Human Factors Engineering

Prof. V. K. Tiwari
Prof. P. K. Ray
Department of Agricultural and Food Engineering
Department of Industrial and Systems Engineering
Indian Institute of Technology, Kharagpur

Lecture - 51
Definition of Shift Work, Problems with Shift Work, Effect on Circadian Rhythms

Dear students and the participants, this is the 11th week and we will be discussing a very important topic called Human Factors Principles and Design of the Shift Work. There will be 5 lecture sessions in this week. Let us discuss importance of designing the shift work as per ergonomic and human factors principles.

As you are aware that the shift work is very common and usually, we will find that in the shift work the workers or the operators or the humans in general they face a particular kind of conditions and situations. And almost all work type workplaces designing the different types of the work systems, following ergonomic and human factors principles is our objective. During shift works the operators face different kinds of situations. Whatever may be the workplace or what may be the types of industries or a or the types of jobs they do, there are certain the conditions we have to maintain in the shift work, so that the workers maintain the right kind of a work capacity as well as the fitness and health of workers.

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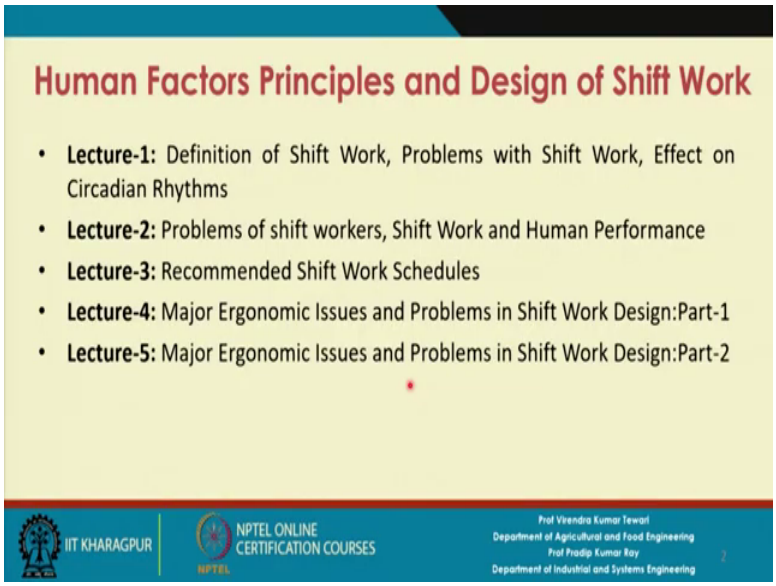

There are the 5 lecture sessions in this week. The list of topics are as follow:

Lecture-1: Definition of Shift Work, Problems with Shift Work, Effect on Circadian Rhythms.

Lecture-2: Problems of shift workers, Shift Work and Human Performance.

Lecture-3: Recommended Shift Work Schedules.

Lecture-4: Major Ergonomic Issues and Problems in Shift Work Design: Part-1.

Lecture-5: Major Ergonomic Issues and Problems in Shift Work Design: Part-2.

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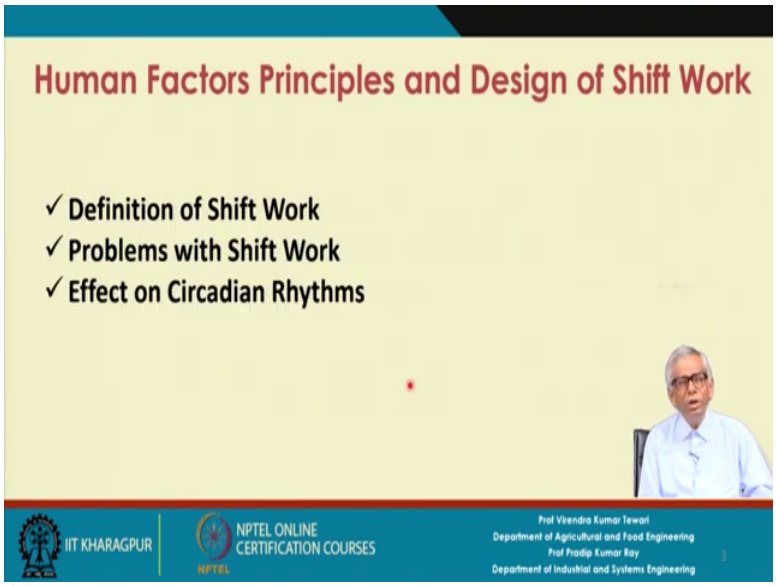

These are the topics we will be discussing today:

a) Definition of Shift Work.0

b) Problems with Shift Work.

c) Effect on Circadian Rhythms.

