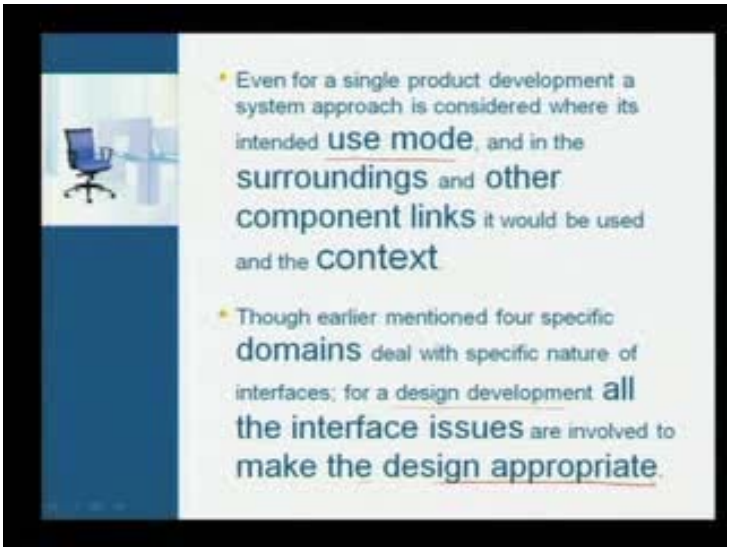

Now, what about four specific domains, hardware, environmental, cognitive and macro, but how these domains contribute to design development? That would be the basic input for today's discussion. Even for a single product development, a system approach is considered, where its intended use mode, and in the surroundings and other component links it would be used, and the context that need to be considered. Though earlier mentioned four specific domains deal with specific nature of interfaces; for a design development all the interface issues are involved to make the design appropriate. So, for the specific design development, we need to consider a system design approach, and all the ergonomics domains, the specialties are to be considered.

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Now, for a successful product or design, it has to satisfy the context, the content and the user's requirements. Nearly, every product we use, it is justified in asking exactly what it is, that is, through its form, appearance. The product should tell about its usefulness through its appearance, that is, form, shape, size, texture, color and overall appearance. It should tell about its usefulness to its intended user and what it does? That is the function. See, it must also tell that function, and finally the people will judge the product, with how it performs, that is, linking this two with human compatibility aspects.

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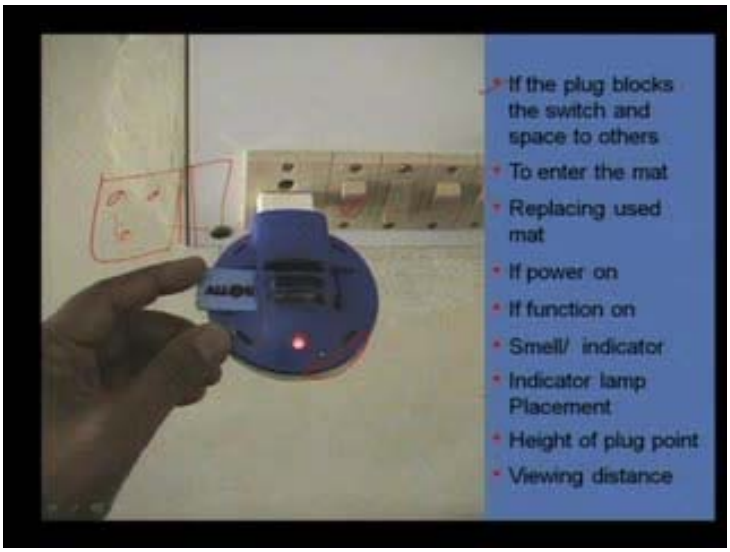

Now, with some examples, if we see how all this development, the ergonomics domains are used for a specific product development and new ideation over that. Now, see for an example, here we will discuss need to consider all the ergonomic domains, now this is a case, if mosquito refiller.

Now, what issues are coming here when we use this product? After seeing this, one thing comes, if the plug blocks the other switches or its own switch - space to others. If some other switches are here like this, then what is happen, for certain, if another we place it here, whether there will be enough space in between. So, to control that there is a specific bent is given, so after plugging in, there are some products that it can be vertically fitted.

Now, second point is, on this product on this product to enter the mat, what are the problems are there? It is very easy to push the mat, it will come inside and there is a grove, so it will fit this grove, but the thing comes to remove the used mat, we have to push it to another mat type of product, otherwise with simple finger, it is little difficult to push it out. So, for certain, the space here it needs to be considered, so that the fingertip can go in to push this out. When we are not regularly using it means, the used mat does not require to be replaced with another new mat or something like that.

Now, replacing the used mat that problem we need to consider, if the power is on, now this is a power operated. Now, when we switch on here, it does not guarantee that this

power is on or power is coming to this equipment, so what is happen? Now, how this machine functions, this machine functions that the coil is heated, and with that heat the chemical substance comes out from the mat. Now, either you have to smell it or touch it to feel that hot feeling, but it is not appropriate, so what is happen? An electronic electrical indicator is provided here, so that when the switch is on, the power indicator will be on.

