Ergonomics for Beginners Industrial Design Perspective

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Module No. # 02

Discipline approach: Ergonomics / human factors

Lecture No. # 04

Domain, Philosophy and Objective

Welcome to this fourth session on Ergonomics for Beginners Industrial Design Perspective.

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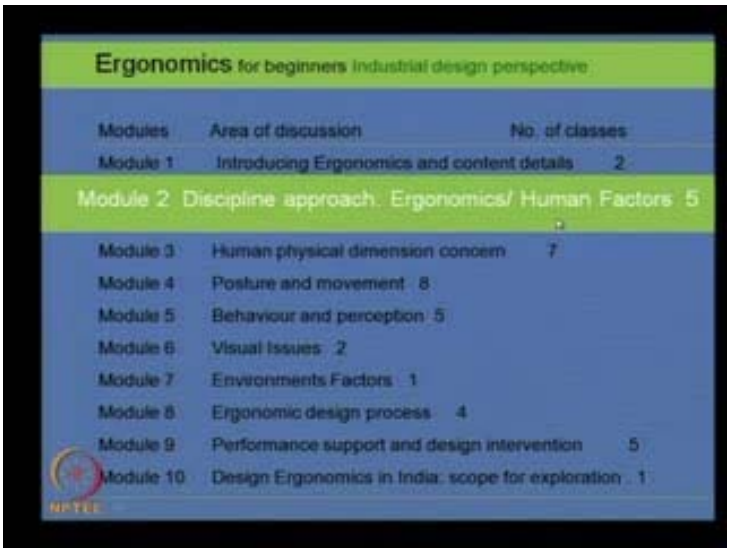

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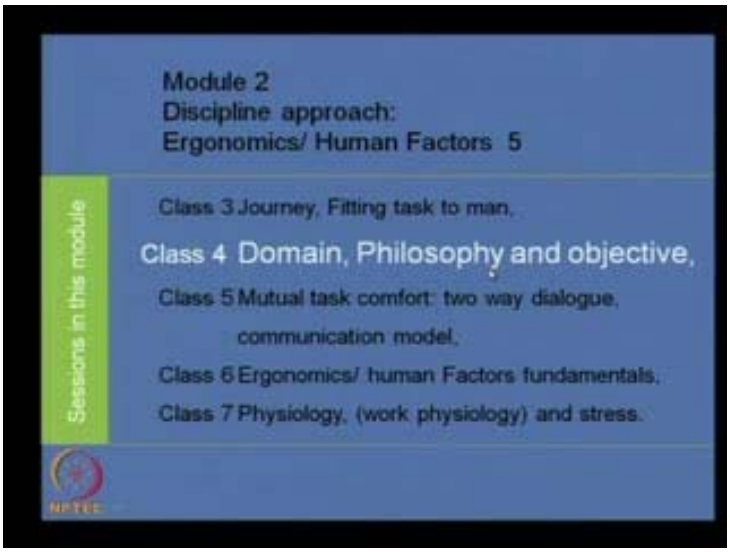

Now with this, now under module 2 the Discipline Approach: Ergonomics and human factors. So, there are total five classes and today is the fourth class and in this module to second class that is Domain, Philosophy and Objectives.

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So, now this current session will have, first we will discuss the last class gist and ergonomics a business promotion ergonomics and human factors acceptance in general, the philosophy, the objectives of ergonomics man - machine - environment interface system and ergonomics domains developed in different times and with different aspects;

that is hardware ergonomics, environmental ergonomics, cognitive ergonomics and macro that is organizational ergonomics.

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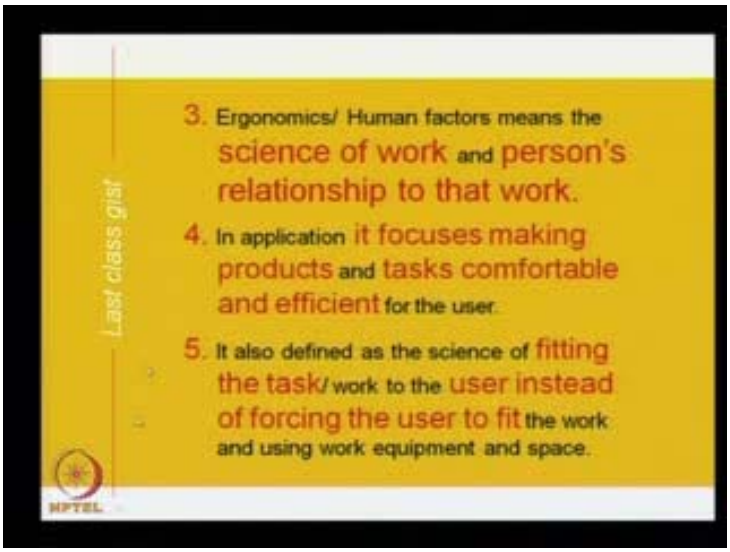

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Now, the last class we have discussed ergonomics and human factors as a discipline. It is originated from military requirement initially and designers feeling to satisfy people have enriched the subject domain. Ergonomics and human factors means, the science of work and person's relationship to the work. In application it focuses making products and tasks comfortable and efficient for the user. It also defined as the science of fitting the task and work to the user, instead of forcing the user to fit into the work and using work equipment and space with this, we concluded last session that human compatibility with product reliability, safety and context, that is the optimum use of human resource for maximum benefit means and methods we have discussed.