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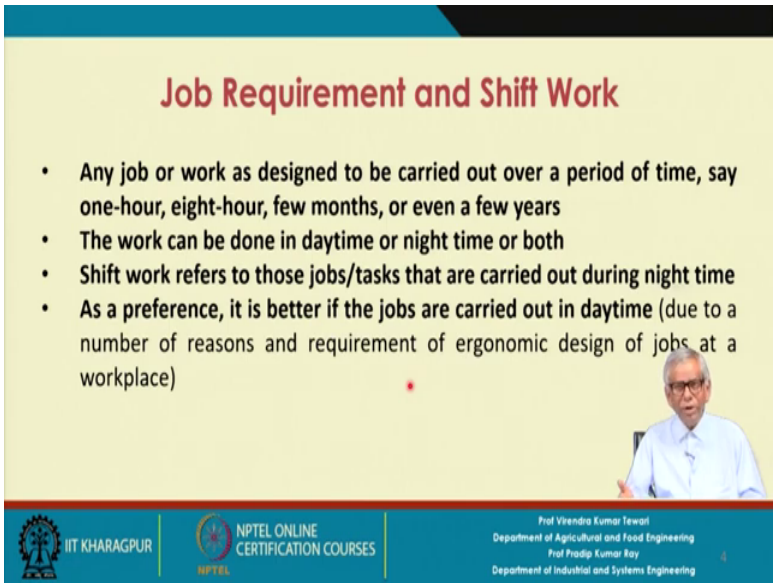

This is a common occurrence that your shift work is not appropriately designed you will find that this the Circadian Rhythm of the human body will be affected and this effect is very negative and ultimately it might affect your health status and then it will also affect your work capacity as well as the fitness with respect to the jobs.

Now let us first talk about the job requirements and the shift work, as you are aware that the shift work is designed in such a way that the jobs being carried out during this the night shift or evening shift, it will have a direct negative impact on the worker as well as the performance.

So, work system performance will be negatively affected. You must know that for a particular shift work what kind of jobs are required to carry out. The work can be done in daytime or nighttime or both. Now the question is which time you will prefer daytime or the nighttime? Normally everybody knows the daytime work is preferred. Whereas, in certain cases you cannot avoid nighttime work.

And there are certain advantages of working in the night shift or in the evening shift. So, the shift work refers to those jobs or task that are that are carried out during nighttime.

Normally, what we say that the jobs which are being carried out in the time period from 7 pm to 6 am So, any work if you carry out during this time period that work is referred to as the shift work. As a preference, it is better if the jobs are carried out in daytime (due to a number of reasons and requirement of ergonomic design of jobs at a workplace).

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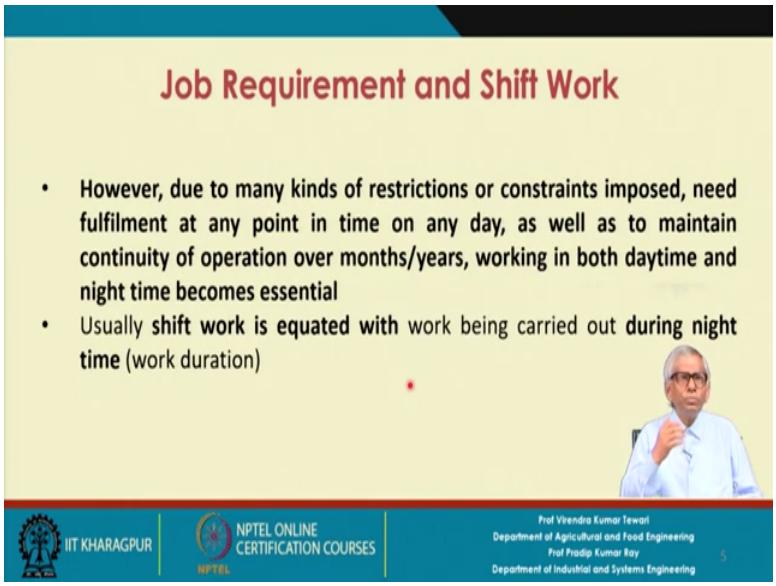

However, due to many kinds of restrictions or constraints imposed, need fulfilment at any point in time on any day, as well as to maintain continuity of operation over months/years, working in both daytime and night time becomes essential. Usually shift work is equated with work being carried out during night time (work duration).