Now, the question comes, power on, it does not mean that it is function is on, so in certain machines there are another control that if we switch on that then, another switch will glow - another indicator will glow - to say that, yes, the machine function is on. Now, here either we may need to put two switches, or after putting a switch on, if this is hence if this lamp is on, than it can be said that with internal circuits, we can it can said that, ok, its function is also on. But, if we want to give some space in between - time space – then, the two indicators are necessary.

So, now, the indicator lamp placement, it depends on the height of the plug point and viewing distance. Now, if this machine is below my eye level then, this indicator should be on the top of this product, so that I can see it properly. Now, if the product is above my eye height then, if that indicator is on the top, difficult I cannot see it. So, in that case, whether we require to put another light indicator connect to bottom, so that in any case, if it is placed below my eye level or above my eye level anybody can see that.

Now, the question comes, the distance of giving etcetera, so after seeing this, if we can make a indicator spot in the side area powering both little top and bottom and this corner, so what is happen? This product, if it is placed above eye height, at eye height or below eye height wherever, or from whatever the distance and viewing angle, it can be seen, so these are the cases we need to consider.

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Now, another point, the plug point location in room, normally what is happen, most of the plug points are placed near the door. Now, if it is placed near door and if the door is open, or frequently it is closing and opening then, what is happen? This product may not function properly.

So, in that case, the anticipated mode of use and placement location needs to be considered. Now, ideally what is happen, some people say that this product or may be any kind of mosquito repellent or whatever, it should made it on, close all the windows and doors, lit for some time, then switch on all the fans, open the windows and doors, so that all the air moves out, then close all the windows and doors. And then, you may switch on fans or ac or whatever, with or without this machine switching on, so normal people say that.

Now, with this, so ideally, we can say that near door, inside the room or room center, where it will be kept, it is ideally the center of the room. So, from that a new thought is coming, if this type of a machine or product is fitted on the ceiling fan itself. So, what is happen, when ceiling fan moves that this product will get power as well, and then it will emit the chemical fumes. And with the use of a remote control or specific time control, we can make use of this product. Then, a range of product development possibilities are being thoughtful, so like this a product is developed.

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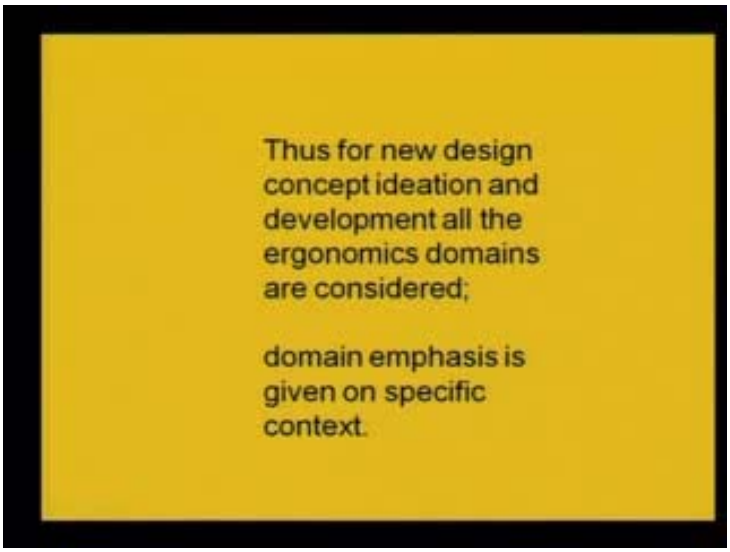

So, now, with this, it can be said that, thus for new design concept ideation and development all the ergonomics domains are considered; domain emphasis is given on specific context. Now, to explain this, in this case, what is happen? First this plug point and etcetera, this pushing, this inserting mat, all these things are coming under hardware ergonomics, is a direct physical interface. Now, this indicator system and etcetera to sense, it is function or a perception of the user people, that is, that cognitive ergonomics aspect.

And now, where it will be located center or different corners of room, or at the center, these all are considered through environmental issues. environ[mental] Ergonomics areas or macro ergonomics areas, means, in which context and the surrounding things, how many people will be there, for how long it will be operative, etcetera, all this aspect one can say that it is being considered with macro ergonomics aspects.

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So, with that, it can be said that, thus for new developed design concept ideation and development all the ergonomics domains are considered; domain emphasis is given on specific context. Now, if we see this figure, this is a total system with varied level of complexity, here all the ergonomics issues are considered like, the seating areas and etcetera, seats, the climbing, the physical contact like that hardware aspect. Cognitive aspect is that to it have so many things inside, that is, through perception and etcetera, all these things are from cognitive ergonomics point of view.

Inside the air quality and illumination level, music and etcetera, all these things are considered from environmental level. And the macro ergonomics level is that all the seats, that is, the work specific workstation areas and their links in between inside aisles and etcetera, and all other component links and space in between, and the airplane itself, the body and the sight, this accessories and etcetera, or how they are linked altogether these are coming under macro ergonomics level, as a management issues are also coming here.