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Finally, we mentioned that man - the prime system component, while designing human behavior abilities, limitations in terms of physiological, physical and behavioral and other context specific characteristics should be taken into consideration, with this today we are we will start with a note that, ergonomics has a business claim and beneficial effects now in industrial design.

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Ergonomics has become business promotion word that we hear so often, these days particularly in the high tech industry tagged to their products. Now it can be said that, now here in this chair, it is a eurotech chair in advertisement a special mention is there that, ergonomic - this word is mentioned here. This area this ergonomic, this word is specifically mentioned means with this the business claim is made. Now another example we can say with this advertisement of a Hindware product that, x ergonomics means extra ergonomics, but it cannot be said that there is some extra ergonomic, normal ergonomics or inadequate ergonomics if in a product the ergonomic aspects are considered it has to be good design. So, by using this ergonomic word human and human factors and ergonomics it is acceptance in market is being promoted.

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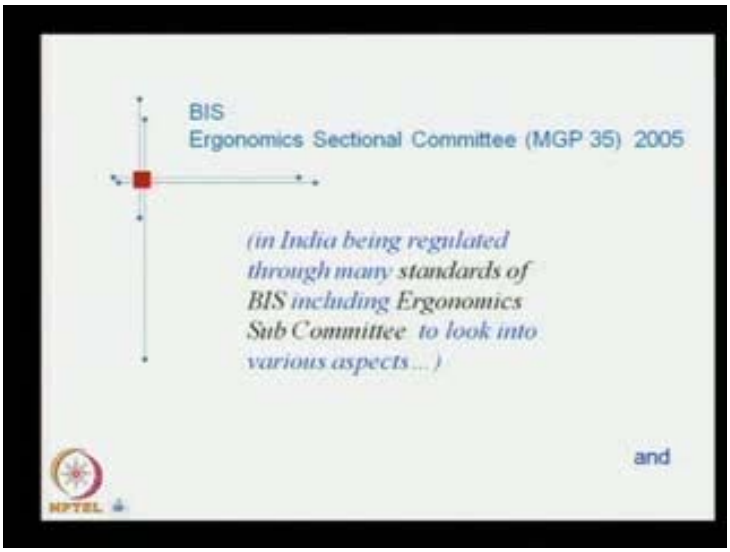

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Now, ergonomics based development and marketing policies are well adopted in design that is products tagged with ergonomics design. Now, more of standard more of Indian standard, they are also making many standards with ergonomics requirements. In India, being regulated through many standards of BIS and latest inclusion of ergonomics subcommittee to look into various aspects of ergonomics in various products; so, BIS has constituted an ergonomics sectional committee MGP 35 in 2005 to look into this aspect. And some references can be drawn from ISO certifications etcetera that it has well

acceptance in production process, safety and occupational health areas, and management issues.

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Now, what philosophy it carries? The ergonomics operates on the premises of fitting task to man in work and leisure, and better design for people. Now, if we see this product a mix in a home, mixie cum grinder in this case all the features here, it ensures safe operations and fear free use mode. Now though this products mentions that, we do not need to hold this lid while it is in operation, still while it is on people try to put one hand on it, thinking that it lid may fly off; it may fly it may not fly, but how to give them the user the psychological safe feeling.

Now, if we have the clippings like this way or like these clippings. So, that psychologically it will it may appear it is secured. So, now, whatever we design should cater the needs of the anticipated users with application of best scientific principle and appropriate technologies; that is while designing, the trust factors to be understood and accordingly, these to be addressed in the design features.

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Now, basic objectives of ergonomics; the basic objectives of ergonomics is to increase productivity, safety while working or while using the product or the system, comfort for effective use through balancing task characteristics and human compatibilities.

If we see this two side figures here, it mainly stresses on safe operation and the features for that and in this case, the manual material handling how easily or how comfortably this can be carried, lifted, transported from one place to another place; that is the manual material handling to be considered and accordingly the design features can be made. So, these are the basic objectives of ergonomics that is to increase productivity, safety and comfort for effective use.

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Now, when we see safety not only in product safety, but the feeling of this like this is an website it is said that, in a train how people are transported, how people are traveling trains offer insight into India that image carries it, that is safety is a concern nowadays. Now we need to discuss this matter or study this matter and apply this from user's point of view, as well as facility point of views and here the human information needs to be considered and that is the application area of ergonomics.

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Now, comfort for effective use; now in this work situation it can be said that, the comfort for effective use. Now the vision distance arm angle and then the sitting area, all these things needs to be considered, that is the comfort for effective use in this case, the man, the machine and the whole environment relationship needs to be established. So, that a compatible work environment can be created that is in this whole system, man is the prime system component, that is the prime issue we need to consider in ergonomics studies and applications.

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Now, another area is the work equipment and productivity. Now in this case, this is a food processing unit, where depending on various fruit and vegetables available in market, these ladies they make various products, fruit products, food products like in this case, some pickles making operation, ginger pickle operation making operation and in this figure it is said that, while cleaning the skin of ginger by using a metal knife and using a bamboo stick, splitted bamboo stick in these too, it is said that this bamboo stick also worked well.