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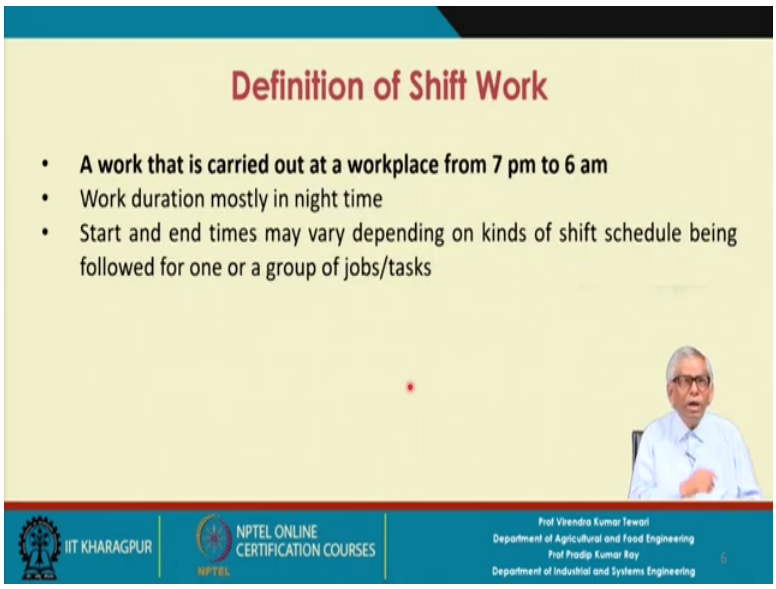

A work that is carried out at a workplace from 7 pm to 6 am. This is a general definition for shift work.

Work duration mostly in nighttime start and end times may vary depending on the kinds of shift schedule being followed for one or a group of jobs or tasks. So, there is certain the flexibility in defining the start time and the end time.

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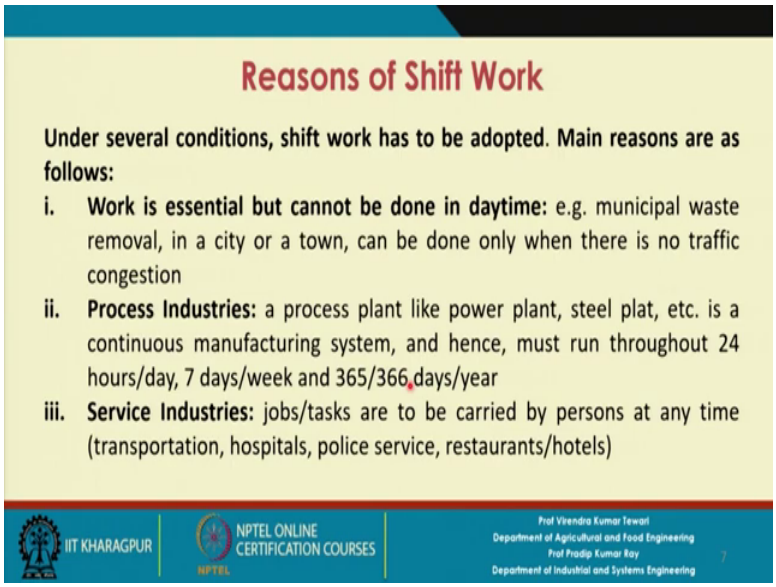

Under several conditions, shift work has to be adopted. Main reasons are as follows:

First reason is Work is essential but cannot be done in daytime, e.g. municipal waste removal, in a city or a town, can be done only when there is no traffic congestion

Second one is Process Industries. A process plant like power plant, steel plat, etc. is a continuous manufacturing system, and hence, must run throughout 24 hours/day, 7 days/week and 365/366 days/year.

Third reason is Service Industries. Jobs/tasks are to be carried by persons at any time (transportation, hospitals, police service, restaurants/hotels).