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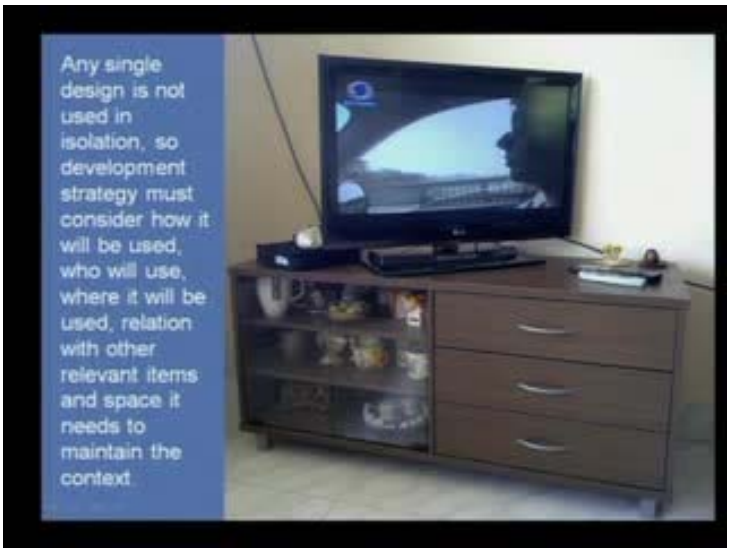

So, these types of system with varied level of complexity are also there, one can consider from this various domains points view. Now, any single design, this is a television set kept on a rack, on a special stand for any single design is not used in isolation.

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So, development strategy must consider, how it will be used, who will use, where it will be used, relation with other relevant items and space it needs to maintain the context. Now, this product, now we can see that how this lady is looking to this television set, it is not a good position to view the television set then, it would be better if she can turn

towards the television and can see the TV, but in comparison to the other locations in that space, in that confined room is like this.

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So, this room has a specific shape, so where all the chairs and etcetera, are kept like this and there is no other option to place it, so for (()) to get the larger view and angle, so this things have to be kept here, and so what is happen those people they can see like this way, but they can see like but here what is happen, you have to see like this.

So, there is no other option but this one, so for this, it can be said that various components layout in a confined space and activity compromises a single design's context specific use. So, even when we develop a single product, it has to be considered with other similar product or accessories and the space together from a system point of view.

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Now, for this another thing is that, that is most important, that is, the personal feeling, satisfaction. Now, this is a special case in a toilet where from this, if we see this one from this angle, this is the main entrance area, with this entrance area, if someone looks at so these are the series of urinal pence and then from this mirror through this mirror, it is not easy or it is not very aesthetic to get a view of all this people who are using this urinal pence.

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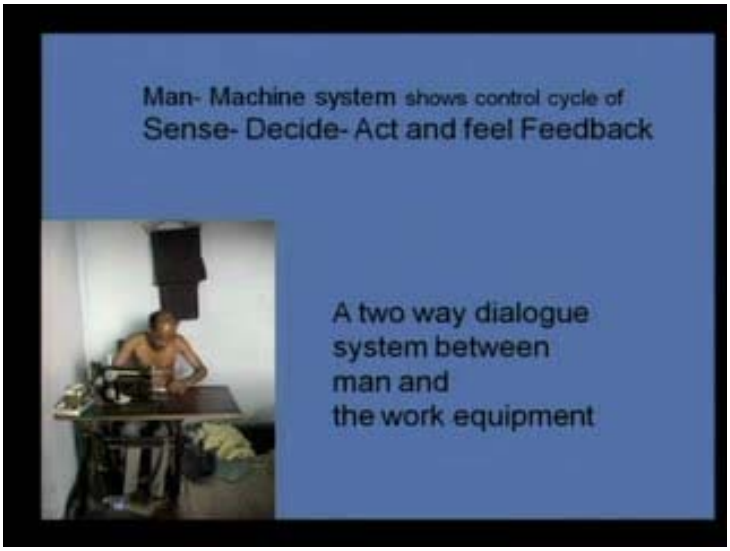

So, vision and layout of utility components must follow privacy feeling that is another aspect of ergonomics to be considered for component layout in a specific space. Another Now, I would like to say that man machine system shows control cycle of Sense- Decide- Act and feel Feedback, a two way dialogue system between man and the work equipment.

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Now, in this case figure, now how much pressure he requires, how much push, pull he requires in this area, it is a two way dialogue. How much is that he is looking or getting feedback from machine, and after judgment he is doing the activity. From other sense, we can say, here also the direct control of input and output, intensity of work accordingly increases or decreases. In this case, while filling up this jar, jar face is very small but this water may not go inside properly, so what is happen? Man is always creative, this person has created his own device that is he cut a special plastic bottle and put it upside down like this way, so it has become a funnel.

Now, what is happen? So, this is a funnel, now from here, you see whether this water goes inside only, and accordingly he push - apply - the pressure on it, means, he controls the water flow here with a specific feedback from here. So, by this way it can be said that, for each every or each action while using any design or making any effort, it has to be two way dialogue from the machine or the work matter and from the users.