In this case it can be said that, hand tools or work tool it should be locally available as far as possible, low maintenance and sustainable design development is necessary. And then, all these things are related to productivity incrementing. Now, how we can increase the productivity? That is also another area of study of ergonomics and where the effective work tool development is also a product development area.

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Now, if we see this figure, this is a full fruit processing unit in a village set up, where we need to study in a system design approach that is work environment and productivity.

So, for this work environment and productivity, we need to consider the different designs of the furniture, work equipment and the layout of different components, workplace and the space in between to link the all the workstations and the workers, the human being while in a specific work area and while he or she is in movement, that is circulation in consideration. So, thus work environment and productivity has relation.

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Now, ergonomics and human factors looks into the issues of specific requirements, that is optimum use of human resource to achieve maximum benefit to overcome multiple risk factors, risk factors means that is the mostly safety, safe and the work load etcetera, it should be within the physiological tolerance limit.

Now, in this case it can be said that, varieties of disabilities and work context requires development to be seen from that angle. In this case, how the structures can be developed? In this case, how this clumsiness can be improved? In this case, this is a special figure, this person while he is cycling with one leg, he has lost one leg, he use the walking aid on cycle and wherever he needs he stops that cycle, park it and uses his (( )). Now the question comes, how easily he can carry this material whether a special accessory is to be fitted on this bicycle that also is a necessity. Now for this, user's friendliness and compatibility, that is man and product, man and system match is necessary.

So, we can say that users friendliness and compatibility between man and his surroundings and articles for his use to be established and studied accordingly and in different design application to be done; and it will be evaluated, further it creates desired effect.

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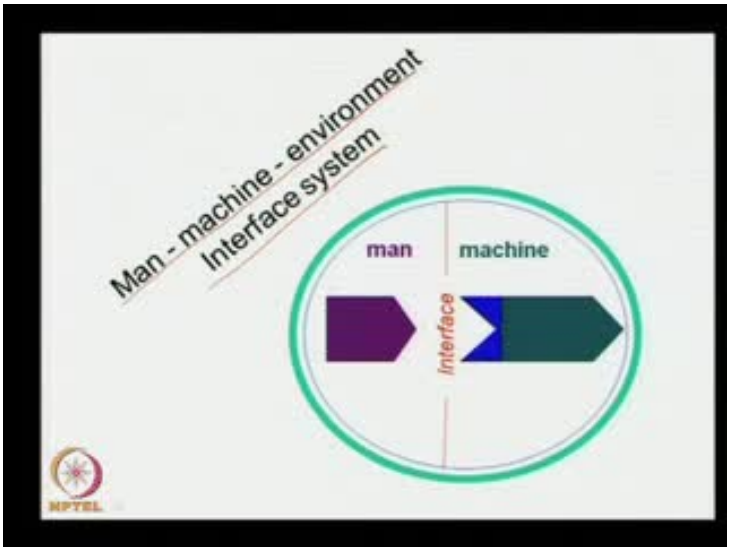

Now with this, it can be said that, the ergonomics is man – machine - environment interface system, where the machine and man has a good interface and the total working environment.

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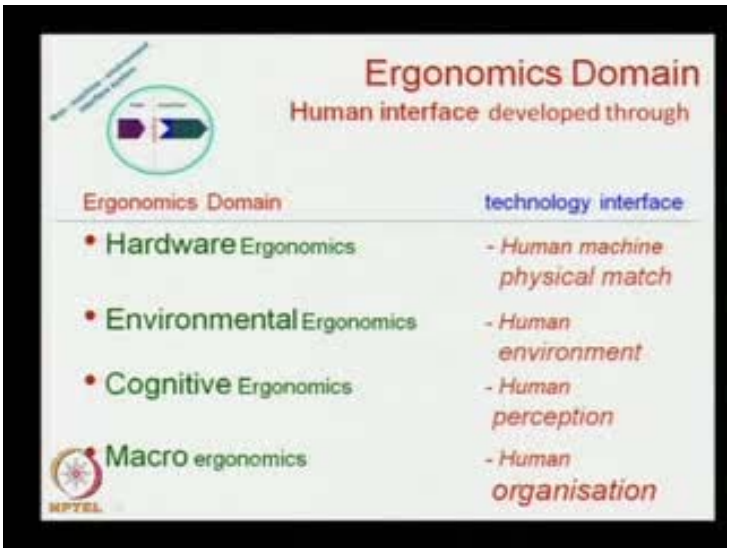

Now, if we see that ergonomics has few established domain like ergonomics domain that human interface developed through new technology interfaces and their names also were made accordingly. Likely hardware ergonomics here, human machine physical match are normally studied in that region. Next environmental ergonomics, here human environment relationship is checked, that is environment means space, heat humidity ventilation, illumination, vibration, noise etcetera and its effect on the productivity and working.

Cognitive ergonomics that is human perception how we think about something and how we react, how we judge and thereby the feedback system we give it to the machine and whatever output comes from machine, it is input to man and how that two way dialogue establishes it, by that error human error can be reduced that needs to be checked and that area is a cognitive ergonomics area.

Now, macro ergonomics that is human organization means, different work activities, the work items furniture etcetera to make a special workstation and the varieties a different workstations or number of workstations, how it is linked together and all this workplaces and similar type or varieties works places, how it is linked and then overall a total work

area that is that organization is developed and that interaction in between this area are looked after and that area is considered as a macro ergonomics areas.