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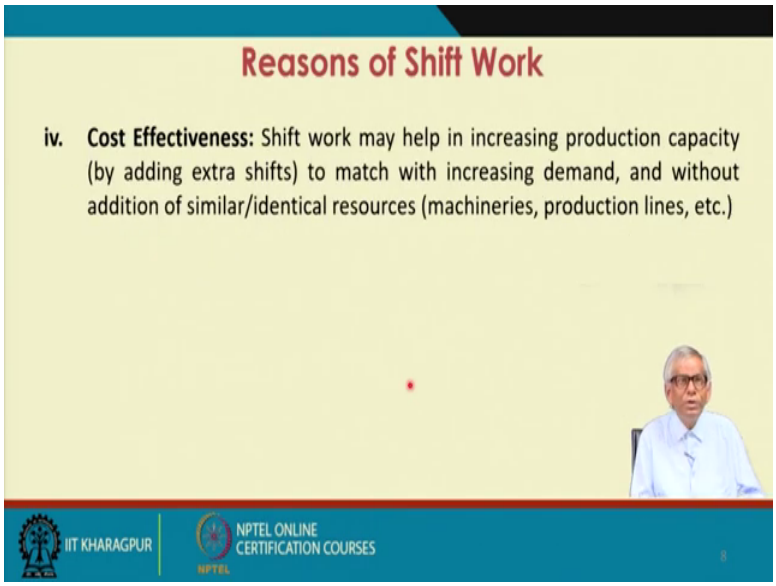

Fourth reason is the cost effectiveness. Shift work may help in increasing production capacity (by adding extra shifts) to match with increasing demand, and without addition of similar/identical resources (machineries, production lines, etc.).

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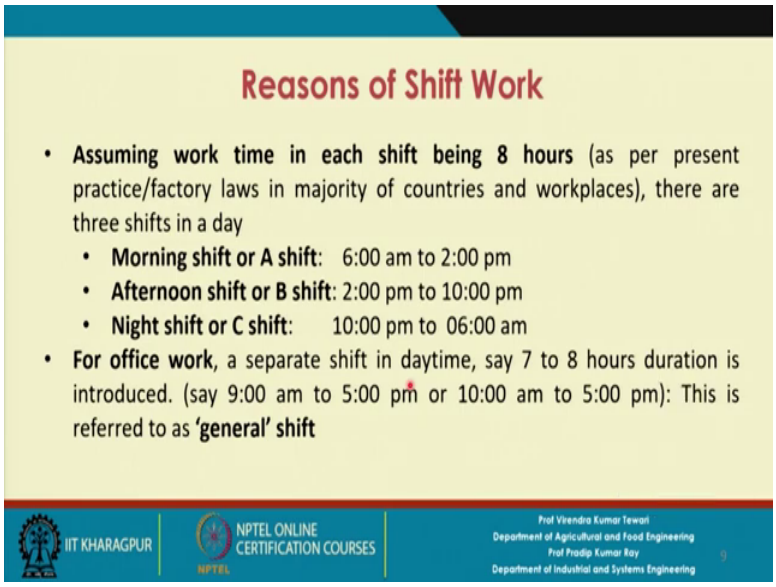

Assuming work time in each shift being 8 hours (as per present practice/factory laws in majority of countries and workplaces), there are three shifts in a day.

Morning shift or A shift: 6:00 am to 2:00 pm.

Afternoon shift or B shift: 2:00 pm to 10:00 pm.

Night shift or C shift: 10:00 pm to 06:00 am.

For office work, a separate shift in daytime, say 7 to 8 hours duration is introduced. (Say 9:00 am to 5:00 pm or 10:00 am to 5:00 pm): This is referred to as 'general' shift.