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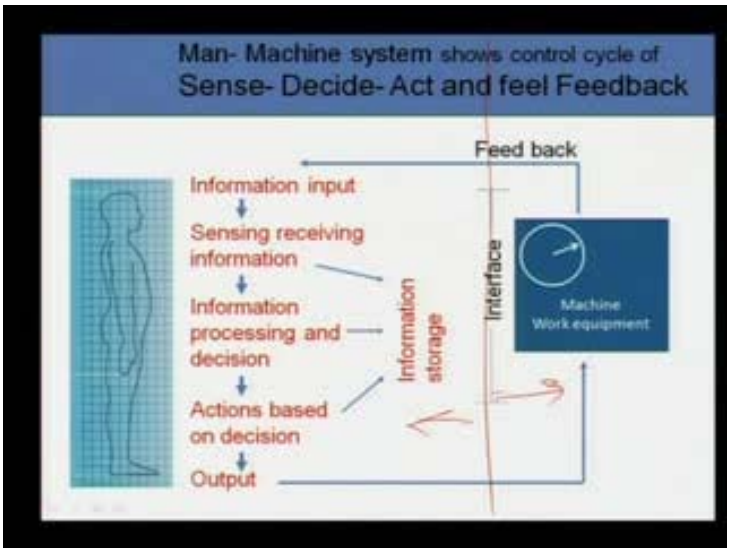

Now, if you see through a diagram Man- Machine system shows control cycle of Sense- Decide- Act and feel Feedback. Suppose, this portion is the machine portion, this is the machine portion and this side is the man portion. So, man, first information input something comes to him; information comes either if it is generated from own.

So, this information input comes from the sensing receiving the information, after sensing received information, information processing and decision going on in the man. Then, action based on the decision is acting - motor action - and then, whatever output comes from this man, it is the input to the machine, and machine after activity during certain extent, the machine it gives feedback through some meters or some other indicators and that goes as feedback to the man.

So, this is the case, the man and machine and in between this interface is how they are interacting with each other, so this two way dialogue needs to be established properly. And so, for that something man excels in some issues, and some issues machine excels like, machine excels in the repetitive action like that away, but man excels in judgment. But now, it is that some specific judgment type of control is also given in machines to supplement the man's effort.

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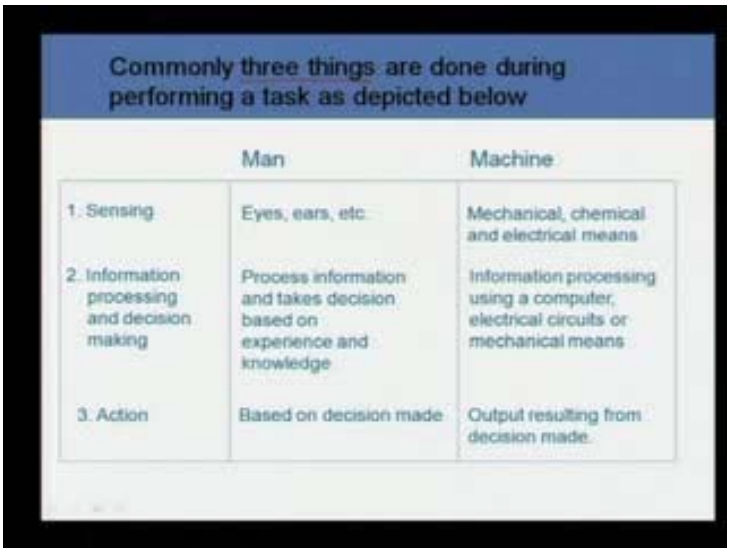

Now, commonly three things are done during performing a task as depicted below in this table. Now, man portion and machine portion; now man, the sensing, first he senses something, that is, through eyes, ears etcetera, and machine mechanical, chemical and electrical means – it senses machine. Man information processing and decision making through the process information and takes decision based on experience and knowledge; for machine, information processing using a computer, electrical circuits or mechanical means. Action based on decision making or for machine output resulting from decision made.

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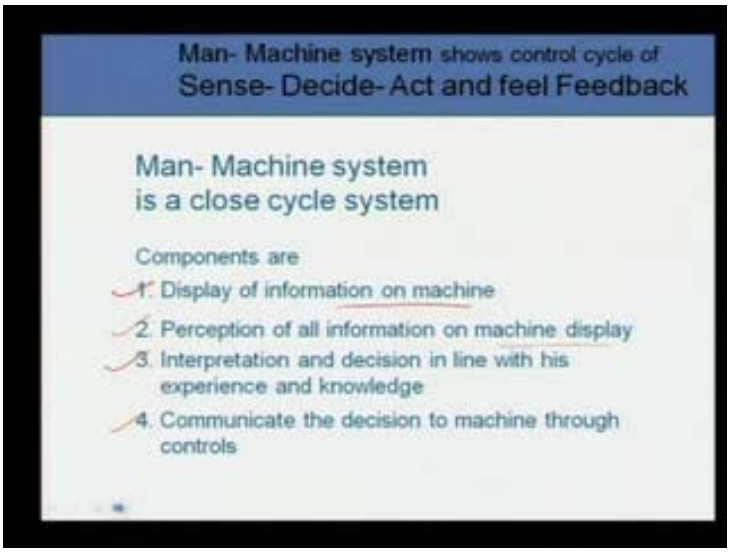

So, with this we can say that, commonly these three things are done during performing a task at the performing as task sensing, information processing and decision making and action. Now, man machine system is a close cycle system, the components are display of information on machine, perception of all information on machine display. Third is that interpretation and decision in line with his experience and knowledge; fourth, communicate the decision to machine through controls.