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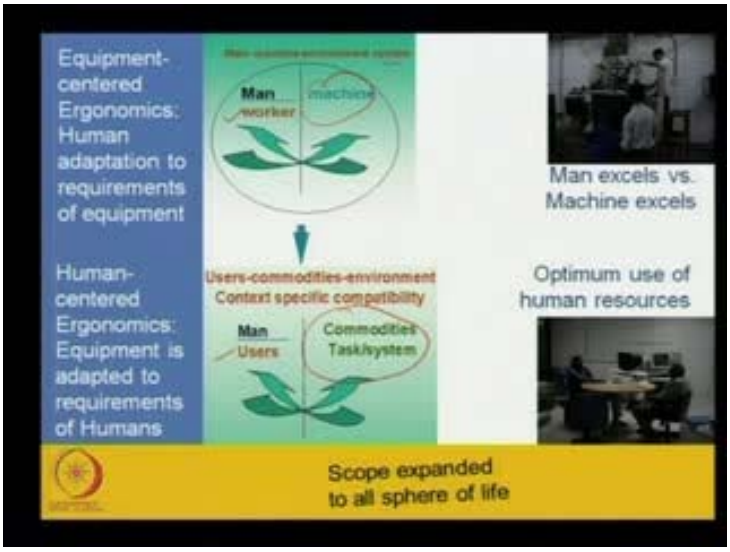

Now, from origin time and now the ergonomics is being used there some shift is seen, the first is that the man - machine environment system was first developed, where man machine that environment that interaction was there. Now, there man was considered as worker, like in this case we can say that, man excels in some of this points versus machine excels.

Now, how to match these two excels to get maximum benefit the productivity that was the considerations at the beginning and that was considered as equipment-centered ergonomics. Human adaptation to requirements of equipment that was considered and of now instead of machine, it has the commodities because not only machine and many items that man uses, we can say that user's commodities environment and that is context specific compatibility that is now the ergonomics is looking for.

Here the man was worker, here man is replaced as users and instead of machine now it is seen as commodities, tasks and systems. Now here it can be said that, human centered ergonomics, if it has started with an equipment-centered ergonomics, now it is a human centered ergonomics where equipment is adapted to requirements of humans. That is in this case we can say that, optimum use of human resource for its maximum benefit, now

with this the scope expanded to all sphere of life. Now ergonomics stands here and looks forward for further expansion in newer areas.

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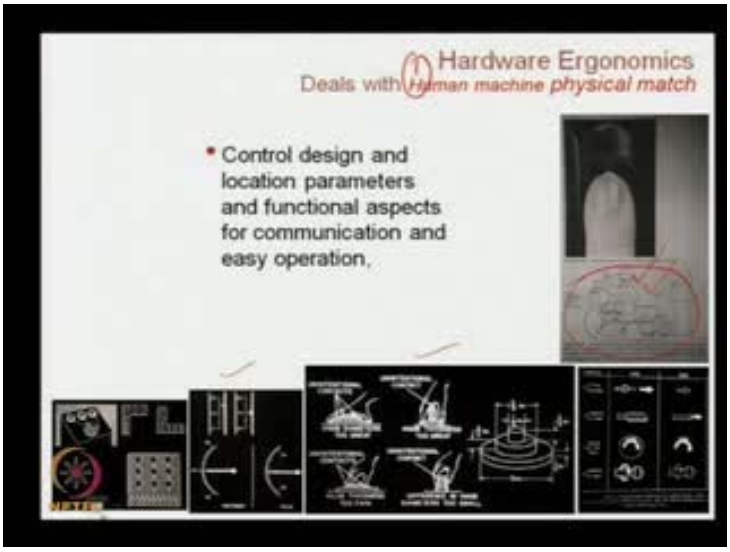

Now, I would like to discuss little in depth of different domains of ergonomics. The first is that hardware ergonomics, it deals with a human machine, physical match; the example we can say the control design and location parameters and functional aspects for communication and easy operation. Example in this case, how the switches controls etcetera easily to be operated, in this case the meters and etcetera scales, how easily to read and understand the meaning of these things and design accordingly. Here the total arm, total palm greapy palm diameter and how we can operate easily without any ambiguity, that area is considered.

In this case, some symbols that is something good and poor quality, now some symbols if it is like this way, it says the easy to recognize this type of things are not that easy. In this case, these are the easy and all things when it is within the circle and etcetera it is clearly mentioned for what purpose, but it is open ended, it does not give that much facility, how to operate it or what does it mean, like that way. In this case, if we have to operate in such a way that clockwise kind of thing then instead of very narrow line, it should be the thicker line means, stress on the information that will be the…

So, these aspects are considered as a control design and location parameters and functional aspects for communication and easy operation. This case here we can say that,

in this figure, it is a video recording system where all lights are from different sides and etcetera it is, but the backside of the camera where the main person is working, there is no light very less light. So, for the switch is there to avoid any mistake, there should be at least minimum double sensory systems would be there. So, that maybe while switching on off or any specific position to be handled, it should have at least not only sliding, but also it should have a different texture. So, with this texture and etcetera, it gives the operational tool. So, this is one area of the hardware ergonomics.