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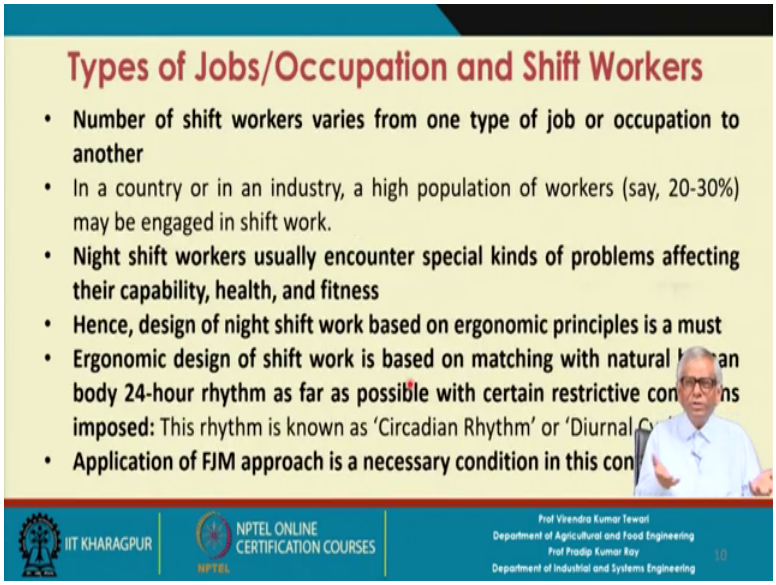

Number of shift workers varies from one type of job or occupation to another; it is job specific.

In a country or in an industry, a high population of workers say 20 to 30 percent may be engaged in shift work.

Night shift workers usually encounter special kinds of problems affecting their capability, health, and fitness

Hence, design of night shift work based on ergonomic principles is a must

Ergonomic design of shift work is based on matching with natural human body 24-hour rhythm as far as possible with certain restrictive conditions imposed: This rhythm is known as ‘Circadian Rhythm’ or ‘Diurnal Cycle’.

Application of FJM approach is a necessary condition in this context.

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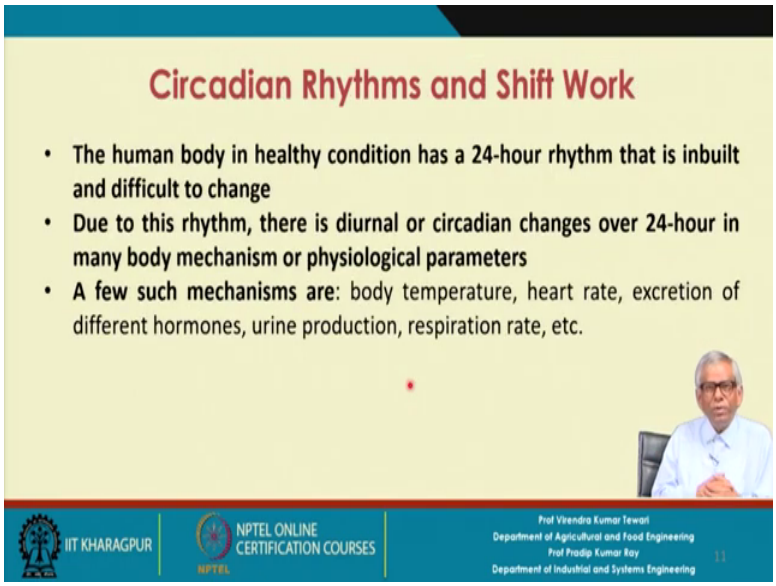

Later on, we will come to know that there are persons the individual factors. So, they are not at all suitable for carrying out job during night shift. So, those persons must not be engaged in the night shift work. Let us talk about the Circadian Rhythm and the shift work. The human body in healthy condition has a 24-hour rhythm that is inbuilt and difficult to change

Due to this rhythm, there is diurnal or circadian changes over 24-hour in many bodies mechanism or physiological parameters.

A few such mechanisms are body temperature, heart rate, excretion of different hormones, urine production, respiration rate, etc.