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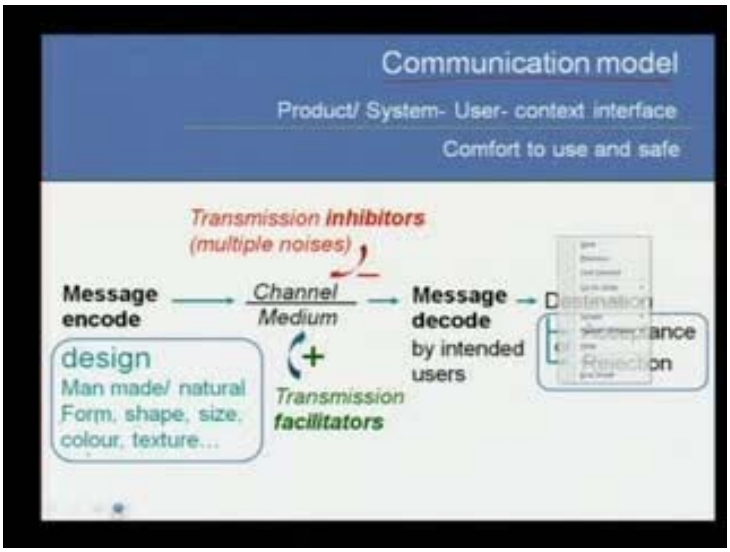

Now, next aspect is that, this input and output understanding through a communication model. Now, whatever we use, we are encoding some message into that, suppose, in this pen, from this shape, size, color, total look wise, volume, some message is inside, so that the person who is going to use it, he can see it and he can decode the information. How easily I can decode this that accordingly it will be easier to perceive about this product, and then means, after decoding this information should go to destination and if it matches with my requirement then, will accept it or other, it will reject it.

Now, in this message decode, encode and message decoding, this channel there are some transmitter inhibitors are there. Like, if light condition is very less here, I cannot see it, though everything is encoded here, but I cannot decode it because, in this channel the proper information is not coming to me. So, these are the noise in this channel transmission, but if the proper light source and everything is proper there, then I can see

it properly, and so what is happen? I can decode the information, encoded here easily or smoothly, so these we can say that transmission facilitator.

Now, with this, if I see through this diagram, the message encodes, that is, design man made or natural, that is, through form shape, size, color, texture, etcetera, the message we are encoding. These will go through some medium or channel for the message decoding by intended users. In this some transmission inhibitors, that is, multiple noise with access negative transmission, this noise means, maybe illumination level, ventilation level, if I want to do something but, that ventilation is coming, heat, humidity, vibration, do something is within here, but if it vibrates, then and it will be difficult to see it; either the object vibrate man remains static, or man vibrates object human static, or both vibrate in same way or in different way, the act the effect on that.

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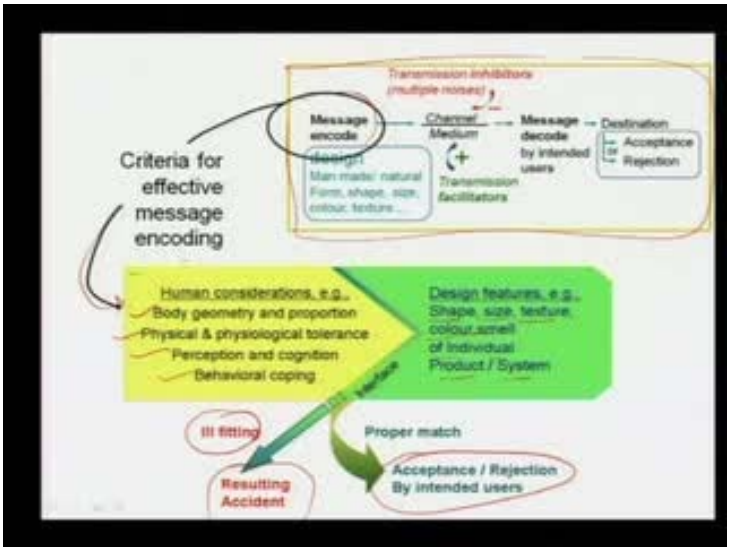

So, these are some of the noises, and obviously, sound, noise and etcetera. And transmission facilitators will be just opposite to all those issues, and to facilitate. Now, after message decode, it will go to destination, mean, either accept it or reject it. Now, the message encode, if some problem is there; in this diagram, we can say the message encode, the criteria for effective message encode is that, if we see this diagram, now this yellow color portion, if we consider as human considerations, and this greenish area that design features and this one is the interface, in between this two.