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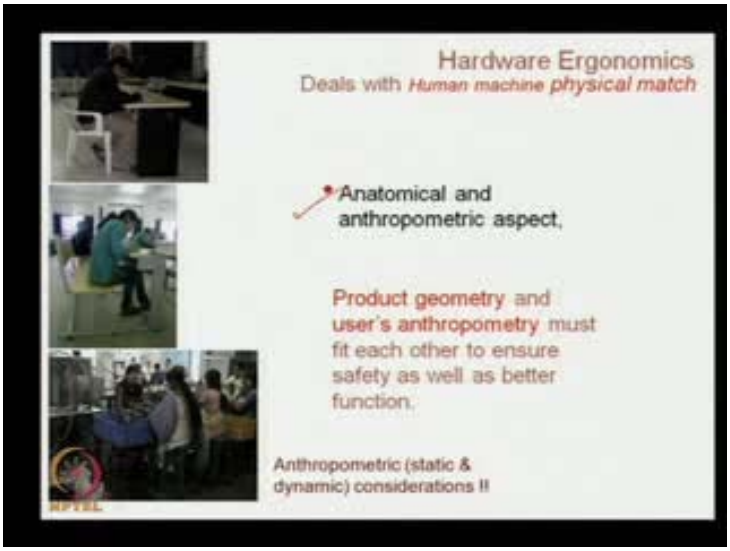

Now, another thing that anatomical and anthropometric aspects, here how to sit easily comfortably like that way, that is a product geometry and users anthropometry must fit each other to ensure safety as well as better function. Here, anthropometry that is static and dynamic considerations needs to be considered.

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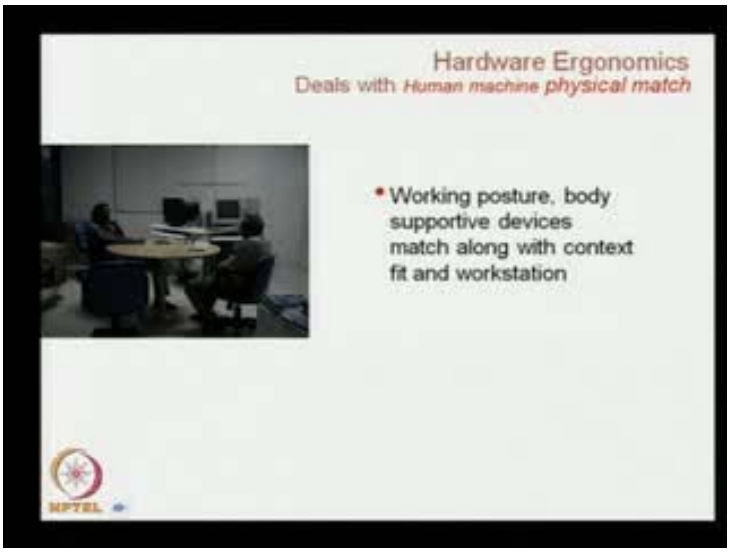

In this case, working posture, body supportive devices that is seat, bed etcetera match along with the context fit and workstation.

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Need and design support justified a task demand posture, whether we need to modify the work method or the design is being used, while working that can be that posture can be improved. Now here are some figures that it says that, what is the problem of mismatch for the task and posture? Now here we can say that, this reading stand is made with adult human body dimension, but when a child studies child reads it, then what can be done

here? In that case, a design solution can also be given that, if in this board, in this board if the paper is made like this way and if some clippings are there, so that for adult it can be sliding up. So, that adult can read from like this way and if the paper is sliding down then what is happened, a child also can read this paper. So, these are the some by this we can say that, postural modifications can be done, betterment can be done.

So, means varieties of postures are used in daily activities which need task and context specific design considerations at home, at work and at the peer group meeting, different postures also mention about the mood of that context. If we understand the mood and the human body dimension that man is expected to do or use the design then accordingly, design dimension can be fixed and the final design can be developed.

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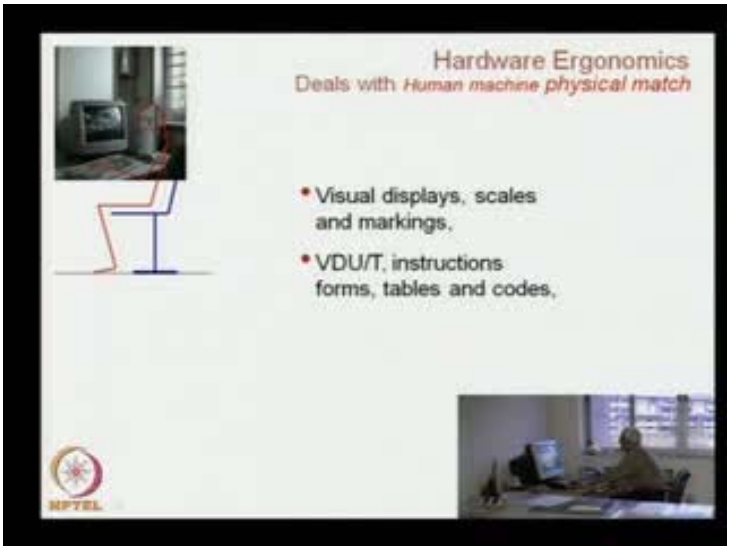

Now, under this hardware ergonomics that is direct physical match and etcetera, it has visual displays scales and markings that we showed earlier, that is this visual scales and markings and video unit and what are visual display unit and terminals, instructions forms tables and codes.