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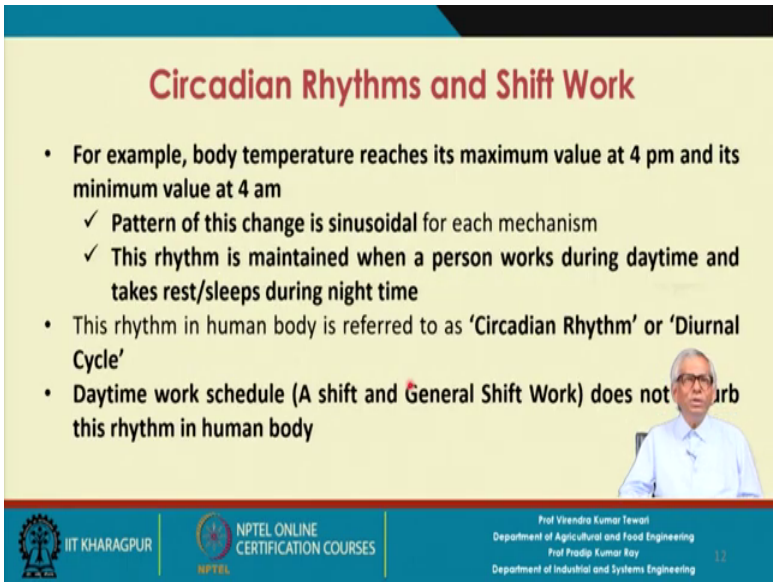

For example, body temperature reaches its maximum value at 4 pm and its minimum value at 4 am. Pattern of this change is sinusoidal for each mechanism. This rhythm is maintained when a person works during daytime and takes rest/sleeps during night time. This rhythm in human body is referred to as 'Circadian Rhythm' or 'Diurnal Cycle'. Daytime work schedule (A shift and General Shift Work) does not disturb this rhythm in human body.

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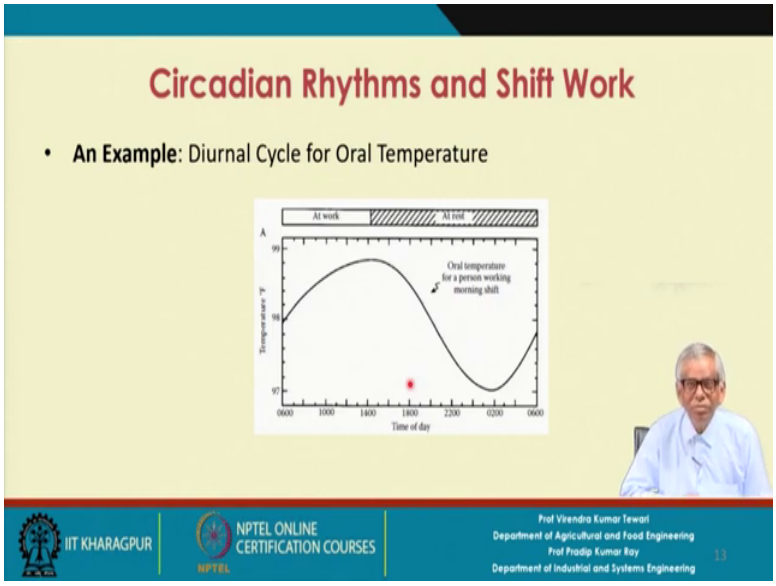

So, this is the typical changes in the Oral temperature during 24 hours and you can see a sinusoidal curve. At 4 pm you get the maximum value and when you are taking rest at 4 am, it reaches the minimum value. When it reaches the minimum value, you must be in a sleeping condition. If you start working over there it will have some effect on human body and will react.

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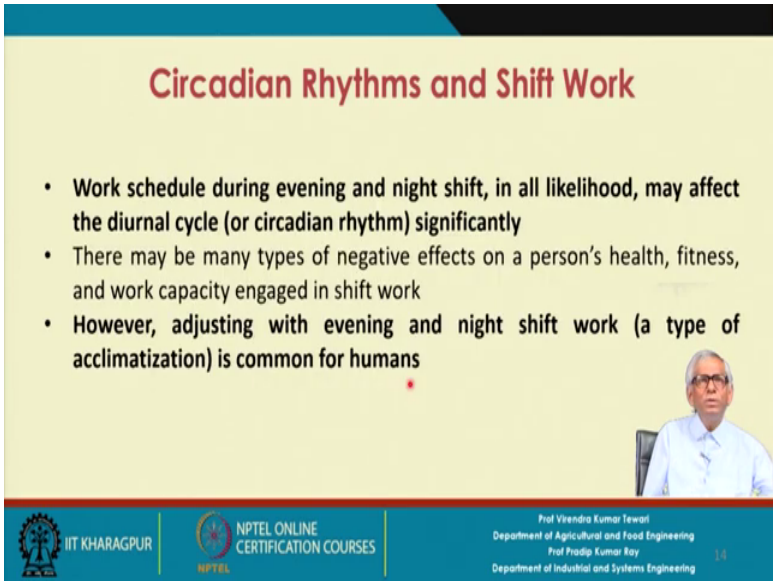

Work schedule during evening and night shift, in all likelihood, may affect the diurnal cycle (or circadian rhythm) significantly. There may be many types of negative effects on a person's health, fitness, and work capacity engaged in shift work. However, adjusting with evening and night shift work (a type of acclimatization) is common for humans.