Now, human considerations as for example can be said that body geometry and proportion knowledge, physical and physiological tolerance limits, perception, and cognition, behavioral coping, etcetera. And for design features as for example, shape, size, texture, color, smell of individual product or system. If these two factors are not matching each other requirements, if interface is not matching, this if it is an ill fitting then, it results in accident. And if proper match is there, then acceptance or rejection whatever by intended user means, the total message has gone to the person. Now, so what is happen, while encoding the various messages, we need to consider this is interface issues.

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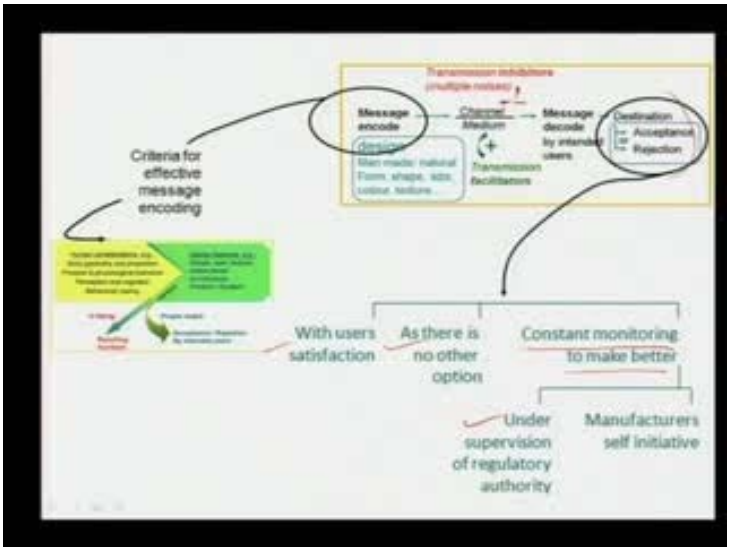

Now, the destination that acceptance or rejection, with this acceptance and rejection some factors are playing role, that is, it depends on with user satisfaction, then acceptance will be there. If the, say, new person when we use the product that is satisfaction or somebody else as mentioned about the satisfaction, that influences me in selecting or accepting the design. And there is no other option; only the product is there, so I have to use it, so there might some mismatch issues, their the accident and etcetera, chances are there.

Another thing is that, constant monitoring to make better the product, there are two aspects maybe considered, that is, under supervision of regulatory authority like BIS and etcetera, all the regulatory authorities, they keep control on the quality and manufactures

self-initiative. To keep themselves well in competitive market, there is a requirement to maintain better always in their product.

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So, with all these issues, one of the most important thing is that human requirement and the product features should match together, that is, the interface and that will be the two way dialogue. Ergonomics or human factors is said, is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the process profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance. This is the area of ergonomics that we need to consider while designing a product or a system.

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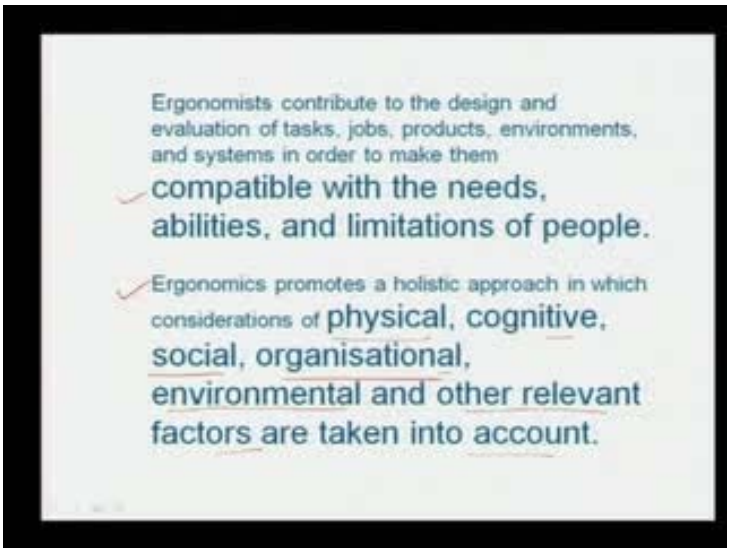

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Now, ergonomists contribute to the design and evaluation of tasks, jobs, products environments, and systems in order to make them compatible with the needs, abilities, and limitations of people. Ergonomics promotes a holistic approach in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken into account. At present, there exist domains of specializations as per international ergonomics association reference is that physical ergonomics, to have the physical interface with any product or space or a system; cognitive ergonomics

that perception; organizational ergonomics that is all linking among various products or product systems.