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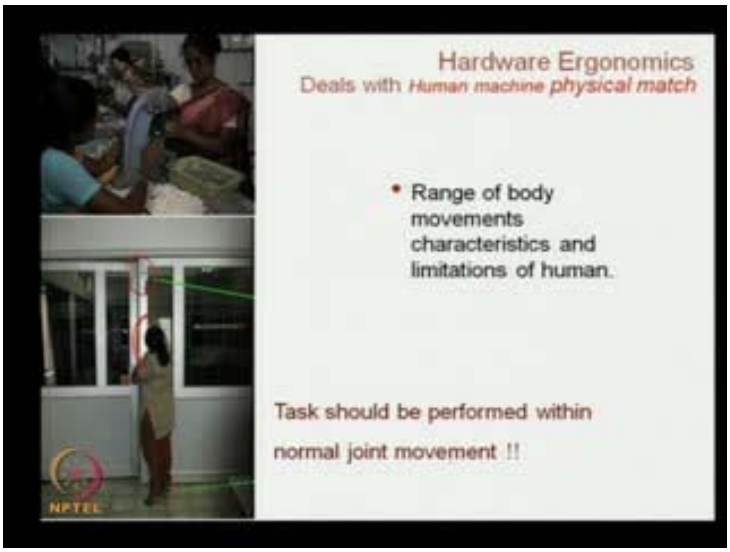

The range of body movements, characteristics and limitations of human like that the range of body movement to operate these activities, the range of body move and movement and within whether this would be lowered down or what system it can be done so that, this operation will be within comfortable arm reach level and etcetera. So, task should be performed within normal joint movement. So, the range of joint movement that needs to be studied and applied appropriately according to the contextual requirement.

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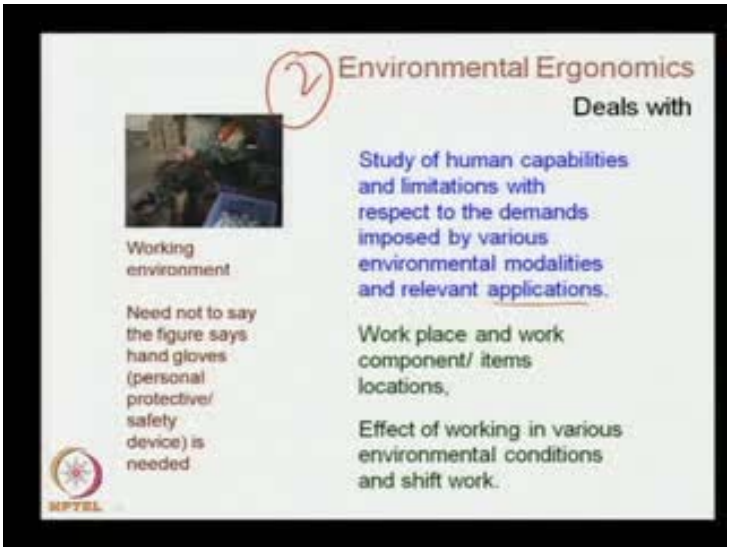

Now, a second domain of ergonomics is that environmental ergonomics, that deals with the study of human capabilities and limitations with respect to the demands imposed by various environmental modalities and relevant applications. Workplace and work component or items location, effect of working in various environmental conditions and shift work, these are the within environmental ergonomics.

Now, in this working environment after studying this or maybe space arrangement, various component locations in relation to the man, a center point to be studied and to be worked upon to increase the productivity level of the efficiency of this man, heat, humidity, ventilation, light, noise, vibration, color, etcetera. From this figure it says that, need not to say the figure says hand gloves that is personal protective or safety device is needed here.

Now, the interaction between environment ergonomics and hardware ergonomics there, that every aspect it is little difficult to separate. In different domains to look into a specific problem, all the ergonomic domains are seen together with specific emphasis.

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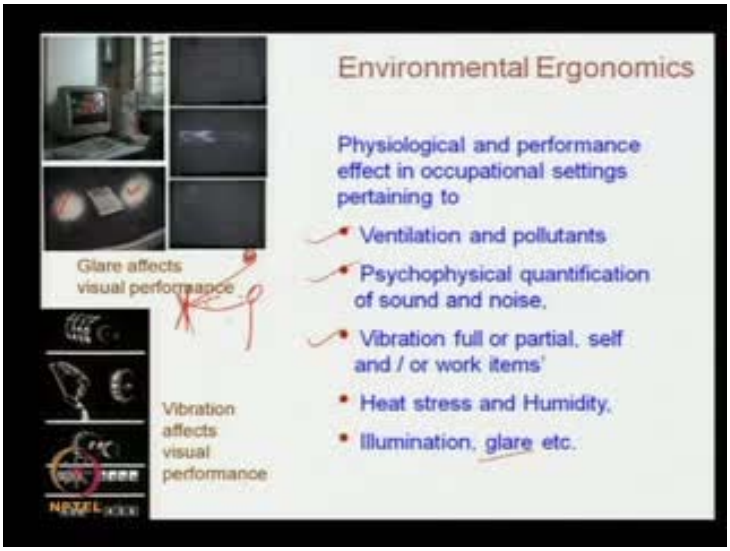

Environmental ergonomics is that physiological and performance effect in occupational settings, pertaining to ventilation and pollutants, psychophysical quantification of sound and noise, vibration full or partial, self and or work items.