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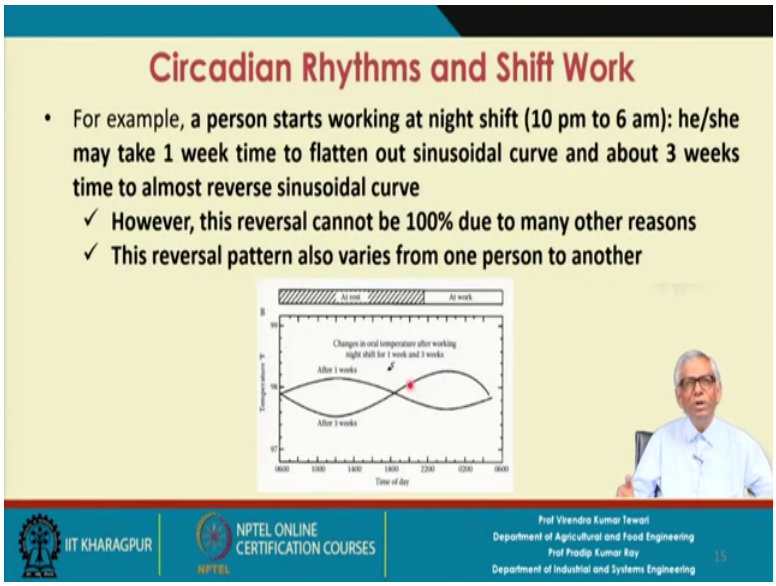

For example, a person starts working at night shift (10 pm to 6 am): he/she may take 1 week time to flatten out sinusoidal curve and about 3 weeks time to almost reverse sinusoidal curve. However, this reversal cannot be 100% due to many other reasons. This reversal pattern also varies from one person to another.

Just look at this figure in fine. Here you will find that person is at work during night time, during daytime he is not working. We can see his effect on sinusoidal curve, after 3 weeks it might be reversed, but not 100% reversal is possible.

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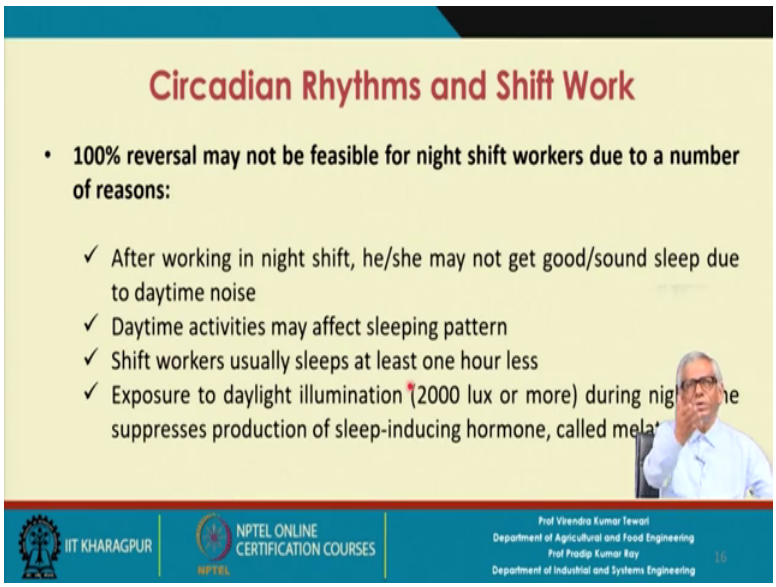

100% reversal may not be feasible for night shift workers due to a number of reasons, they are as follow:

1. After working in night shift, he/she may not get good/sound sleep due to daytime noise.
2. Daytime activities may affect sleeping pattern.
3. Shift workers usually sleeps at least one hour less.
4. Exposure to daylight illumination (2000 lux or more) during night time suppresses production of sleep-inducing hormone, called melatonin.

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