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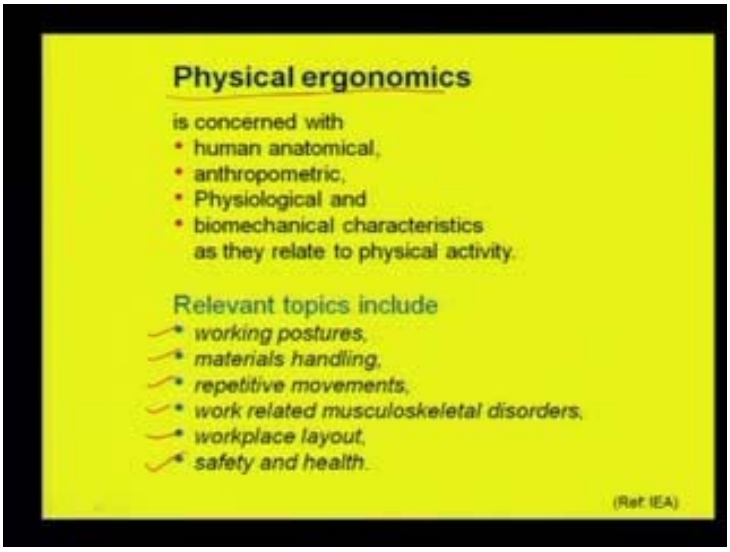

Now, I would like to look into the specific areas that falls under the specific domains as per international ergonomics associations. Like physical ergonomics is concerned with human anatomical knowledge, anthropometric - the body dimensions, physiological and biomechanical characteristics, as they relate to physical ability. And relevant topics include under this physical ergonomics are, working postures, and the design development for that, how working postures can be improved, less tiring, less physiological problems, more improve or we can say that establishing comfort, material handling, how easily a material can be handled, transported from one location to another location, and what type of design and method solutions can be given. Repetitive movements, what sort of facilities we can generate where repetitive movement maybe controlled, work related musculoskeletal disorder.

There are many work where to maintain that work posture or to apply some muscle force or to adopt the whole body to that task demand, there are some musculoskeletal disorders are there, how this can be brought under control, for that specific design development of work tools or other work accessories, work system methods can be developed, workplace layout to easy linking with different sets of working areas means, man and machine that

component, you need similar type of unit or varieties of units, what would be the linking among them and safety and healthy issues.

These are the relevant topics under physical ergonomics, people have started people have started now and lot of developments are being carried out. Next class is many or some of the issues will be discussed with examples from our regular life experiences.

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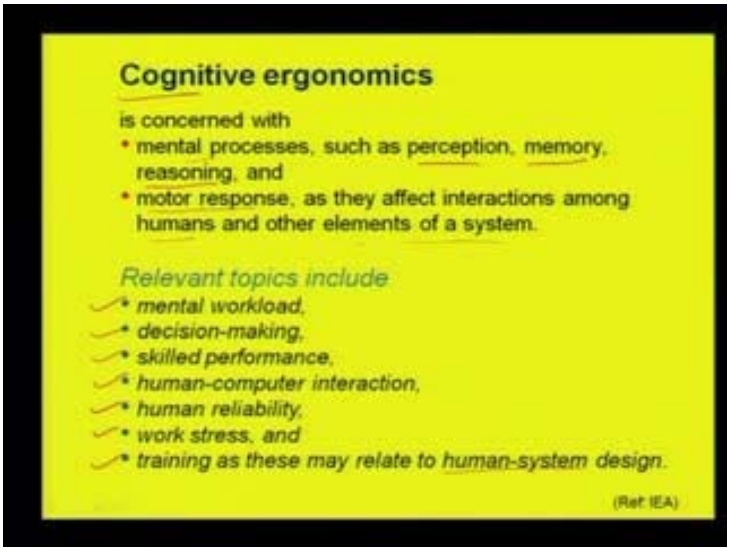

Now, under cognitive ergonomics, the cognitive ergonomics is concerned with mental processes, such as perception, memory, and reasoning and motor response, as they affect interactions among humans and other elements of a system. Under this, the relevant topics include mental workload, decision-making skilled performance, human-computer interaction - this computer is not only the computer any kind of visual display units also - human reliability – means - less error, work stress and training, as these may relate to human system design.

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Organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies and processes. And the relevant topics include the communication. How something can be communicated to others, to the machine, or from machine some output, how it could easily be communicated to the operator, so that we can understand the status of machine functioning and can work upon accordingly or can give some input to the machine accordingly. The crew resource management work design, design of working times, team work, participatory design, community ergonomics, cooperative work - means - with different types of people and their different types of work activities, how to make a links, new work paradigms, virtual organizations, telework, and quality management. So, these are the at this moment specific domains of ergonomics as per recent international ergonomic associations point of view.