Suppose what is happen in this case if we see suppose vibration effects visual performance. Now in this case, this person which has to read this readings here, but if the person vibrates or and the equipment vibrates, the visual performance will effect accordingly or heat stress and humidity, and illumination and glare. Now comes illumination and glare, it is said that, though we will discuss this in details in following classes, but now here we can say that if that low illumination level, performance detail, but that is also in specific way.

In certain cases, in different illumination level suits different activities. Now glare sometimes it mostly it effects negatively, but sometimes it also effects for specific purpose, like in this case it can be said that the glare, that this in this table the lamp source is on the top, but the two shadows are coming here and it gives a this comfort glare.

But in this case, the TV screen and this computer screen, the light source is coming from here and it is replaced to the eye and so, what is happen? All the image of outside window it comes through this screen. So, whatever I would like to concentrate here, it is difficult. So, this is that disability here and in this one discomfort glare. Now the surface of this and the lighting source it has direct relationship, in this case if we see that specific light source and when the surface is angled, when the person eye and the surface this angle matches, it gives the maximum glare. So, either to modify the source of illumination angle or if we can change this reflecting circles, accordingly our glare effect can be reduced.

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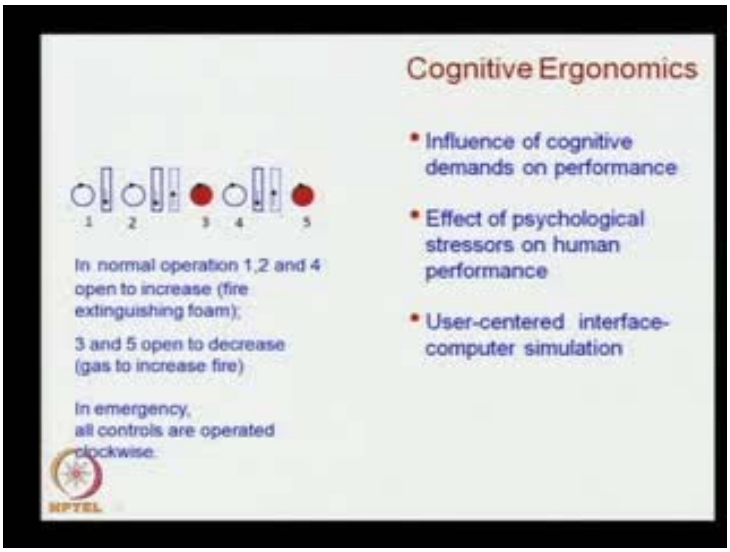

Now, a major area of ergonomics is cognitive ergonomics; that is the perception area of people. Now, cognitive ergonomics it the influence of cognitive demands on performance this is one area, another area effects of psychological stresses on human performance user centered interfaces, computer stimulations etcetera, a good amount of psychological findings are used in this. As for example, it can be said that suppose in a work area this 1, 2, 3, 4, 5, these are the controls knobs; in normal operation 1, 2 and 4 if you increase clockwise it the action increases and 3 and 4 if you open clockwise, it decreases.

Now in a setup, if we keep all this together, where a fire machine is there or a fire accident is there, in that case then in any danger, the man cannot think properly there a judgment to proper to give a proper judgment is also difficult, at that time for a specific switch to operate in one direction and another switch in different direction difficult.

So, in this case if we keep 1, 2, 4 this thing for fire extinguishing foam means, if we in 1, 2 and 3 if we switch on then, fire extinguishing foam that output will be increased and 3 and 4 these are for gas to increase the fire level, now for here what is happen? Here if we rotate all the switches in a clockwise movement, then what is happen 1, 2, 4 when you operate it increases the foam secretion, foam output to extinguish the fire and 3 and 4 though we are operating in same direction, it reduces the gas.

So, now in a single machine control a single operation, desired task is being done; in emergency all controls are operated clockwise, but when we are in full control of our mental stability at that time, we can selectively we can operate which one to operate which one not to operate, but in emergency it is difficult. So, a single movement would be better.

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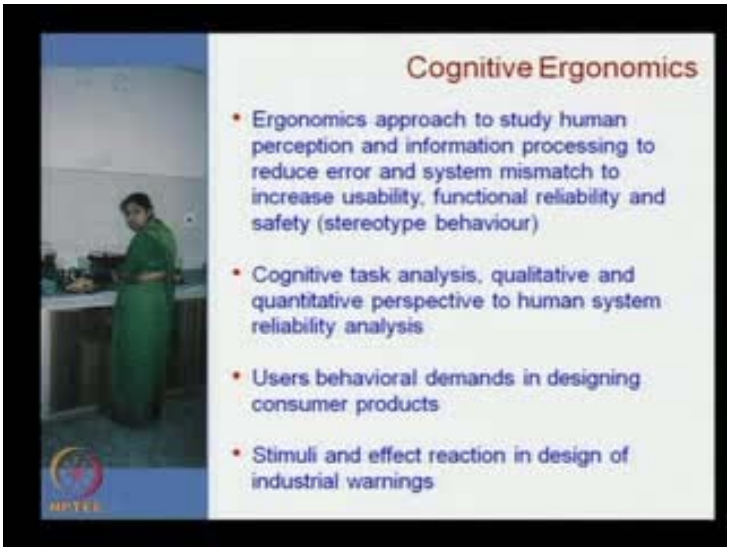

Now, another cognitive ergonomics under that area is that ergonomics approach to study human perception and information processing to reduce error and system mismatch to increase usability, functional reliability and safety that is stereotype behavior.