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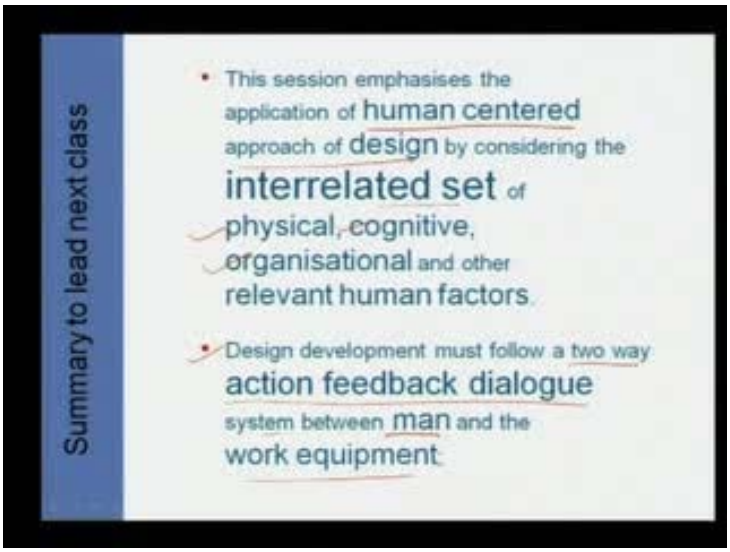

Now, today, whatever we discussed let us summarize this, this session emphasizes the application of human centered approach of design by considering interrelated set of physical, cognitive, organizational and other relevant human factors. Second, discussed second most important thing we discussed today is that, design development must follow a two way action feedback dialogue system between man and the work equipment, so that when the man operates a machine, how much intensity he should apply on the machine, and after function or while functioning, the machine should say about its status through some output measure to the person to cross check its man's input level.

So, by that way, the man and machine get two way dialogue have a good work match can be established. And the match between human requirement and machine or the design features should match each other, from physical point of view, from physiological point of view and from behavior, that is, cognitive point of view.

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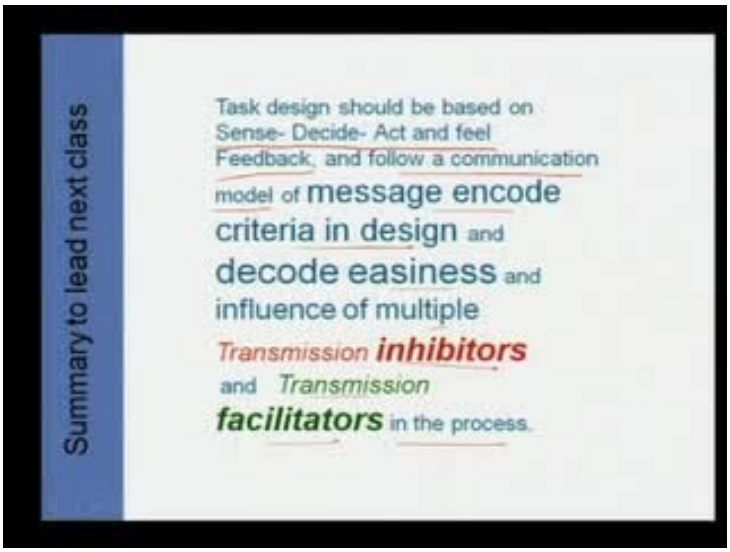

Now, task design should be based on sense decide act and feel feedback system and follow a communication model of message encode criteria in design and decode easiness and influence of multiple transmission inhibitors and transmission facilitators in the process. Not only to make the design perfect, a single unit, but where it will be used, along with other items to be used, there other concerns like light, heat, ability, ventilation, etcetera, or the information indications how easily it is being handled that needs to be considered. If it is not done properly vibration and etcetera noise like that, so it will be transmission inhibitors and if it is in a good condition it is mentioned, according to users compatibility limit, then it will be kept as transmission facilitators.

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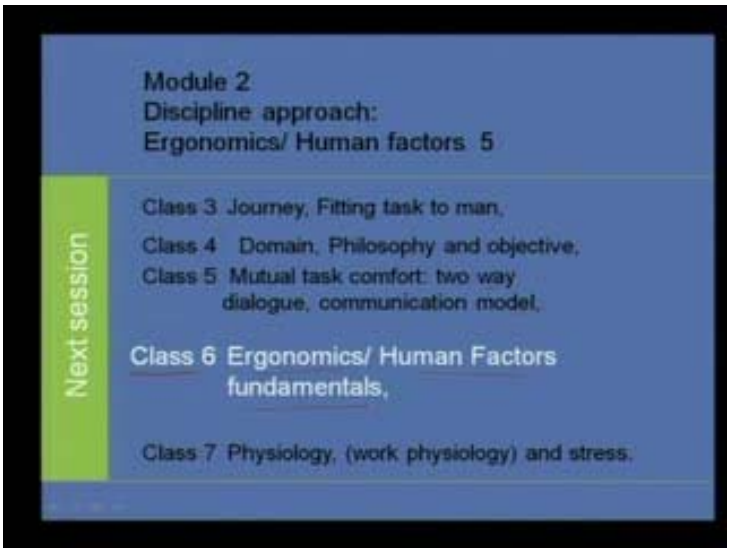

So, today, we have completed the class 5 fifth class, that is, mutual task comfort two way dialogue and communication model. And next session would be the class number 6, there we will discuss ergonomics and human factors fundamental issues, so with this we would like to conclude today's session, so thank you.