Cognitive task analysis qualitative and quantitative perspective to human system reliability analysis, users behavioral demands and designing consumer products, stimuli and effect reaction in design of industrial warnings in this case, while operating so many switches, so many items, different color code, different shape size of the control knobs and etcetera, it gives a proper input of how to operate all the things with a controlled point.

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Now, macro ergonomics macro ergonomics is that organization, human organization interface technology, this is the fourth level of ergonomics. Application of ergonomics principles in organized sectors for better productivity and safe operation, office and corporate ergonomics and its cost effectiveness is under this macro ergonomics area. In this packaging unit, the ergonomics workplace layout criteria should be implemented otherwise this opposite layout it reduces the productivity and it creates uneasiness or reduces the efficiency of people to work here.

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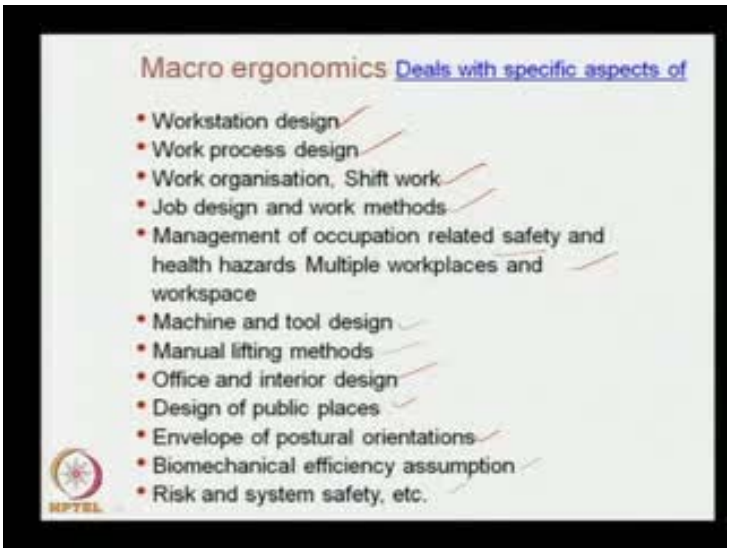

Now, macro ergonomics deals with specific aspects of workstation design, work process design, work organization, shift work, job design and work methods, management of occupation related safety and health hazards, multiple workplaces and workspaces design, machine and tool design, manual lifting methods, office and interior design, design of public places, envelope of postural orientations, biomechanical efficiency assumption, risk and system safety etcetera. That is the whole organization where man to man relation, man to work equipment relation, many work equipment and single man and many men with many equipment with specific work units all this links and etcetera, all these things are under macro organization ergonomics.

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Now, with this what we have discussed today if we summarize, then we can see that ergonomics based development and marketing policies are well adopted in design, production process, safety and occupational health and management issues. The philosophy behind this ergonomics are mainly the two things, that is fitting task to man and better design for people; occupational health hazards and etcetera whatever we are talking, it comes under this and this design or people and fitting the task. Objectives to increase productivity, safety and comfort for effective use, ergonomics domain human interface developed through hardware, environmental, cognitive and macro organisational issues.

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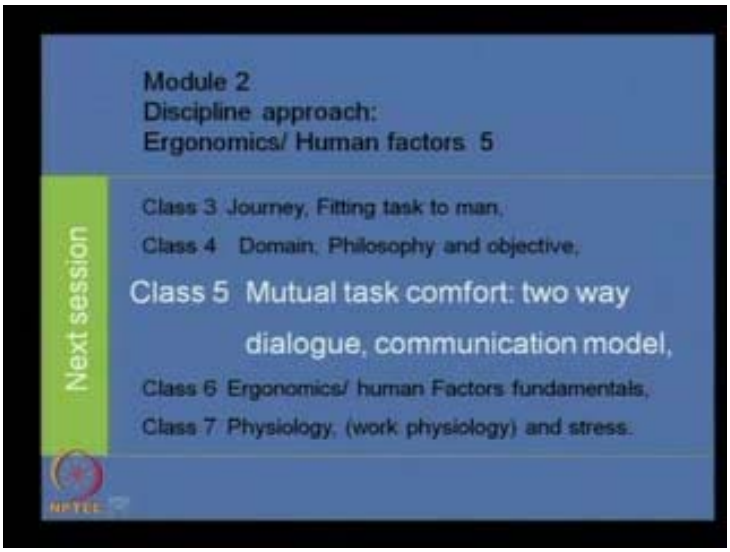

So, next class it will be the class 5 under this module 2, that we will discuss mutual task comfort, that is two way dialogue communicational module. So, till then… so we will see in the next class, thank you.